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AFRICA AND ITS ECOLOGIES: PEOPLE AND NATURE IN THE AGE OF CLIMATE CHANGE

GAPSYM14- **INTERNATIONAL CONFERENCE**

10th December 2021 – Ghent University

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INTERNATIONAL CONFERENCE

GAPSYM14: Africa and its ecologies: people and nature in the age of climate change

Friday 10 December 2021

Online

GAP
Ghent Africa Platform

TABLE OF CONTENTS

PROGRAMME

8h30-9h00: Registration

9h00-9h15: Welcome by the President of the AUGent Africa Platform

9h15-10h00: Keynote lecture: *Africa and its ecologies: people and nature in the age of climate change*, by Tafadzwanashe Mabhaudhi (Centre for Transformative Agricultural and Food Systems, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, South Africa)

10h00-11h00: Parallel session 1

	Vermeylen Room	**Prior Room**
	Chair: Jan Nyssen (Ghent University, Belgium)	*Voice and power in the representation of environmental issues and their human rights implications in Africa: A multidisciplinary encounter* Chair: Marie-Bénédicte Dembour (Ghent University, Belgium)
10h00	*Valley-bottom agriculture in a changing climate and its impact on stream flow and land use in southern highlands, Tanzania* Norbert J. Ngowi (Mzumbe University, Tanzania)	*Power, voice and representation in the production of evidence at the African Court on Human and Peoples' Rights – A case study* Nele Schuldt (Ghent University, Belgium)
10h20	*Distributional changes of the snail Bulinus truncatus, intermediate host of Schistosoma spp., in the face of climate change* Tim Maes (KU Leuven, Belgium)	*Indigenous knowledge traditions and varying epistemologies amongst migrant farmers in Ghana* Branwen Peddi (Ghent University, Belgium)
10h40	*Climatic change adaptation strategy for dry season amaranth cropping systems in the tropics: A case study from irrigated watermelon (Citrullus lanatus) as live mulch* David Ojo (University of Ibadan, Nigeria)	*Towards an aesthetics of waste: the representation of social inequality in the Francophone literature of the Indian Ocean islands* Sara Buekens (Ghent University, Belgium)

11h00-11h30: Coffee break

11h30-13h15: Parallel session 2

	Vermeylen Room	**Prior Room**
	Chair: Marc Heijde (Ghent University, Belgium)	Chair: Luce Beeckmans (Ghent University, Belgium)
11h30	*Yangambi's Wood Biology Laboratory: knowledge generation for tropical forest ecology and management* Mélissa Rousseau (Royal Museum For Central Africa, Belgium)	*Building land resilience in NW Ethiopia: lessons learned from five years of overseas research collaboration* Amaury Frankl (Ghent University, Belgium)
11h45	*Urgent need to monitor climate change to improve policies and strategies for the sustainable management of tropical forests in the Congo Basin* Emmanuel Kasongo Yakusu (Université de Kisangani, DRCongo)	*Diurnal cycle of summer rain in the Ethiopian mountains using climatological model data* Emnet Negash (Ghent University, Belgium)
12h00	*African and Amazonian carbon sinks are diverging: science and policy implications* Wannes Hubau (Ghent University, Belgium)	*How changes to land cover and hydrological connectivity between 1935 and 2020 affect runoff response in the Tsili catchment (Ethiopia)* Kiara Haegeman (Ghent University, Belgium)
12h15	*Quantification of* miombo *woodland deforestation in the Lufira Biosphere Reserve (DRC), an argument for its withdrawal from the World Network of Biosphere Reserves?* Yannick Useni Sikuzani (University of Lubumbashi, DRCongo)	*Mapping the Humanitarian Emergencies in Tigray* Sofie Annys/Jan Nyssen (Ghent University, Belgium)

12h30	*Trait-based approach to unravel Pericopsis elata saplings performance under different levels of competition* Jean Pierre Ngongo Lushima (University of Kindu, DRCongo)	*Studies on students' awareness on climate change education in Nigeria: a case study of the University of Ibadan* Olanrewaju Blessing Obeisun (University of Ibadan, Nigeria)
12h45	*CongoFlux* *- an eddy covariance flux tower in the Congo basin* Pascal Boeckx (Ghent University, Belgium)	*Ecosystem disruption and zoonoses* Anthony Denayer (Vétérinaires Sans Frontières, Belgium)
13h00	*Construction and Evaluation of a Statistical Model of Seasonal Forecast in Cameroon* Hermann Nana (University of Yaoundé 1, Cameroon)	*A long-term hydroclimatic history of the eastern Lake Victoria region* Gijs De Cort/Dirk Verschuren (Ghent University, Belgium)

13h15-14h00: Lunch + poster exhibit

Poster Room 1

- Basile Luse Belanganayi (University of Liège, Belgium): "The wood anatomical structure between two dated marks reveals periodicity of secondary growth of rainforest species"
- Ruben De Blaere (Royal Museum For Central Africa, Belgium): "Smart classification of Congolese timbers: deep learning techniques for enforcing forest conservation – SmartWoodID"
- Brice Djiofack (Royal Museum For Central Africa, Belgium): "Building carbon stocks in regrowing forests in the Congo Basin: opportunities of natural regeneration and planting trees"
- Azubuike Erinugha (Nasarawa State University, Nigeria): "Communicating Effects of Deforestation through *Kar Dare Ya Same Mu* Climate Communication Experimental Short Film in Keffi, Nigeria"

- Félix Laurent (Royal Museum For Central Africa, Belgium): “Vital Rates of Forest Dynamics Driven by Traits: study of the relationship between wood anatomy and vital rates for emblematic species of the Congo Basin rainforests”
- Guenolé Géraud Sidoine Mankou (Université Marien Ngouabi, DRCongo): “How involving wood anatomy in a trait-based ecology of Congo Basin tree species?”

Poster Room 2

- Aristide Akpa (Catholic University of Louvain-la-Neuve, Belgium): “Farmers’ perceptions and preferences for climate-smart inland management for rice production in West Africa: Evidence from Benin”
- Ogochukwu Anozie (University of Benin, Nigeria): “Roles of extension agents in climate change adaptation among capture and culture fishers in the Delta South Agro-ecological zone, Delta State, Nigeria”
- Simeon Biodun Bolarinwa (University of Ibadan, Nigeria): “Africa: between climate change, population growth and sustainability”
- Ayodeji Ogunleye (Obafemi Awolowo University, Nigeria): “Impacts of Farmers’ Participation in Social Capital Networks on Adoption of Climate Change Adaptation Strategies in Nigeria”
- Ivy Okello (Sokoine University of Agriculture, Tanzania): “Investigating seasonal changes in tsetse and non-tsetse population density, prevalence and drug sensitivity of African animal trypanosomes in Homa-bay, Kenya”
- Paul Martial Tene Tayo (University of Yaounde 1, Cameroon): “Contribution of organic farming tools in the fight against climate change: Effects of two formulations based on Oyster shell and Neem on the production of organic cocoa seedlings in Cameroon”
- Maarten Verschaffelt (Ghent University, Belgium): “Spatio-temporal variability in snowfall and snowmelt in the African mountains”

14h00 – 15h00: Keynote lecture: *Feminist Ecologies of Africa: Tracing the Vernaculars of Liberation of the Gendered Commons,* by Ruth Nyambura Kilonzo (African Ecofeminist Collective, Nairobi, Kenya)

15h00-16h30: Parallel session 3

	Vermeylen Room	**Prior Room**
	Chair: Ilse Ruyssen (Ghent University)	Chair: Pascal Boeckx (Ghent University)
15h00	*In pursuit of equity for climate refugees and climate migrants in the Global South: Implications for the Paris Agreement* Dumisani Chirambo (Seeds of Opportunity NGO, Malawi)	*Climate change effect on planting date and cultivar choice under dryland maize (Zea mays L.) production in South Africa* Robert Mangani (University of Pretoria, South Africa)
15h20	*Family physician perceptions of climate change, migration, health, and health care in sub-Saharan Africa: an exploratory study* Charlotte Scheerens (Ghent University, Belgium)	*Climate suitability predictions for the cultivation of macadamia (Macadamia integrifolia) in Malawi using climate change scenarios* Emmanuel Junior Zuza (The Open University, UK)
15h40	*Climat Change and Migration to South Africa: Exploring the Role of Climate- and Environment-Related Adversities in Mobility Decision-Making* Robin Jilesen (University of Pretoria, South Africa)	*Improving Smallholder Livelihoods through Third Party Certification in Western Burkina Faso Orchards* Parfait K. Tapsoba (University of Abomey-Calavi, Benin)
16h00	*Health, access to healthcare and international migration in Africa* Els Bekaert (Ghent University, Belgium)	*Climate change and cattle production in Nigeria: Farmers' perception of the effects and adaptation strategies in the derived Sahel Zone of Yobe State* John Olayinka Makinde (Federal University of Technology, Minna, Nigeria)

16h30-17h00: Coffee break

17h00-18h00: Panel discussion:

- Ruth Nyambura Kilonzo (African Ecofeminist Collective, Nairobi, Kenya)
- Tafadzwanashe Mabhaudhi (Centre for Transformative Agricultural and Food Systems, University of KwaZulu-Natal, South Africa)
- Laurence Defrise (Agriculture & Climate Expert, Belgian Development Agency)
- Moderator: John Vandaele (Mo* Magazine, Belgium)

18h00: Closure

ABSTRACTS KEYNOTES

Feminist Ecologies of Africa: Tracing the Vernaculars and Cultures of Liberation of the Gendered Commons

Ruth Nyambura Kilonzo

African Ecofeminist Collective, Nairobi, Kenya

This seminar presentation aims to excavate the vernaculars, cosmologies and pluriverses of liberation (Zapatistas, 1996; Escobar, 2020), over three important periods (ant-colonial and anti-imperialist, the onset of neoliberal globalization and present day) of women-led struggles and social movements in Africa over the gendered commons through an exploration of the salient material and historical aspects that weave them together, as continuities rather than mere episodic events, within a longue durée (Arrighi, 1994; Brownhill, 2009) framework.

Vernaculars and cultures of liberation are used here to refer to the *weapons of the weak* (Scott, 1985), the rich variety of political language forms and their material articulations deployed historically by the *subaltern* (Spivak, 1988), those on *democracy's margins* (Ngwane, 2021), and very specifically within the intersecting worlds of gender, ecological and agrarian politics and struggles in Africa. Importantly, the *gendered commons* refer to "…those places in the world in which women and men live "*in common*" within elaborated subsistence relations, far from or actively rejecting the coercive policies of commodification, as well as both building and defending alternatives to socially and ecologically destructive global corporate capitalism" (Brownhill, 2009).

Finally, this presentation will explore the temporal, local, transnational and international, as well as the pastiche pedagogical methods of solidarity making / doing of women's social movements, people's and popular (feminist) histories through the insurrectionist histories of African women's struggles over the gendered commons.

Africa and its ecologies: people and nature in the age of climate change

Tafadzwanashe Mabhaudhi

Centre for Transformative Agricultural and Food Systems, School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, South Africa

Africa is one of the most vulnerable continents to climate change. Its economies rely on climate-sensitive sectors such as agriculture, and its adaptive capacity is generally low. This is worsened by a legacy of socio-politico-economic issues related to unemployment, inequality, poverty, governance, and human and country-level capacity to respond, making climate change an urgent developmental and sustainability challenge. Much focus has been on economic development. For example, the SDGs emphasise economic components, with less emphasis on the social and environmental dimensions of sustainable development. However, the economic dimension is embedded within the socio-political, with social cohesion, dignity, equality, freedom, and justice elements. By this interpretation, you cannot have economic development at the expense of social integrity and social resilience. Equally, there is a need to better understand ecological integrity and resilience, focusing on key elements exposed to risk and vulnerability. All of this is then underpinned by governance. Furthermore, strategies on how Africa should adapt and mitigate climate change are mostly externally-driven solutions focused on economic development. They are not bespoke to local circumstances and often exclude the social and environmental dimensions, enabling rather than preventing, severe negative impact at the local and regional scale, thereby undermining sustainable socio-economic development. Additionally, climate adaptation and mitigation policies are framed at a national scale, creating a policy-scale disconnect between national vs household. They lack consideration of interlinked issues such as local biodiversity benefits, poverty, inequality, social cohesion and culture, all of which play out at the household unit and not the nation. This lack of context limits the applicability of proposed solutions for Africa. This is important

as most of Africa's people still reside in rural areas and are dependent on climate-sensitive natural resources for livelihoods and wellbeing. The focus should be on transformative and nexus-smart solutions, considering broader systemic issues and empowering people to develop local solutions to global problems. For example, we could leverage Africa's geographic advantage, natural and social capital to promote a transition towards sustainable and resilient local food systems that balance the need to increase production with environmental, human health, socio-economic, and wellbeing concerns within the planetary boundaries. This requires a better understanding of nature's contribution to people in a meaningful manner for current and future generations. While we often measure this as economic, it is broader. It includes other elements of nature that feed into human wellbeing, not just human livelihoods or physical needs and links to social integrity and social resilience. This includes a sense of place, existence values, spirituality and traditional, cultural aspects, etc. This will balance the economic with the socio-political and capacity building, which underpin governance, and the environmental dimensions for sustainable development. The positive impacts of empowering local people and promoting local solutions to global challenges would translate to enhanced resilience to climate change on a continental scale.

ABSTRACTS PRESENTATIONS

Mapping the Humanitarian Emergencies in Tigray

Sofie Annys[1], Emnet Negash[1,2], Lars De Sloover[1], Tim Vanden Bempt[3], Jan Nyssen[1]

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At the beginning of November 2020, after months of rising political tensions, an armed conflict emerged between the Government of Ethiopia and the - now ousted - Tigray Regional Government. As the conflict arose in the aftermath of a destructive locust plague and on top of the ongoing covid-19 pandemic, soon the realization came that the conflict would have a major impact on the Tigray Region's population, estimated at 6 million. Therefore, the objective of our research is to document as much information as possible on the rapidly evolving humanitarian situation, by making use of the 'power of maps', and hence to make the invisible visible. For this, we have collected qualitative as well as quantitative evidence on the situation on the ground, and have prepared 22 maps on different topics, ranging from background information on rainfall, topography, population density, land cover… to territorial control by the different parties involved in the conflict, humanitarian needs and access, civilian casualties, internally displaced people, banking and telecommunication services, and food insecurity. To prepare these maps, we have derived information from secondary data sources (mainly reports from humanitarian organizations), and also have collected our own data based on telephone interviews (n > 2000) with long-trusted key informants in different (sub-)districts of the region. The interviews comprised of general data collection (n > 1500), semi-structured interviews (n > 300), in-depth interviews (n > 100) and generalist interviews with office holders

at regional, national and international levels (n > 100). Due to telecommunication blackouts, data collecting has been very challenging. As of the end of April 2021, the research results show that (i) conflict incidents still occur on a daily basis, (ii) more than 7800 civilian casualties and 200 massacres* have been reported**, (iii) more than 2200 civilian casualties have been fully documented**, (iv) up to 1.7 million people have been internally displaced, (v) more than 4.5 million people are in need of humanitarian aid, (vi) humanitarian access remains restricted due to safety issues, and (vii) many war crimes and crimes against humanity have been committed. Even though many people already live in a dire situation, the continuation of the Tigray conflict may lead to another failed harvest in the 2021 cropping season and consequently could lead to a widespread famine. Via this atlas, we hope to provide valuable information to humanitarian organisations and local governments, and to raise international attention for the conflict – which may lead to independent investigations on war crimes.

*A massacre has been defined as 'a conflict incident in which at least 5 civilians were killed on the same day at the same location'. **This is only the tip of the iceberg, as information only gradually becomes available.

References

Annys, S., Vanden Bempt, T., Negash, E., De Sloover, L., Nyssen, J., 2021. Tigray: atlas of the humanitarian situation. Journal of Maps, preprint. https://www.researchgate.net/publication/349824181_Tigray_Atlas_of_the_humanitarian_situation

Health, access to healthcare and international migration in Africa

Els Bekaert[1, 2]

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[2] UNU-CRIS

Despite increasing scholarly attention across disciplines for research on (i) migration in the face of anthropogenic climate change, (ii) the impact of climate change and (iii) migration on health and the local healthcare system, the link between health(care) and migration has not yet been empirically established. Moreover, migration literature has mostly focused on the health impacts of migration, but the avenue that health and healthcare may drive migration instead received far less attention. This may especially be worrying in Africa, a region particularly vulnerable to the adverse effects of climate change, characterized by a high level of mobility and host to already fragmented and overstretched health care systems. Recent Lancet reports, the 'UCL-Lancet Commission on Migration and Health' and the '2019 report of The Lancet Countdown on health and climate change' specifically recognize the challenges these events pose, already today, but increasingly into the future.

Specifically, this study aims to empirically analyze the role of health(care) and international migration aspirations and preparations in Africa. To this end, this study relies on a large internationally comparable individual-level survey dataset, the Gallup World Poll (GWP). From the GWP, we can identify respondent's aspirations and preparations to migrate permanently abroad. Moreover, it allows us to identify respondent's health conditions (whether one has health problems) and their assessment of the local availability of quality healthcare. Specifically, this study considers how individual's health status and their access to high-quality and inclusive healthcare may drive migration behavior by focusing on the period 2009-2015 across 47 African countries.

Preliminary results suggest that Africans who are dissatisfied with local availability of quality healthcare have a higher aspiration to migrate abroad. The likelihood that these migration aspirations are turned into actual preparations, however, depends on more traditional determinants such as household income, network effects and skill level. Furthermore, mixed results are found on the role of individual health status on migration aspirations and preparations.

CongoFlux - an eddy-covariance flux tower in the Congo basin

Pascal Boeckx[1], Thomas Sibret[1,2], Marijn Bauters[1,2], Emmanuel Bulonza[1,3], Lodewijk Lefevre[1,2,5], Paolo Cerutti[4], Michel Lokonda[6,7], José Mbifo[6], Baudouin Michel[3], Hans Verbeeck[2]

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The Congo basin is home to the second largest tropical forest in the world. Therefore, it plays a crucial role in the regional water cycle, the global carbon cycle and the continental greenhouse gas balance. Yet, very few field-based data on related processes exist. In the wake of global change, there is a need for better understanding current and future response of the forest biome in this region. A new long-term effort has been set up to measure exchange of greenhouse gasses between humid lowland tropical forest in the Congo basin and the atmosphere via an eddy-covariance (EC) tower. Eddy-covariance research stations have been used for decades already in natural and man-made ecosystems around the globe, but Central

Africa remains a blind spot. The so called “CongoFlux” research site has been installed right in the heart of the Congo Basin, at the Yangambi research centre in DR Congo. The specific scientific objectives of this EC station are 1) to measure inter- and intra-annual CO_2 and H_2O exchange allowing quantification of the net ecosystem exchange (NEE) and water use efficiency (WUE), 2) to measure N_2O and CH_4 fluxes to obtain a full greenhouse gas balance and 3) to determine the impact of atmospheric pollution including N deposition, tropospheric ozone (O_3) and black carbon (BC) on NEE.

Keywords: Eddy Covariance, Flux tower, Greenhouse gases, Congo basin, Tropical forest, Africa

Towards an aesthetics of waste: the representation of social inequality in the Francophone literature of the Indian Ocean islands

Sara Buekens

Literature Department, Faculty of Arts and Philosophy, Ghent University

Now that humanity has entered the "Anthropocene", a new geological era in which human activities have become the primary driver of many changes in the earth's ecosystem, this interaction of humans with the surrounding world also raises questions about the impact of ecological problems on the human body. It is from this perspective that I will study the contemporary Francophone literature of the Indian Ocean islands, where rapid urbanization and industrialization and the advent of the consumer society have increased the problems of waste treatment, altered the living spaces of specific population groups and reinforced social inequalities.

I will focus on how Francophone literature from the Indian Ocean islands represents waste, a subject usually unappealing to the Western reader, and what rhetorical strategies are used to link the issue of garbage to that of social imbalances. I will show how authors such as Jean-Luc Raharimanana and Ananda Devi "recycle" waste by introducing it into a literary discourse, in order to give voice to the most destitute habitants, who lead a life surrounded by garbage in the suburbs of large cities. By giving a place to what belongs to the "outside of", which is undesirable and therefore easily becomes "ineffable", these authors testify to a social commitment while resorting to very specific artistic strategies: the reintegration, in a particular aesthetic context, of plastic and discursive materials deemed obsolete or abject, such as the detailed description of waste in all its forms and aspects, as well as fragments of the language used to talk about waste by the local communities.

I will propose an ecopoetic reading, which focuses on the form of the text. This will allow me to reveal the stylistic choices that Raharimanana and Devi use to articulate ethical considerations about the links between the human body and its material environment, in terms of toxicity and justice, health and environmental racism.

Primary sources

Anande Devi, Ève de ses décombres, Paris, Gallimard, 2006.

Jean-Luc Raharimanana, Lucarne, Paris, Le Serpent à Plumes, 1996.

---, Za, Paris, Éditions Philippe Rey, 2008.

In pursuit of equity for climate refugees and climate migrants in the Global South: Implications for the Paris Agreement

Dumisani Chirambo

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Climate change is a threat to the attainment of the Sustainable Development Goals (SDGs) since unmitigated climate change will exacerbate poverty and inequality within and across countries. Hence, it will arguably create new forms of social disruptions and conflicts for which many existing institutional and legal frameworks will not be able to contend with. For example, sub-Saharan Africa, South Asia and Latin America could see more than 140 million people undertake national and international migrations attributed to climate change by 2050. Unfortunately, despite the projected increases in the number of "climate refugees or climate migrants", there is no international legal recognition for such a group. Therefore, such individuals and groups cannot be guaranteed international protection as a matter of law. Consequently, climate change is increasing the occurrences of conflicts and populations of "unrecognised groups", hence ultimately making SDG 10.7 (facilitate orderly, safe, regular and responsible migration) and SDG 16 (promote peaceful and inclusive societies for sustainable development) unattainable. Arguably, for the SDGs to be attainable there is a need for the introduction of new policies and strategies that can ensure equity in access to economic resources for climate migrants and inclusive participation of climate migrants in local economies.

The Paris Agreement and Nationally Determined Contributions (NDCs) framework provide a new innovative global governance framework for improving climate change governance and promoting inclusive development based on individual country's capabilities - this unlike the previous regime of the Kyoto Protocol that was characterised by a command and control regulatory framework. Additionally, NDCs provide a framework for countries to periodically ratchet-up their climate change actions and commitments. Arguably, through the NDCs and ratcheting–up concept, there could now be new opportunities to which the plight and rights of "climate refugees or climate migrants" may be gradually introduced and recognised in international law instruments and local socio-economic development contexts. Consequently, this exploratory study, through analyses of case studies, project reports, policy reviews, policy briefs and academic literature, aims to identify the processes that can improve the recognition and empowerment of "climate refugees or climate migrants" to reduce conflicts and promote equity. The study discovered that the NDCs framework has arguably more potential than the SDGs framework to build institutions that can enhance the resilience of "climate refugees or climate migrants" to socio-economic shocks. The study concluded that initiating processes to reduce climate change conflicts as caused by climate migration will call for main discussions on NDC implementation to move from how to increase mitigation ambition to the recognition of climate migrants in various socio-economic systems.

A long-term hydroclimatic history of the eastern Lake Victoria region

De Cort, Gijs[1]; Van der Meeren, Thijs[1]; Olaka, Lydia[2]; Cocquyt, Christine[3]; Okoko, George[2]; Verschuren, Dirk[1]

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Unlike most other tropical regions on Earth, the vast mid-elevation plateau forming East Africa is a relatively dry area prone to strong variability in rainfall, with major consequences for the large portion of its population whose livelihood directly depends on agricultural success, and thus on the amount and predictability of local precipitation. Examples of East Africa's variable hydroclimate include the catastrophic droughts in the Horn of Africa and northern Kenya during 2009-2011 and 2016-2017, and the devastating flooding episodes of Kenya's Rift-valley lakes in 2012-2013 and 2020. The importance of improved understanding of the region's natural hydroclimate dynamics cannot be overstated, especially in the context of a future where anthropogenic climate change is compounding the already high demographic and economic pressures on natural water resources. Sediments recovered from the bottom of lakes can provide important tools in this regard, as they contain continuously deposited environmental signals that reflect contemporary climatological and ecological conditions. Such sedimentological archives extend back in time much further than the longest instrumental records.

In tropical regions worldwide there is still great uncertainty regarding the longer-term natural climate variability that forms the reference frame against which anthropogenic climate change and its impacts must be evaluated. For example, it is becoming clear that hydroclimate evolution across East Africa during the last 10,000 years was much more spatially heterogeneous than previously assumed. Also this regional variation in long-term climate

trends has not yet been systematically investigated in relation to possible causal factors, such as the variable influence of moisture sources from the Indian and Atlantic Oceans. Importantly, the vast region where the relative contribution of both sources of moisture is potentially unstable through time, both in the past and towards the future, includes some of East Africa's most important agricultural areas, such as large swaths of rural Uganda and Tanzania where subsistence farming is the main livelihood, and the highlands of central Kenya where the bulk of Kenya's rain-fed crops are produced.

This research highlights the hydroclimatic history of the eastern Lake Victoria region, which includes southeastern Uganda, western Kenya and northern Tanzania, as reconstructed from the sediments of Lake Simbi, a small saline crater lake situated near the Nyanza Gulf of Lake Victoria in western Kenya. Lake Simbi's sediment record reveals the past occurrence of multi-decadal periods of catastrophic aridity with a combination of duration and severity exceeding any drought episode in recent history. These droughts were superimposed on a long-term trend of gradually increasing moisture balance over at least the last ca. 8,000 years.

Lake Simbi, and the eastern Lake Victoria catchment in which it is situated, occupies an intermediate position along the East African equator, wedged in between the western (Albertine) and eastern (Gregory) branches of the East African Rift System. It is thus a key site for studying the spatial continuum of Atlantic- versus Indian-Ocean influence on African hydroclimate. By comparing our new moisture-balance reconstruction from Lake Simbi with similar lake records from different locations along this continuum, we shed light on the long-term patterns that steer East-African hydroclimate and that form the backdrop against which current anthropogenic climate change should be evaluated.

Ecosystem disruption and zoonoses

Anthony Denayer

Vétérinaires Sans Frontières -- Dierenartsen Zonder Grenzen Belgium

Since the 2000s, humanity has been confronted with at least one newly emerging human infectious disease of animal origin, also known as zoonoses, every year. From SARS to avian and swine flu, and from Ebola to Lassa fever, and more recently Covid-19, zoonotic disease emergence and spread has proven to be a serious threat to public health and society as a whole. Globally, about 60% of known infectious human diseases derive from animals, as well as 75% of newly emerging human diseases. And this rate of novel disease emergence is just accelerating.

More than ever, it has become clear that novel disease emergence and pandemic risk are driven by the same human activities that drive biodiversity loss. The underlying factors of increasing zoonotic disease emergence include deforestation and rangeland conversion, intensified livestock production, climate change and antimicrobial resistance (AMR). Vétérinaires Sans Frontières Belgium (VSF-B) urges to reconsider our global animal food consumption and production patterns and to develop an approach that effectively addresses the ongoing and future crises such as zoonotic disease (re-)emergence, AMR, food and nutrition security, climate change and biodiversity loss. According to VSF-B, this approach can be found within One Health, a concept that aims to drive improvements in human, animal and environmental health through a holistic approach.

In order to support the operationalisation of this One Health approach in the 9 Sub-Saharan African countries where we work, VSF-B actively seeks partnerships with universities and research institutions to both increase the impact of our interventions and communicate about our achievements in an evidence-based manner.

Building land resilience in NW Ethiopia: lessons learned from five years of overseas research collaboration

Frankl A.[1]*, Abate M., Abere, T.[2], Adgo E.[2], Amsalu T.[2], Assaye H.[2], Aynalem S.[2], Bodé S.[1], De Wit B.[1], Boeckx P.[1], Deckers J.[3], Strubbe, D.[1], Matheve, H.[1], Lemma H.[2], Lens L.[1], Mequanint F.[2], Muys B.[3], Nyssen J.[1], Poesen J.[3], Tsegaye D.[2], Vancampenhout K.[3], Verstraeten G.[3], Worku G.[2], Wassie A.[2]

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Over the past few decades, agricultural expansion driven by population growth has caused a deterioration of ecosystems and erosion of natural resources in the Lake Tana Basin of NW Ethiopia. To understand the patterns and processes of ecosystem degradation and propose mitigation strategies, the Land Resilience project of the inter-university and multidisciplinary collaboration between two Flemish Universities (Belgium) and Bahir Dar University (Ethiopia) has been engaged in collecting and analysing a wide range of environmental data over three to four years of monitoring (2018-2021). We focussed on understanding two key interrelated aspects of the natural environment: the cascades of sediment, carbon and nutrients from source to sink, and ecological effects on forest remnants and their bird communities. For the cascades, we investigated catchment hydrological response and erosion rates, sediment provenance, catchment suspended and bedload sediment yield, floodplain storage of sediment, carbon and nutrients, and floodplain chronostratigraphy. From an ecological perspective, we studied the biodiversity and ecosystem services of church forests and their matrix, woody vegetation composition and structure, and bird diversity and relative

abundance. Our results indicate that the deterioration of the natural environment reaches critical levels in Lake Tana Basin. Several key environmental indicators point towards degradation: intolerable gully erosion rates (8.9-31.3 Mg ha^{-1} y^{-1}), high catchment sediment yield (c. 5 – 35 Mg ha^{-1} y^{-1}), remnant forests facing mere survival without recovery (e.g., five tree species at imminent risk of disappearance from the region), plantations of exotic tree species negatively affecting the conservation of native species (especially in the proximity of roads), etc. Analysis of changes in environmental indicators compared to records of the recent past shows that land degradation has continued to occur. We stress that under current land management practices, the natural resources are not used in a sustainable way, and therefore, ecosystems face irreversible degradation. To halt environmental degradation and build land resilience to climate change, improving and increasing conservation and restoration efforts should be considered a priority of environmental policies.

Keywords: Ecosystem, Forest ecology, Land management, Natural resources, Sediment yield, Soil erosion

How changes in land cover and hydrological connectivity between 1935 and 2020 affect runoff response in the Tsili catchment (Ethiopia)

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Over the past two decades, the concept of connectivity has been used to describe and quantify various factors affecting fluxes of water and sediment at different scales. Changes in land use and land cover (LULC) affect hydrological connectivity and therefore influence hydrological processes such as the rainfall-runoff response and sediment redistribution. The objective of this study was to assess the effect of long term (85 years) land cover changes on the hydrological connectivity and the rainfall-runoff response in a semi-arid montane catchment in northern Ethiopia. Land cover and drainage network changes between 1935 and 2020 of the Tsili catchment (27.5 km²) in the Tigray region were mapped using aerial photographs (1935, 1967, 1994) and detailed satellite images available through Google Earth (2020). The Soil and Water Assessment Tool (SWAT) was used to model rainfall-runoff responses for LULC at four time steps. As river discharge measurements are not available, peak discharges were estimated by determining the riverbank width (RBW) for every time period, whereafter the RBW was used in a linear regression model. The estimates of peak discharges served as reference for the modelled data. Over the last 85 years, agricultural land expanded considerably. In 1935, only one third of the area was used for agriculture, while in 2020 two thirds of the land is cropland. This increase happened mainly at the expense of forests (reduced from 12% to 1.4%) and shrubland (50% to 21%). In the course of the 20th century grassland more than doubled but decreased thereafter to a smaller area than in 1935. Settlement and village areas increased from 0.3% to 1.7%. Drainage density of the catchment increased from 1.14 km/km² to 1.8 km/km² and the mean riverbank width increased from

7.6 m to 10.4 m between 1935 and 2020. SWAT simulations resulted in an increase of average annual surface runoff of 40% going from 283.8 mm in 1935 to 403.2 mm in 2020 in line with land cover changes. Consequently, the runoff coefficient in the catchment increased from 32% to 47% between 1935 and 2020. Strong significant correlations have been found between surface runoff, river bank width, drainage density and area of cropland. The results indicate that the expansion of agriculture, at the expense of natural vegetation such as forests and shrubland, went along with a sharp increase in surface runoff and hydrological connectivity and consequently also an increase in RBW and drainage density.

African and Amazonian carbon sinks are diverging: science and policy implications

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Structurally intact tropical forests sequestered ~1 Pg C yr^{-1} over the 1990s and early 2000s, equivalent to ~15% of fossil fuel emissions. Climate-driven vegetation models typically predict that this carbon sink will continue for the remainder of the 21st century. However, recent plot inventories from Amazonia show a declining rate of carbon sequestration, potentially signalling an imminent end to the sink. Here we assess whether the African tropical forest sink is also declining.

Records from 244 multi-census plots across 11 countries reveal that the African tropical forest sink in aboveground live biomass has been stable for three decades, at 0.66 Mg C ha^{-1} yr^{-1}, from 1985-2015 (95% CI, 0.53-0.79). Thus, the carbon sink responses of Earth's two largest

expanses of tropical forest have diverged over recent decades. A statistical model including CO_2, temperature, drought, and forest dynamics can account for the trends. Despite the past stability of the African carbon sink, our data and model show that very recently the sink has begun decreasing, and that it will continue to decline in the future. This implies that the intact tropical forest carbon sink on both continents is set to end decades sooner than even the most extreme vegetation model estimates.

Published independent observations of inter-hemispheric atmospheric CO_2 concentration indicates increasing carbon uptake into the Northern hemisphere landmass, offsetting a weakening of the tropical forest sink, which reinforces our conclusion that the intact tropical forest carbon sink has already saturated. Nevertheless, continued on-the-ground monitoring of the world's remaining intact tropical forests will be required to test our prediction that the intact tropical forest carbon sink will continue to decline.

Our findings were recently published in *Nature* (March 2020) and have important policy implications: given tropical forests are likely to sequester less carbon in the future than Earth System Models predict, an earlier date to reach net zero anthropogenic greenhouse gas emissions will be required to meet any given commitment to limit the global heating of Earth.

Our results also have important implications specifically for African forests. One of the key results of our analysis is that the African forest carbon sink is remarkably stable, in sharp contrast to the rapidly declining Amazonian sink. This shows, for the first time, that African forests will play an increasingly important role in stabilizing Earth's climate in the future. As such our paper represents a landmark study, putting Africa on the scientific map as well as on the political agenda. Our study identifies a major battlefield in the future fight against climate change: while African forests are our hope for a persistent tropical forest carbon sink, they will be increasingly threatened by human disturbance, as Africa is the only continent with predicted exponential population expansion in the coming century. This calls for an urgent action plan to reconcile forest conservation with a growing need for resources.

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Climate Change and Migration to South Africa: Exploring the Role of Climate- and Environment-Related Adversities in Mobility Decision-Making

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This work examines the impacts of climate- and environment-related stress on migration from several sub-Saharan African countries to the prominent migration destination of South Africa. It describes the factors and processes that influenced migrants' decisions to leave their countries of origin and provides insights into the experiences of these individuals before, during, and after migration.

Data was gathered through semi-structured interviews with 20 migrants now residing in South Africa's Gauteng province. The majority of migrant-participants originated from Zimbabwe and Malawi, while others came from Nigeria, the DRC, Ghana, and Mozambique. Additional information was gathered through semi-structured interviews with experts of migration, climate change, and environmental problems in Africa, as well as from secondary material, such as reports, grey literature, and academic publications.

The complexity and multicausality of migration are central themes in this work, and one of the key arguments presented is that migration is typically a function of multiple migration drivers working in tandem. These drivers tend to be highly intertwined and cannot be meaningfully understood in isolation from one another. The focus of the study was therefore not limited to environmental causes for migration. Instead, migration was placed into a wider context in which environmental- and non-environmental conditions are interlinked.

The principal finding is that, although climatic and environmental stresses are not the primary drivers for migration to South Africa, they play important direct and indirect contributing roles. Direct environmental contributions that appeared in the study included drought, land degradation, floods, and erratic rainfall, having affected participants mostly through impacts on smallholder agriculture. Such environmental drivers, however, did not occur in isolation, but were found to frequently intersect with economic, political, social, and demographic adversities. In addition, the study shows that climatic and environmental adversities have likely contributed to important non-environmental migration drivers, thereby indirectly contributing to migration. The presence of potential migration drivers does not necessitate that migration will take place. Instead, the study shows that an individual's response to these conditions is mediated through intervening obstacles and facilitating factors, personal and household characteristics, and expectations of the destination.

Although some migrants in the research sample had experienced improvements in their life standard since migrating to South Africa, the majority of migrants indicated that their lives were still characterised by insecurity, precariousness, and hopelessness.

Given the severity of projected climate change in sub-Saharan Africa and South Africa's prominence as a destination country, it follows from these findings that both current and future impacts of environmental pressure on migration to South Africa should be effectively understood and managed. Further research into the scale and nature of climate- and environment-related migration to South Africa is therefore required. Additionally, policies should be drafted that take account of and respond to the complex, but very real ways in which the climate and wider environment contribute to migration to South Africa. This includes coordination and collaboration between South Africa and migrant-sending countries to facilitate successful adaptation efforts at home, as well as the reshaping of South African migration policies as to improve the conditions for migrants in the country.

Trait-based approach to unravel Pericopsis elata saplings performance under different levels of competition

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Pericopsis elata is a light-demanding species from the tropical rainforests of Africa. It is a valuable species producing a wood of great commercial value, making the species the target of a marked overexploitation. It poorly regenerates below the canopy and its natural populations are declining. The promotion of its silviculture is therefore one of the best ways to support the sustainability of its populations and guarantee the long-term survival of the species. Unfortunately, much remains to be done in this respect. While it has been clearly established that the species performs well in plantation, the effects of planting density on its growth performance and trunk quality are poorly elucidated. The aim of this study is to evaluate the influence of planting density on the growth of *P. elata* seedlings using the trait-based approach. We measured the growth of 540 *P.elata* seedlings and calculated the functional traits on a subset of 60 seedlings at 17, 29, 41 and 53 months after planting. Studied plantations are installed in Kisangani, DRC, since 2017 following the Nelder II design that allowed testing multiple densities in a small area. We examined several commonly measured functional traits, for which global relationships with individual tree growth are expected: specific leaf area (SLA), leaf area (LA), chlorophyll content (Chl), leaf fresh mass (LFM) and leaf dry mass (LDM), stomatal density (Dstomata), stomatal size, stomatal conductance (Gsmax). The statistical analysis by the linear mixed model and different comparison tests (Anova & Kruskal Wallis) led us to the following results: the results show significant positive correlations between leaf traits (Gsmax, LDM, LFM, Chl, Stomatal sizes, LA) and growth of *P. elata* (Figure 1). Competition combined with maximum stomatal conductance to water vapor (Gsmax), specific leaf area (SLA), dry mass, and chlorophyll content improve the prediction of *P. elata* growth at the juvenile stage. The leaf traits showed particular patterns of variation from each other following the competition gradients established at planting. Spacing at planting was found to be a very influential factor on the photosynthetic capacity of *Pericopsis elata*. Reducing the spacing from 158751 stems/ha to 690 stems/ha led to a decrease in SLA (by 34%) and consequently an increase in photosynthetic capacity.

Keywords: *P. elata*, Foliar traits, Growth, Planting density, Silviculture

ANNEX

1. Relationship between leaf traits and growth

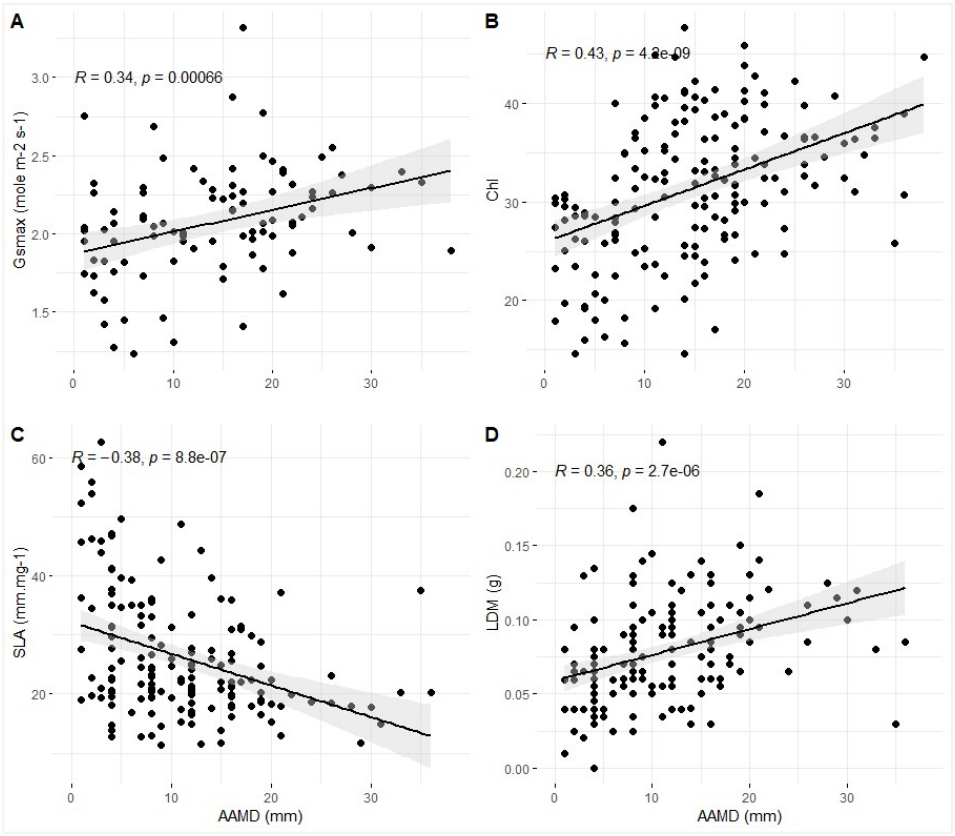

Figure 1. Correlation between leaf traits and mean annual diameter growth. A: Correlation between maximum stomatal water vapor conductance and diameter growth. B: Correlation between chlorophyll content and diameter growth. C: Correlation between specific leaf area and growth. D: Correlation between dry mass and diameter growth.

2. Evolution of growth as a function of competition

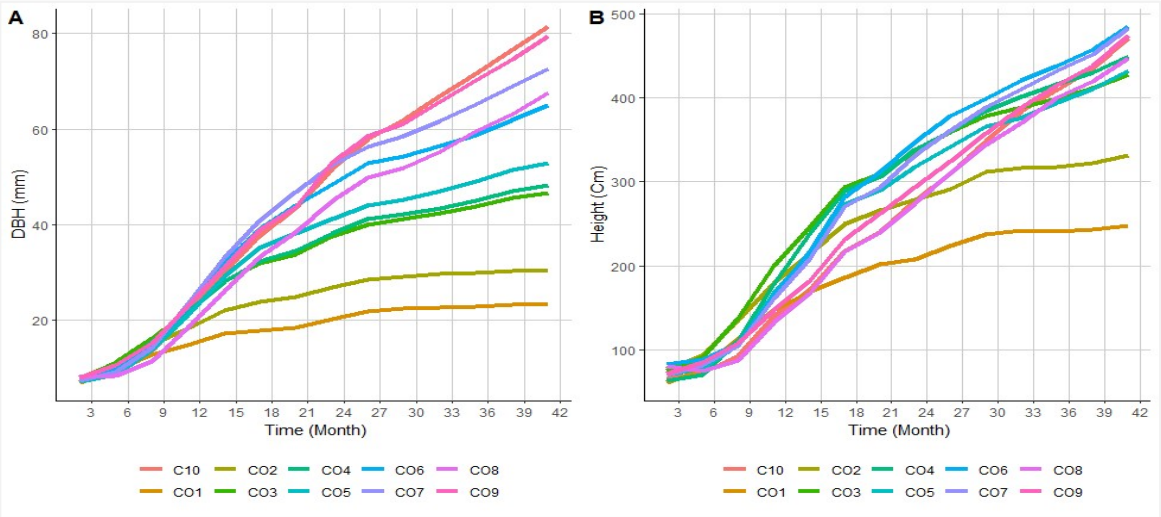

Figure 2. Evolution of growth as a function of competition (CO1 to CO10 are the competition levels in the device).

Distributional changes of the snail Bulinus truncatus, intermediate host of Schistosoma spp., in the face of climate change

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Climate change affects the distribution of many vector-borne diseases through its effects on disease agents and both the intermediate and final hosts. Species distribution models could provide a useful tool to infer current and future distributions of host and pathogen species and allow for the prediction of disease risk. Correlative models accurately predict present species distributions but they lack the capacity to forecast future distributions. The use of experimental data on species' tolerance limits in so-called mechanistic models increases the accuracy of future predictions considerably. Schistosomiasis is such a vector-borne disease where detailed information on both host and parasite ecology could support accurate predictions of future disease risk. Schistosomiasis is a tropical disease caused by parasitic flatworms of the genus *Schistosoma* that are transmitted through freshwater snails and affects both humans and livestock. Forecasting future schistosomiasis risk remains difficult due to the unknown effects of rising temperatures and changing rainfall patterns on both snails and parasites. A recent systematic review showed that ecological data feeding mechanistic niche models is lacking and that research efforts differ greatly between snail

species, life stages and abiotic factors (e.g. temperature, rainfall,…). Furthermore, a lack of standardisation across studies impairs inter-study and interspecies comparability of the data.

In our upcoming study we will start collecting ecological data for *Bulinus truncatus,* an intermediate host for the bovine parasite *Schistosoma bovis* and the human parasite *Schistosoma haematobium*, causative agent of urinary schistosomiasis. In this study we will subject *B. truncatus* snails originating from different locations to different temperatures in a laboratory setting. Snails will be kept at constant experimental temperatures for 4 months. During this period, life history parameters such as survival and growth will be monitored closely. Physiological endpoints will be measured in the last surviving snails of each location to assess physiological responses to elevated or lowered temperatures. Additionally, we will use reduced representation sequencing to screen for genetic signs of local adaptation to climatic factors. Special attention is given to a firm and standardised experimental design comprising of large sample sizes, replication, and a large temperature gradient coverage that could set a new benchmark for experimental designs in schistosomiasis research. In a follow-up study, the data collected during these experiments will be used to construct mechanistic species distribution models for *B. truncatus* to predict the future distribution of this species and the associated schistosomiasis risk under different climate change scenarios. Once completed, this project will serve as a proof-of-concept study illustrating the importance of reliable ecological data on disease vectors so that we can prepare for changing disease distributions in the future.

Climate change and cattle production in Nigeria: Farmers' perception of the effects and adaptation strategies in the derived Sahel Zone of Yobe State

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Climate change exerts its effect on both crops and livestock production in Nigeria in different ways. However, most of the previous climate change studies have focused on food crops and only few literature have evaluated climate change effects on livestock with fewer even having looked at large ruminants such as cattle. Heat stress associated with climate change is a severe challenge to cattle farmers because of its negative effect on both cattle management and meat production. This study was carried out to determine the perception of cattle farmers on the effects of climate change on cattle production in Yobe State, Nigeria. The study specifically described the socio-economic characteristics of cattle farmers in the study area, determined the perception of the cattle farmers on climate change, identified the problems facing cattle farmers and the adaptation strategies employed by the cattle farmers in their production. A multistage sampling procedure was used to select respondents for the study resulting in a total of 140 respondents. Structured interview schedules were used to elicit data from the respondents. Data collected were analyzed using both descriptive and inferential statistics such as frequency counts, percentages, mean and standard deviation. The results showed that all the respondents (100 %) were males implying that cattle production is a male dominated

activity. The mean age of the respondents was 44.62 ± 10.31 years while the mean cattle farming experience was 13.93 ± 4.16 years. The mean household size was 18.71 ± 2.04. In addition, effects of climate change on the rearing season of cattle (4.97) was ranked highest among the respondents' perception on climate change followed by temperature changes in the study area (4.94). High cost of feed (4.86) was ranked highest among the effects of climate change on farmers' cattle production, followed by disease outbreak (4.60). Similarly, high cost of feed (1.00) was ranked highest among the problems facing cattle farmers in their production followed by the incidence of diseases and parasites (0.96). Some of the adaptation strategies employed by cattle farmers to cope with the challenges posed by climate change in the study area include: change in feed formulation, increased water supply, tree planting around paddocks and reduced heat supply. The study concluded that the majority of the farmers were aware that climate change has negative effects on cattle production. It was recommended that more awareness on the effects of climate change on cattle production should be created and that farmers should engage professionals like veterinary doctors to manage the health of their cattle.

Keywords: Perception, Effect, Climate change, Cattle production, Adaptation strategies

Climate change effect on planting date and cultivar choice under dryland maize (*Zea mays* L.) production in South Africa

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Maize (*Zea mays* L.) is one of the most important field crops in South Africa, therefore the ability to produce high yields and maintain yield stability is of great concern. Climate change will likely be a major factor limiting the ability to achieve the required stable yields. Temperature increases over Southern Africa are projected to be approximately 1.5 to 2 times higher than the increase in the global mean temperature and this will influence frost incidence as well as moisture availability at different developmental stages of the crop. An understanding of how maize production will be influenced by these factors can provide guidance in formulating effective adaptive measures. In this study, we conducted an analysis of climate change impacts under dryland maize production in Bloemfontein and Lichtenburg, two major maize growing regions in South Africa, using climate data generated by six Global Climate Models under two radiative forcing scenarios (Representative Concentration Pathways (RCP) 4.5 and 8.5). The analysis was performed for four planting dates, November 15, December 15, January 15, and February 5. The results indicate that the last spring freeze will likely shift earlier in the future at both locations, regardless of the projection scenario and climate model. There was an opposite trend for the first winter frost, which shifts to later dates in both locations. Days to maturity receded as years progressed from the baseline period (1991-2020) to the far future (2051-2080), with higher rates observed under the RCP 8.5

scenario. This decreasing trend for time to maturity was in fact observed at both locations, with higher rates of reduction observed at later planting dates. Results indicate an increasing trend in the frequency of days with a maximum temperature above 35°C at the end of the century during both the vegetative and reproductive stages, at both locations, most notably for the RCP 8.5 scenario. A reduction in the frequency of days with minimum temperature less than or equal to 0°C as time progresses to the future was also noted and will specifically affect the later planting dates. Lastly, higher rates of water deficit under RCP 4.5 will likely be experienced at both locations. The two earlier planting dates showed a higher water deficit at the vegetative growth stage and a lower water deficit at the reproductive stages. An opposite trend was observed with the latter two late planting dates where high water deficits were estimated for the reproductive stage and lower deficits were observed for the vegetative stage. Receding of onset of last spring freeze dates might provide an opportunity for early plantings on the assumption that there will be available moisture that would permit planting activities. Increasing trends of higher water deficit and higher temperatures at both developmental stages, and the possibility of exacerbated drought call for breeding of maize cultivars that are tolerant to these stresses and adapting agricultural practices in the future.

Construction and Evaluation of a Statistical Model of Seasonal Forecast in Cameroon

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The objective of this study is to build and then evaluate a statistical model of seasonal forecasts in Cameroon. This study was carried out in four agro-ecological zones of Cameroon with the test stations of Kaélé, Meiganga, Nkongsamba, Yaoundé and Kribi. This study consisted of developing in each of these stations statistical forecast models which were first checked over their calibration period (1958-1987), and then they were evaluated over a later period (1989-1993). It emerges from this evaluation that the sea surface temperatures so far used during the PRESACs (Seasonal forecasts in Central Africa) explain "roughly" the rainfall in Cameroon and especially in the cities of Yaoundé and Kribi where the multiple correlations between the sea surface temperature and rainfall indices are 0.70 and 0.71 respectively. It also follows that the Hit Skill Score and the rate of coincidence between forecast and observed rainfall indices vary from 65 % to 85 % and 76.66 % to 90 % respectively. No model has false alarms. Strong connections have been established between rainfall in Cameroon and temperatures on the Atlantic coast of Africa. These results argue in favor of exploring other predictors to improve predictions.

Diurnal cycle of summer rain in the Ethiopian mountains using climatological model data

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Topoclimate, orographic rains on windward slopes and leeward rain shadow control the rainfall variability in tropical mountains (Van den Hende et al., 2021). Such rainfall variability has a substantial societal impact. For instance, they can cause differences in the wealth of rain-fed agriculture farmers among the windward and leeward sides of the mountain. However, due to a lack of detailed scientific knowledge, a “one-size-fits-all” approach has so far been used in determining priority zones for conservation and distributing agricultural inputs, without considering the inter-event variability of rainfall. This study aims at characterizing and understanding the spatio-temporal characteristics of the summer rain climatology over the Ethiopian highlands by use of the regional climate model ALARO-0 at 4 km resolution. Therefore multiple determining factors are explored including: wind categories (windward or leeward), wet-day or dry-day categories and elevation. These are used to categorize the diurnal cycles of different meteorological variables including wind-speed, temperature, humidity, as well as rainfall frequency and intensity. Ethiopia’s summer rain exhibits a clear diurnal pattern with the highest rainfall during the afternoon hours 1100–1800 EAT and the minimum values identified in the morning hours 0200–0900 EAT. During these hours, the mountainous areas receive up to 1.5 mm hr^{-1} for as long as six hours a day, while lowlands receive little to no rainfall at most of the times. The predominant afternoon

maximum rainfall, as well as the prevalence of windward over leeward events and high orographic rainfall suggest terrain-induced ascent owing to thermal rather than wind-induced forcing (Kirshbaum et al., 2018). This is consistent with pronounced differences in the diurnal cycles of wind speeds. Flash floods in catchment headwaters and hydrological deficit in the flood-plains are also evidencing higher rainfall with increasing elevation - where highland farmers mainly depend on rainfed agriculture while lowlanders could not harvest almost any crop unless supplemented by spate irrigation (Negash et al., 2020). This suggests the need for a way out from the “one-size-fits-all” agro-ecosystem management approach towards a site-specific approach taking into account topoclimatic differences.

References

Kirshbaum, D. J., Adler, B., Kalthoff, N., Barthlott, C., & Serafin, S. (2018). Moist orographic convection: Physical mechanisms and links to surface-exchange processes. *Atmosphere*, 9(3), 80.

Negash, E., Gebresamuel, G., Embaye, T. A., Nguvulu, A., Meaza, H., Gebrehiwot, M., Demissie, B., Gebreyohannes, T., Nyssen, J. and Zenebe, A. (2020). Impact of headwater hydrological deficit on the downstream flood-based farming system in northern Ethiopia. *Irrigation and Drainage*, *69*(3), 342-351.

Van den Hende, C., Van Schaeybroeck, B., Nyssen, J., Van Vooren, S., Van Ginderachter, M., & Termonia, P. (2021). Analysis of rain-shadows in the Ethiopian Mountains using climatological model data. *Climate Dynamics*, *56*(5), 1663-1679.

Valley-bottom agriculture in a changing climate and its impact on stream flow and land use in southern highlands, Tanzania

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Dynamic utilisation of areas on the higher elevations can help to mitigate impacts of climate change in low-income countries. Valley-bottom agricultural systems in the southern highlands of Tanzania are important corridors for food, health, and water securities as climate change effects on livelihoods are on the rise. Research on the utilisation of the higher elevation landscapes for agriculture is a key to the local farmers to maintain valley-bottom agricultural systems and ecosystem services in a changing climate. However, feedback on the shifting of traditional agricultural systems, which have been using available moisture and water around the raised cumber beds within the valley-bottom system, to the higher elevation landscapes, is not readily available. The objective of this study was to investigate the effects of shifting of these agro-systems with respect to the flow of water and major land use in a changing climate in the Iringa district of the southern highlands of Tanzania. Whereas the TREND v.1.02 software, supplemented with rainfall-time series data with Climate Hazards Group InfraRed Precipitation Station data (CHIRPS) was used to estimate stream flow on lower elevations, ERDAS imagine 15 software was used to estimate changes in the cover of major land use. Results show that despite receiving a relatively high annual mean rainfall of 80mm and above, the stream flow had worsened in 2005/2006 and 2010/2011. This implies that the stream flow variation was mainly caused by climate variability and the system of farming used. On the land use however, it was found that between 1985 and 2015, areas preferred for cultivation (the

floodplains and swamps) within lower elevations had declined by about 47% and 18% respectively. This decline encouraged more woodland and forests clearance for cultivation and settlements on the uplands, leading to the decline of these by about 9% and 8% - while cultivation and settlements land increased by about 157% and 52%. Although this move is considered by the local farmers as an alternative strategy to climate change adaptation for improving food security and ecosystem services in the area, this system however led to soil erosion, silt transportation and deposits on the lower landscape, thus impacting both stream flow and arable land cover for cultivation on the lower valley elevations. While a lot of water was found in the furrows between the raised cumber beds on the lower elevations during the rainy season, local farmers rarely do re-direct this water back to the main channels; thus, leading to more water loss. Therefore, promotion of appropriate strategies of returning water to the mainstream while increasing food production is highly recommended. This would increase the water budget for irrigation downstream and food security during the changing climate in the area.

Keywords: CHIRPS, Cumber bed, ERDAS, SAGCOT, Valley-bottom

Studies on students' awareness on climate change education in Nigeria: a case study of the University of Ibadan

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Climate change which is usually deduced from observations and data is of great importance to the economic, social and environmental health of people. It is usually explained as the long-term significant change in the expected average weather patterns of an area over a specific period of time. A study on students' awareness on issues pertaining to climate change at the University of Ibadan, Nigeria was carried out using the descriptive quantitative research design approach consisting of 300 randomly selected student respondents each from the various departments, in ten of the faculties represented at the University. The instrument used for the study was by administering a 5 point modified Likert scale type questionnaire, and the data collected were analyzed using descriptive statistics. The research findings revealed that the majority of the respondents were aware that industrial releases, gas flaring, bush burning, overgrazing, deforestation and improper sewage disposals are amongst the human activities responsible for climate change. Also, flooding, drought, erosion, reduction in economic growth and increases in amounts of diseases are some of the challenges resulting from climate change. Thus, the causes and effects of climate change are well known to the students. However, it would be good if the continuous monitoring of the climate factors is being carried out by the various governmental monitoring agencies assigned to do so in the country, so that more information could be provided for the public on climate change awareness including the mitigation of their impacts and the adaptation to these changes by the masses where mitigation is not possible. In essence, this study had revealed that there was adequate awareness among students on issues pertaining to climate change at the University of Ibadan

and the integration of climate change studies into the educational curriculum of students would create even better awareness. Moreover, the environmental monitoring agencies in the country could also benefit immensely from this study especially on the statistics pertaining to the public's (students) level of awareness concerning climate change issues for their own enhanced performance.

Climatic change adaptation strategy for dry season amaranth cropping systems in the tropics: A case study from irrigated watermelon (*Citrullus lanatus*) as live mulch

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Watermelon (Citrullus lanatus) could reduce soil temperatures and improve soil moisture levels in the dry off-season of sub-Saharan Africa in predominantly rainfall agriculture, resulting in reduced needs for irrigation and providing additional income to farmers from produce harvested in mixed cropping systems. This study therefore seeks to quantify the impact of watermelon live mulch on irrigation requirements, adaptation to climatic change and yield potential of an amaranth production system in the dry off-season. Grain amaranth was planted at 0.75×0.75 m spacing, and there were three sowing densities of watermelon: 1.5×0.45; 1.5×0.90; 1.5×1.50 m. Control plots were planted with only grain amaranth. Averaged over two consecutive cropping seasons, irrigation water requirement was optimally (P=0.05) reduced compared to the control plot. Amaranth grain yields were highest at 1.5×0.90 m watermelon plant spacing. Maximum soil temperature was reduced by the watermelon mulch relative to the control. Soil moisture content was also significantly (P=0.05) greater in the live mulch treatments compared to the control. Our research demonstrates that live mulch lowers soil temperatures, reducing water requirements for irrigation in the dry season, and provides opportunities in the adaptation of agricultural production systems under climate change scenarios.

Keywords: Off-season, Soil, Temperature, Moisture, Farmer

Indigenous knowledge traditions and varying epistemologies amongst migrant farmers in Ghana

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Indigenous and local knowledge traditions are at the heart of a lot of agricultural practices. So too in Ghana. In the most Northern regions of the country however, farmers are facing increasing difficulties with a changing climate. A lot of research delves into coping mechanisms for farmers in dealing with these difficulties, but fewer scholars pay attention to the impact this may have on indigenous knowledge. How do holders of indigenous knowledge maintain or adapt their traditions in these regions that are faced with a rapidly changing environment? In other words, should academics, citizens or human rights experts be concerned with possibly losing these knowledge traditions?

The case of Ghana becomes especially interesting when looking at the historical migration patterns of farmers. Typically, farmers of the Northern areas in the country will move for an (in)definite period of time towards the South, in order to benefit from more favourable growing conditions. This begs another question: do migrant farmers contribute to the creation of new traditions and epistemic communities? So, how dynamic are these bodies of knowledge and who are the agents of change?

This presentation will touch upon these main questions, while taking a human rights and knowledge sovereignty focal lens on qualitive (preliminary) data I have collected by means of participant observation and semi-structured interviews in the Spring and Summer of 2021 in Ghana. Without a deeper understanding of the political issue of how indigenous knowledge is represented, heard and included within the hegemonic framework of academic traditions,

the above-mentioned questions cannot be dealt with. This is a struggle that is not only present within the context of Ghana, but one that can be found all over the globe.

Yangambi's Wood Biology Laboratory: knowledge generation for tropical forest ecology and management

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Located in the Yangambi Biosphere Reserve, at the heart of the Congo Basin, the Wood Biology Laboratory is unique in Sub-Saharan Africa. It allows to study the functioning of trees on-site, next to the newly built flux tower. Fully equipped with state-of-the-art microscopes and other equipment, the Lab aims at three main goals: research, capacity building and assistance to varied partners. Firstly, Congolese and international scientists can conduct top-notch research on wood anatomy and dendrochronology to better understand forests' contribution to climate change mitigation and adaptation. In particular, topics such as tree growth patterns and functional traits, forest dynamics, vegetation history, wood properties, carbon stocks or trees responses to stressors are being explored. Secondly, capacity building activities are carried out for Congolese stakeholders from both public and private sectors involved in forest management and timber trade. Those activities include timber identification trainings achieved in close cooperation with trained local technicians and scientists. Regarding the academic component, the Lab has hosted several MSc and PhD students from the University of Kisangani, contributing to a programme implemented by the EU-funded FORETS project.

The Lab is also playing a key-role in the setting up of South-South partnerships with so far Madagascar, Namibia, South Africa and Cameroon. Thirdly, in the context of large scale plantations and other agroforestry systems currently set up in the Yangambi landscape (EU funded FORETS and NPC projects), the Lab contributes to identifying multipurpose native species able to meet the challenge. Regarding the support to legal logging and timber trade, the Lab provides timber identification services. To conclude, this Lab gives a unique opportunity to study wood and tropical trees and build capacities on forest ecology and management right next to Central Africa's forests.

Family physician perceptions of climate change, migration, health, and health care in sub-Saharan Africa: an exploratory study

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Background: While family physicians (FPs) are community-oriented generalists and should be the entry point for the population's interaction with the health system, they are underrepresented in research on the climate change, migration, and health(care) nexus. Similarly, FP insights into building capacity through integrating health-determining sectors (recommended WHO-strategy) for climate-resilient and migration-inclusive health systems is needed, especially in regions such as sub-Saharan Africa (SSA). Therefore, we explored FPs perceptions on climate change, migration, and health(care) in SSA and on intersectoral capacity-building opportunities.

Methods: Three focus groups of each 10 FPs conducted during the 2019 WONCA conference in Kampala, Uganda were transcribed verbatim and inductively analysed.

Findings: FPs' perceived interactions related to 1) migration and climate change, 2) migration for better health and health care, 3) health impacts of climate change and the role of health care, and 4) health impacts of migration and the role of health care. We coined these complex and reinforcing interactions as continuous feedback loops intertwined with socio-economic, institutional, and demographic context. Furthermore, FPs identified intersectoral capacity-building opportunities on micro, meso, macro and supra level: multi-dimensional and multi-layered governance structures; improving FP training and primary health care working conditions; primary health care providers as community and policy educators; collaboration between health sector and civil society; and more responsibilities for high-income countries.

Interpretation: This study points towards future interdisciplinary research questions and complexity theory to analyse the nexus and identifies responsibilities for FPs and primary health care in intersectoral capacity-building strategies.

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Power, voice and representation in the production of evidence at the African Court on Human and Peoples' Rights – A case study

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Africa has long been facing the perils of environmental degradation and climate change. From a legal perspective, it is a fascinating region of study due to the explicit justiciability of environmental claims. The right to a healthy environment is enshrined under Article 24 of the African Charter on Human and Peoples' Rights (ACHPR) and assures peoples the "right to a general satisfactory environment favorable to their development." Unlike in other regional human rights systems, where a number of substantive human rights have been interpreted to incorporate an environmental protection component, the African Convention provides this express avenue for claimants.

The groundbreaking 2001 case by the Social and Economic Rights Action Centre against Nigeria before the African Commission on Human and Peoples' Rights (AComHPR) provided a golden opportunity for peoples' voices to be heard and to reclaim their power. The complaint in this case concerned the consequences of environmental degradation in Ogoniland (in the Niger Delta of Nigeria) caused by Shell Corporation in collusion with the Nigerian government. My aim is to examine how voice and power intertwine in a case that was decided favorably for the applicants. The Commission had a variety of evidentiary sources to assess, including a mission conducted by the AComHPR. My goal is to identify moments in which the Commission picks up on these various sources, thereby choosing to amplify the voices of the applicants. In deconstructing the judgment from a socio-legal perspective, I seek to understand how the AComHPR utilizes language in a manner capable of translating deplorable conditions, including those caused by private actors, into rights capable of protection under the African

Charter. Moreover, I will examine how facts are constructed as 'truths' from both parties involved in the litigation process.

The aim, therefore, is to better understand how voice, power and representation may be constructed to advance African communities' claims for a satisfactory environment. With increasing pressure on communities as a result of environmental degradation and climate change, effective representation and platform before the regional human rights courts is paramount. As power comes from being heard and acknowledged, the voice that the African Court on Human and Peoples' Rights, as well as the AComHPR can give to suffering communities may represent a key factor in advancing rights-based environmental claims in Africa.

Quantification of *miombo* woodland deforestation in the Lufira Biosphere Reserve (DRC), an argument for its withdrawal from the World Network of Biosphere Reserves?

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The Lufira Biosphere Reserve (LBR) is a protected area located in Southeastern DR Congo, created for the conservation of *miombo* woodland, an ecosystem threatened by anthropogenic activities developed in the region. However, scientific studies regarding land cover dynamics within the LBR are non-existent to date. This study maps and quantifies the land cover dynamics within and around the LBR, based on diachronic analysis of five Landsat images (1979 (date of its recognizing by the UNESCO), 1986, 1998, 2008 and 2018) and field verification missions. Landscape metrics were utilized to understand changes in landscape pattern. The results indicate that *miombo* woodland area has been reduced by a factor of three in the LBR, as it covered 11.2 km² in 2018 compared to 85.3 km² in 1979. The annual deforestation rate between 1979 and 2018 was 1.8%, almost eight-fold higher than the rate registered at the country level. Within the LBR, this deforestation has been offset by an increase in areas occupied by grassy savanna (+16.9 km²), as well as fields and fallows (+53.3 km²). Further, water and wetland area increased by 17.9 km² in 39 years whereas the wooded

savanna, the bare soil and built-up decreased by 24.9 km² and 4.0 km² respectively. The increase in the proportion of grassy savanna is a tangible evidence of the degradation of past forest resources. In general, analysis of landscape spatial pattern dynamics through landscape metrics showed a process of creation and aggregation of grassy savanna, water and wetlands, as well as fields and fallows, as opposed to dissection and attrition of *miombo* woodland, wooded savanna, bare soil and built-up. Overall, the LBR has undergone a major transformation, mainly deforestation, due to demographic pressure and the development of subsistence activities in a precarious economic context. So, the small forest patches that persist within the LBR owe their existence to the unsuitable nature of their soils or their inaccessibility, due to their location on hills. Consequently, wooded savanna are in turn cultivated or their individuals of reduced stem diameter are also cut for carbonization. Indeed, wood energy production is seen as an essential supplement to household income, which accelerates deforestation and the regression of wooded savanna. The study concludes that in the absence of any land use planning policy, the LBR risks losing its status following the loss of the rare *miombo* woodland patches still existing. For this reason, the DRC has asked UNESCO to remove the LBR from the World Network of Biosphere Reserves.

Keywords: Remote sensing, Landscape ecology, Anthropogenic pressures, *Miombo* woodland deforestation, Ecosystem services, Lufira Biosphere Reserve

Improving Smallholder Livelihoods through Third Party Certification in Western Burkina Faso Orchards

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Fruit production in Burkina Faso is dominated by mango, which represents more than half of the orchards nationwide. This study aims to determine the socioeconomic impacts of sustainable mango production in western Burkina Faso at the level of producers involved in the Rainforest Alliance certification project. For this purpose, an operating account of the group's producers was established. The results reveal that the producers are all male, with an average age of 44 years and a relatively low level of education. The average farm size is 20.85 Ha with a density of 100 trees per Ha. Farming practices comply with the specifications of the Rainforest Alliance, GLOBAL GAP, Bio, Tesco Nurture, Albert Heijn, Grasp and BSCI certification standards. Varieties produced by members of the group are Amélie, Kent, Keitt, Brooks and Springfield with respective orchard frequencies of 48.1 percent, 25.9 percent, 14.8 percent, 7.4 percent, and 3.7 percent. The total annual income of an average producer is 1,495,424 FCFA, while the annual income per person in his household is 124,618 FCFA. The income from mango production (19% of the total annual income) increases the producer's household disposable income per person per year by 30,300 FCFA.

Keywords: Burkina Faso, Smallholders, Rainforest Alliance Certificate, Sustainable Agriculture, Mango, Sustainable Livelihoods

Urgent need to monitor climate change to improve policies and strategies for the sustainable management of tropical forests in the Congo Basin

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Tropical forests play a key role in regulating Earth's climate, particularly by storing 428 billion tonnes of carbon in biomass and soil (equivalent to more than half the total atmospheric carbon stock), and by annually sequestering ~15% of anthropogenic CO_2 emissions to the atmosphere. However, forest ecosystem services have been in peril over the last decades. Tropical land-use change (mainly deforestation and regrowth) represents 17% of the global anthropogenic CO_2 emissions. Loss of the tropical forest ecosystem functions is an immediate threat to the habitability of our Planet. In contrast to this growing body of evidence for changing tropical forest functioning, is the sheer lack of meteorological data for tropical forests. However, climate stations are relatively rare in the tropics, particularly in equatorial Africa, and satellites generally do not perform well. This situation does not favour the climate

change research related to the forest sector in this region. The evolutionary trend of the vulnerability of this forest massif to increasing climatic and human pressures is now confirmed by numerous recent studies. The management of this precious forest heritage, which has local, national, regional and international interests, must currently focus on the impacts of climate change and the lack of sustainability of its exploitation. Indeed, understanding the impacts of climate change on the forests of the Congo Basin and their unsustainable exploitation is essential to predict the future of the Earth. Studies on climate change in Central Africa are very weak (and almost rare in DRC). Forest monitoring efforts are slowly increasing, but the number of available climate records is dramatically decreasing. Climate data are often derived from satellites, which are not very efficient in equatorial Africa, or from interpolated gauge datasets, which have very low station coverage in the Congo Basin. This leads to substantial uncertainty, illustrating the need for long-term ground-based climate records. Here, we illustrate some results of the climate change analysis carried out with 61 years (1960-2021) of ground-based climate monitoring focused on precipitation and temperature in the Yangambi reserve, located in the heart of the Congo Basin. The ground climate observations are then compared with those extracted from the Global Precipitation Climatology Centre and the Tropical Rainfall Measurement Mission (a satellite product). These climate monitoring observations indicate a continuing shift towards a warmer and more seasonal climate in the Congo Basin forests. Given this situation and the anthropogenic pressures on forest ecosystems in this region, we are trying to ask and answer some questions: What are the responses of forests (bio-physical vulnerability) to the combined pressures of climate change and unsustainable exploitation? What is the analysis of the socio-economic vulnerability and adaptation strategies of forest-dependent people to climate change? How can deforestation, forest degradation and unsustainable logging be effectively tackled in the context of ongoing climate change? How to plan and/or improve forest mitigation and adaptation strategies to climate and global changes? What are the priority national and regional policies, strategies and actions for climate change and sustainable forest management?

Climate suitability predictions for the cultivation of macadamia (*Macadamia integrifolia*) in Malawi using climate change scenarios

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Climate change is altering suitable areas of crop species worldwide, with cascading effects on people reliant upon those crop species as food sources and for income generation. Macadamia is one of Malawi's most important and profitable crop species; however, climate change threatens its production. Thus, this study's objective is to quantitatively examine the potential impacts of climate change on the climate suitability for macadamia in Malawi. We utilized an ensemble model approach to predict the current and future (2050s) suitability of macadamia under two Representative Concentration Pathways (RCPs). We achieved a good model fit in determining suitability classes for macadamia (AUC = 0.9). The climatic variables that strongly influence macadamia's climatic suitability in Malawi are suggested to be the

precipitation of the driest month (29.1%) and isothermality (17.3%). Under current climatic conditions, 57% (53,925 km^2) of Malawi is climatically suitable for macadamia. Future projections suggest that climate change will decrease the suitable areas for macadamia by 18% (17,015 km^2) and 21.6% (20,414 km^2) based on RCP 4.5 and RCP 8.5, respectively, with the distribution of suitability shifting northwards in the 2050s. The southern and central regions of the country will suffer the greatest losses (≥ 8%), while the northern region will be the least impacted (4%). We conclude that our study provides critical evidence that climate change will reduce the suitable areas for macadamia production in Malawi, depending on climate drivers. Therefore area-specific adaptation strategies are required to build resilience among producers.

Keywords: Malawi, Macadamia, Suitability, Climate change, Ensemble model

ABSTRACTS POSTERS

Farmers' perceptions and preferences for climate-smart inland management for rice production in West Africa: Evidence from Benin

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Rice represents a staple food for developing countries, providing around 20% of their daily required calories. Since rice cropping is depending on water availability, its production is threatened by a high scarcity of rains that occurred over the last decade driven by climate change. In response to this, the Smart-valley technology represents an opportunity for smallholders to overcome the rain's scarcity. Indeed, Smart-valley is a low-cost inland valley management technology with high yield and a low usage of fertilizer. In addition, farmers can implement the technology themselves. Since the introduction of the technology to farmers in Benin, studies were carried out to measure its impact on the production, and the results have proven the high yield of the technology. However, the perception of beneficiaries is still important to ensure a sustainable adoption for both women and men. This study aims to fill in this gap, and in addition, investigate the determinants of the gender gap in the adoption concern. The study uses, in opposition to the traditional method, the approach based on the supply and demand of the technology developed by Sall in 2000. The method suggests that the gap between the demand and the supply can help scientists to make adjustments on the

technology in order to better match with the expectations of the farmers. The determinants of the adoption are analysed using the Probit Model, that is based on the utility that the beneficiaries take from the technology. The results showed that with respect to the characteristics evaluated, beneficiaries together agreed that the high yielding, the easy handling, the water control, and the soil fertility management represented the most important characteristics to the technology that have matched with their expectations. However, results indicated that research has to strengthen their capacities on the use of the power-tiller and the technique of technology implementation. Overall, the Probit Model reveals that land ownership, training on power-tiller, and access to credit are the most important determinants to adopt the technology of Smart-valley in Benin. Furthermore, the gap in the adoption between women and men is that women are loaners of the land, while men are owners. In addition, there is a lack of access to training and credit for women to buy and use the power-tiller to develop the technology on their plots. The study recommends to the scientists to reinforce the capacities of the farmers for the implementation of the technology and to provide especially more support to women for land access and security and access to credit.

Keywords: Perception, Smart-valley, Lowland, Rice, Benin

Roles of extension agents in climate change adaptation among capture and culture fishers in the Delta South Agro-ecological zone, Delta State, Nigeria

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The study examined the roles of extension agents in climate change adaptation among capture and culture fishers in the Delta South Agro-Ecological Zone, Delta State, Nigeria. Specifically, it assessed socioeconomic characteristics of the respondents, perceived impacts of climate change, roles of extension agents, indigenous adaptation strategies and constraints to adopting climate change adaptation strategies by respondents. A multi-stage sampling procedure was used to select 147 respondents. Data was collected through a structured questionnaire and analysed using descriptive and inferential statistics such as Pearson Product Moment Correlation and t-test at 5% significance test.

Most (87.2%) of the respondents were male for both capture and culture fisheries, with a mean age of 44 and 45 years respectively. Respondents' mean years of formal education for capture fisheries was 12 years and for their counterparts 14 years. The perceived impacts of climate change were felt to be high by the respondents, (56.4%) for those involved in capture fisheries and (61.1%) for those involved in culture fisheries. Their level of adoption of indigenous adaptation strategies were found to be low, (53.8%) for capture fisheries and (51.9%) for culture fisheries. The perceived roles of extension agents were felt to be high for both capture and culture, (61.5%) and (63.9%) respectively. The constraints to climate change adaptation in capture fisheries was a lack of access to extension (absence of proper government policies ($\bar{x}$ =1.74)) and a lack of credit facilities ($\bar{x}$ =1.67). While for culture

fisheries, it was nonchalance on the part of the government in the introduction of extension service programs ($\bar{x}$ =1.65), the lack of information on weather incidences ($\bar{x}$ =1.56) and the expensive nature of good culture equipment ($\bar{x}$ =1.56). Age had a significant relationship (r = 0.323; p=0.045) with the perceived roles of extension agents for capture fisheries while perceived impacts had a significant relationship with perceived roles of extension agents, both for capture (r = 0.331; p=0.039) and culture (r= 0.252; p=0.009). Although there was no significant difference in the perceived impacts of climate change (t= 0.196: p = 0.844), there was a significant difference in the indigenous adaptation strategies (t= -2.765; p= 0.006) and the perceived roles of extension agents (t= -2.651; p= 0.009) between capture and culture fisheries. Both capture and culture fisheries felt a high impact of climate change and as a result had a high expectation in terms of perceived roles of extension agents in climate change adaptation. Those involved in capture and culture fisheries should be made more aware of adaptation strategies in order to reduce the impacts of climate change.

Keywords: Climate change, Capture fisheries, Culture fisheries, Extension roles

The wood anatomical structure between two dated marks reveals periodicity of secondary growth of rainforest species

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Trees archive information on growth trajectories in their wood. Analysis of ring patterns on pith-to-bark samples makes it possible to estimate the age of trees, to evaluate past reactions to environmental fluctuations and possibly to reconstruct past climatic conditions. In temperate and boreal regions, lateral tree growth is determined by the regular seasonality of the climate, characterized by a typical winter dormancy which induces the formation of clearly visible rings in the secondary xylem. In the tropics, monitoring of secondary growth is hampered by a less distinct seasonality. Therefore, the absence of clear temporal morphological markers in many tropical plants makes retrospective analyses and accordingly modeling of future tree performance difficult. It is particularly unclear how long the growing season lasts, whether there is a dormancy period and when exactly cambial activity peaks. Given the strong link between carbon sequestration and tree growth, it is also of key importance to date the different phases of wood formation, such as cell division, cell differentiation, cell expansion and lignification.

The rhythmicity of secondary growth is being studied for dominant rainforest species, in the semi-deciduous tropical forests of Western and Northern Congo. The study is conducted in the landscapes of the UNESCO MAB Reserves of Luki (05°35' - 05°43'S; 13°07' - 13°15'E) and Yangambi (0°50'N - 1°00'N; 24°15'E - 24° 30'E), in the Democratic Republic of Congo (DRC). 18 tree species from different functional groups are selected that are common to the two forests.

The cambial zone of the trees has been wounded with a pin and sampled at the same location on a later date. In this way wood samples are available with two exactly known dates of cambium positions: the time of pinning and the time of sampling. Microscopic observation and analysis of the wood produced between the two dates reveals key information on the presence of tree-ring borders and eventually the wood anatomical structure of a growth zone. These observations are supplemented with measurements with high resolution dendrometers, documenting diurnal and seasonal periods of stem swelling and shrinkage. The annual radial growth of each species is being modeled according to the Gompertz function.

Keywords: Cambial marking, Secondary growth, Cambial activity, High resolution dendrometer, Modeling

Africa: between climate change, population growth and sustainability

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Climate change has become a great concern for the present and future generations all over the world. Various climate change-related and other stressors disrupt ecosystems. Further temperature rise, increased rainfall, soil salinization, sea level rise, intensity of extreme weather events like wildfires, hurricanes, drought and flooding are among the impacts. The change has become a crisis, especially in agriculture, where it threatens food security, forces humans and animals from their homes, separates families and endangers livelihoods. Incessant and intractable resource wars between herders and farmers in Sub-Saharan Africa can be traced to climate change. Lake Chad, for instance, is no longer an oasis in the desert. The same fate has befallen many rivers. Due to its vulnerability and low coping capability, Africa has been negatively hit. Overpopulation is equally the greatest threat to its survival. In former times, infant and childhood death and short life expectancy used to control population. Today, increased high birth rates and decreased death rates have contributed to a population surge in Africa. Human population is a major contributor to global warming, so the two are inextricably linked in their collective global environmental impact. Africa is among the hottest places on the earth, so should there be any warming, the situation is going to be dire. The overriding challenges facing our global environment and civilization are to curtail climate change and slow down population growth. The paper explains in detail all about the effects of climate change and population growth. It discusses the concepts, the need for sustainability

and the major developmental points that require sustainability practices. The criteria consist among others of forming a healthy environment, and maintaining economic and social equity.

Smart classification of Congolese timbers: deep learning techniques for enforcing forest conservation – SmartWoodID

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A substantial part of the timber traded each year is still illegal. Illegal logging is the most profitable biodiversity crime. It involves a high risk of irreversible damage to forests since it often implicates overexploitation of highly sought after, sometimes protected, species. This is especially pertinent for tropical species, as it is estimated that 30-90% of the tropical timber volume is harvested illegally (Deklerck et al., 2020; Hirschberger, 2008; Hoare, 2015; Vlam et al., 2018). Timber regulations are already active (CITES, FLEGT, EUTR , Amendment to the U.S. Lacey Act), but implementation and enforcement are a challenge.

Wood identification is crucial in the enforcement process when it comes to verify whether the shipment corresponds with the products mentioned on the accompanying documents. For this reason, there is a growing demand for timber identification tools that can be applied by law enforcement officers.

SmartwoodID aims at improving both identification success and speed by non-experts. The project aims at automating part of the wood identification process by applying artificial intelligence techniques for the analysis of wood anatomical images of timber species of the Democratic Republic of the Congo.

The project focusses on 970 Congolese timbers to create a database with high-resolution scans of the endgrain surface along with expert wood anatomical descriptions. The study material comes from the Tervuren Xylarium. This because said database offers the most complete collection of reference material for the development of wood classification and identification approaches for Congolese species, comprising more than 2000 woody species from the DRC (timber trees, small trees, shrubs, dwarf shrubs and lianas).

The resulting database is used to make an illustrated key for wood identification. The project also takes advantage of the power of modern deep learning approaches. The scans and anatomical descriptions will therefore serve as annotated training data to develop a machine learning assisted illustrated key for wood identification.

References

Deklerck, V., Lancaster, C. A., Van Acker, J., Espinoza, E. O., Van den Bulcke, J., & Beeckman, H. (2020). Chemical fingerprinting of wood sampled along a pith-to-bark gradient for individual comparison and provenance identification. *Forests*, *11*(1), 107.

Hirschberger, P. (2008). *Illegal wood for the European market: an analysis of the EU import and export of illegal wood and related products*. WWF-Germany.

Hoare, A. (2015). Tackling illegal logging and the related trade. *What Progress and Where Next*, 79.

Vlam, M., de Groot, G. A., Boom, A., Copini, P., Laros, I., Veldhuijzen, K., Zakamdi, D., & Zuidema, P. A. (2018). Developing forensic tools for an African timber: Regional origin is revealed by genetic characteristics, but not by isotopic signature. *Biological Conservation*, *220*, 262–271.

Building carbon stocks in regrowing forests in the Congo Basin: opportunities of natural regeneration and planting trees

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Tropical forests are the most diverse and productive ecosystems on Earth (Blundo *et al.*, 2021). Today, there is general agreement about their importance for the global carbon cycle and hence for buffering global climate changes. Tropical forests are indeed large stocks of carbon and influence as such the global carbon balance when changes are induced due to climate change and anthropogenic disturbances (Kearsley, 2013). In recent times, tropical forests have played a crucial role in the rise of atmospheric carbon concentrations. They have acted as a source of emissions, as a result of deforestation and forest degradation. At the same time, they continue to represent a substantial carbon sink as a result of forest regrowth and carbon uptake in natural forest. Indeed, the remaining forests have taken in much of the extra carbon added to the atmosphere (Mitchard, 2018). With both forest loss and climate change likely to accelerate over the 21st century, tropical forests are prone to release even more carbon (Mitchard, 2018; Hubau *et al.*, 2020). Therefore, limiting the global warming to less than 1.5°C above pre-industrial levels will be very difficult to achieve. However, recent studies have shown that halting the destruction of tropical forests and maintaining current regrowing rates can provide at least 30 per cent of all the needed mitigation actions needed to limit global warming to 1.5°C (IPPC report 2021; Lamb *et al.*, 2021). Indeed, we cannot count on the

remaining intact tropical forests alone to halt increasing atmospheric carbon concentrations and avoid a runaway greenhouse effect scenario (Mitchard, 2018; Sullivan, 2021).

Furthermore, sustainable forest management can maintain or enhance forest carbon stocks, and can preserve the forest carbon sinks (IPPC report, 2021; Hubau *et al.*, 2020). Uncertainty impedes our understanding of the global carbon cycle, limiting our ability to simulate the future of the Earth system under different long-term climate mitigation strategies (Sullivan *et al.,* 2021). We explore how to design forest management strategies that can increase carbon stocks and sinks in Central African rainforests, possibly at levels higher than the reference values observed for intact natural forests. We consider the UNESCO's Man-and-the-Biosphere (MAB) Reserves of Yangambi and Luki in the Democratic Republic of Congo as living laboratories to evaluate carbon stocks and sinks in different settings: (1) intact forests, (2) spontaneous regrowing forests, (3) young and old tree plantations and (4) managed forests.

Keywords: Carbon stocks, Forest management, Forest plantations, African tropical rainforest, Climate mitigation

Communicating Effects of Deforestation through *Kar Dare Ya Same Mu* Climate Communication Experimental Short Film in Keffi, Nigeria

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Anthropogenic activities resulting in deforestation and human health impacts in Nigeria are attributable to a lack of environmental sustainability information. Film for development and community cinema frameworks offer inimitable benefits for effective communication and community engagement. *Kar Dare Ya Same Mu* short film captures the effects of deforestation on the environment and on human health in Keffi, Nasarawa State using indigenous characters, traditional songs and the widely spoken Hausa language of the study population. The aim of this quasi-experimental research was to examine ways in which the semi-homogenous audiences responded to entertainment-education short films in indigenous languages and how these responses affected audiences' motivations to take action on combating deforestation. The study was anchored on Film Theory and the Social and Behaviour Change Communication strategy. The study adopted a survey design. Qualitative data were collected from a sample size of 20 Focus Group Discussion participants. Findings spotlight amplified awareness of sustainable environmental protection innovations amidst traditional songs used to pass across embedded thematic messages, which thereby made the film relatable, enjoyable, and understandable to target audiences. The study concluded that climate communication entertainment-education short films like *Kar Dare Ya Same Mu* should be deployed in creating awareness on specified anthropogenic activities of deforestation and its direct and indirect effects on the environment and humans. In conformity, the study

recommended that government and stakeholders should incorporate climate communication entertainment-education films in community engagement for adoption of evidence-based environmental sustainability best practices in combating deforestation.

Keywords: Anthropogenic Activities, Climate Communication, Deforestation, Entertainment Education, *Kar Dare Ya Same Mu*

Vital Rates of Forest Dynamics Driven by Traits: study of the relationship between wood anatomy and vital rates for emblematic species of the Congo Basin rainforests

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The functional traits of a tree have an impact on its individual performance and therefore, at a wider scale, influence the whole population's vital rates. For instance, key functions such as sap flow or mechanical strength depend largely on traits of the secondary xylem. In the tropical rainforest of Central Africa, the relationship between functional traits, specifically wood anatomical features, and vital rates have yet to be precisely characterized. Although the relationship between wood traits and vital rates is well known, it has not yet been characterized for species of the African rainforest. This research focuses on representative species and analyses their wood anatomical characters and vital rates side by side, in order to provide a better understanding of these traits and their potential as predictors for population dynamics. We review the wood anatomical data for these species and complete it with further observations on additional samples gathered in the Congo Basin forests, and compare it with the specific vital rates measured in a system of permanent plots installed in the same areas. Through this work, we expect to improve the general knowledge on how wood characters influence vital rates, and strengthen the usability of these features as indicators for individual and tree population growth dynamics.

How involving wood anatomy in a trait-based ecology of Congo Basin tree species?

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Background

The study of the causes and consequences of variation in pith-to-bark vessel size in plants, particularly tropical trees, is not new, as it has long been recognized that this intra-individual variation plays a key role in determining the physiological performance of trees, from individual to species, including responses to excessive water stress due to drought. While there is an extensive literature on vessel size from pith to bark, particularly in wood science, it is only recently that interest in radial variation in vessel size has become apparent within the paradigm of trait-based ecology that incorporates global change. Despite this recent interest, little is known about the change in vessel size from pith to bark within tropical trees, and how this relates to the light requirements of species. Here, we primarily sought to assess how vessel size fluctuates across the pith-bark gradient in trees of 15 common Central African rainforest species.

Methods

Vessel size was measured in 15 species in a transitional evergreen to semi-deciduous rainforest dominated in places by almost pure stands of Gilbertiodendron dewevrei (Fabaceae), Democratic Republic of Congo. We sampled small blocks of wood about 1 cm thick from 51 trees at 5 cm from the pith and below the bark. Microtome preparations were made

in the wood biology laboratory. We performed microscopic observations and measured vessel size from all selected individual vessels (n ≥ 50) using the imaging software ImageJ. We also used ANOVA to determine whether vessel size differed between juvenile and mature wood, followed up with boxplots to schematically represent the distribution and variability of the data.

Preliminary results

There were significant differences between juvenile vessel size at 5 cm from the pith and mature vessel size below the bark. Vessel size increased across the pith-bark gradient in all trees of 5 species according to the Hagen-Poiseuille physical law. However, it is interesting to note that anomalies were observed for most trees in 6 species, contrary to the theoretical pattern. This contradictory result shows that our understanding of radial variation in vessel size during ontogeny is still fragmentary.

Conclusion

The considerable differences in vessel size change from pith to bark in 51 trees of 11 species in a tropical rainforest suggest that our knowledge of the functional trade-off between hydraulic efficiency and safety is still partial.

Keywords: Vessel size, Pith-bark gradient, Variation, Species, Tropical trees

Impacts of Farmers' Participation in Social Capital Networks on Adoption of Climate Change Adaptation Strategies in Nigeria

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Most of the studies on factors influencing adoption of climate change adaptation strategies among farmers have focused on the economic factors with little or no attention on the impact of collective actions and social capital networks. This paper investigates how farmers' participation in social capital networks influenced adoption of climate change adaptation strategies in Nigeria. This study was carried out in Southwestern Nigeria. A multistage sampling procedure was used to obtain data from farm households. Data collected were analysed using descriptive statistics, binary probit regression, multinomial logit regression, and endogenous switching regression models. Results from the study suggested that a significant difference exist in the number of years spent within the social capital networks, access to weather information and markets between farm managers who adopted climate change adaptation strategies and those who did not. Plot managers who adopted climate change adaptation strategies were found to have obtained higher mean yield and farm revenue than their counterparts. The results further showed that participation in the social capital networks did not only significantly influence plot managers' decision to adopt but also influenced the choice of climate change adaptation strategies adopted by farmers. The study concluded that farmers who choose to participate in social capital networks have a higher level of adopting climate change adaptation strategies than what a random farmer would have

had in Nigeria. We recommend that policies aimed at increasing adoption of climate change adaptation strategies among farmers should be channelled through locally organised farmers-based social capital networks.

Keywords: Climate change, Adoption, Adaptation strategies, Participation, Social capital

Investigating seasonal changes in tsetse and non-tsetse population density, prevalence and drug sensitivity of African animal trypanosomes in Homa-bay, Kenya

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African Animal Trypanosomiasis [AAT] ('Nagana') is a serious livestock disease that affects animal production in Africa with more than 50 million livestock at risk from AAT. Nagana causes reduced milk production, increased risk of infection by other diseases, lower live weight gain, reduced fertility and high mortality rate.

Tsetse flies (*Glossina* spp.) transmit the parasite known as trypanosomes when they feed on a host. Tsetse flies are found in many regions of the African continent, in Eastern Africa it is said to cause an infection of 3.4-23% with a prevalence rate of up to 29.6%. In Kenya tsetse flies are present in 38 out of 47 counties filling a space of roughly 138,000 km^2, including Western, Coast, Rift valley and Central. The distribution of tsetse flies populations varies according to seasons. In the dry season they inhabit moist & cool environments to placate the effect of dry conditions. In Kenya, tsetse flies are highly present in the rainy season (March-May), this declines in the moderately hot season (June-October) and increases again from November to December (short rains).

Studies have been done on the seasonal genetic diversity of populations of tsetse flies in Kenya. It was reported that common allelic frequencies differ slightly between two dry seasons and the genetic diversity in *G. pallidipes* populations in the dry season is higher.

However, there is little information on the dynamics of tsetse infection rate and prevalence it causes in rainy and dry seasons in AAT endemic regions in Kenya such as Western Kenya.

One way to control AAT is by trypanocidal drugs. The problem is that some species are resistant to the drugs. Cases of drug resistant trypanosomes have been seen to rise in AAT endemic regions and regions with high drug use. This includes Ethiopia, Uganda and some regions of Kenya. However, understanding the seasonal dynamics of the population of drug resistant species is still an area that is understudied.

This study assesses the seasonal dynamics of tsetse infection rates and prevalence in animals, determines genotypes of drug resistant species in the tsetse vectors, and recovers blood trypanosomes field isolates to assess the presence of drug resistant species using highly sensitive molecular techniques.

Contribution of organic farming tools in the fight against climate change: Effects of two formulations based on Oyster shell and Neem on the production of organic cocoa seedlings in Cameroon

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Cocoa (*Theobroma cacao* L.) culture in Cameroon represents nearly 30% of non-oil exports and generates a revenue of over 100 billion CFA francs per year to more than 600,000 producers. This has however been affected negatively by parasitic attacks (fungi such as *Phytophtora megakarya* and insects; Mirids and cochineals), poor quality of cocoa seeds and consequently falling prices of cocoa on the world market. To counter the parasitic attacks, chemical pesticides have been used but the latter have proven to be risky environmentally and health-wise. Biocontrol methods have emerged as potential alternatives. The aim of our study was to develop a series of bio-agents capable of protecting plants against parasitic attacks while maintaining a balance on quality of cocoa produced (organic) and being environmentally friendly. Oyster shell was therefore used to formulate a bio-fungicide for substrate (soil) amendment while Neem, corossol and calcium were used to formulate biopesticide with anti-insectidal and anti-fungal properties. The effects of the oyster shell bio-fungicide were evaluated by treating the soil with cocoa seedlings in the nursery at a concentration 10 % W/W every two weeks for three months. The two bio-pesticides formulated were tested for stability and effects against insects *in vitro* and their effects

evaluated in the nursery on cocoa seedlings for 3 months. In the nursery the agro-morphological parameters of growth (height of stem, number of leaves, leaf surface area, fresh and dry weight of roots) were evaluated for three consecutive months every month. With the oyster shell-based bio-fungicide, the load of *P. megakarya* in the soil was equally determined after 12 weeks by measuring the speed of development of necrosis after inoculation of cocoa pods with samples of soil suspensions from both treated and non-treated batches while the two biopesticides were applied on the leaves every two weeks. For the two formulations, the level of resistance was evaluated through quantification of the biochemical markers of resistance (total polyphenols, flavonoids, tannins, total proteins, PR-proteins such as Polyphenoloxidases, peroxidases, polyamine ammoniac lyase, β-1,3-glucanases and chitinases). Our biopesticides 1 and 2 showed strong anti-insectidal effects *in vitro* as they demonstrated 100 % and 75 % ability to kill insects respectively. We observed a slight increase in all the agro-morphological parameters of growth for plants treated with any out of the three formulations. From a sanitary point of view, the soil samples amended with the organic matter showed a weak level of the *P. megakarya* inoculum, which was demonstrated by a low speed of development of necrosis on cocoa pods. Plants treated with our formulations showed a weak disease severity index on leaves which was correlated by significant increases in the level of biomarkers synthesized by various plants from samples treated with our formulations. These significant increases both in defense and growth markers demonstrate that our formulations are effective against various pathogens affecting cocoa and constitute a potential bio-control agent against fungal and insect attacks on plants.

Keywords: Cocoa, *Phytophtora megakarya,* Insects, Biopesticide, Biocontrol, Oyster shell, Neem

Spatio-temporal variability in snowfall and snowmelt in the African mountains

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In Africa, the Intergovernmental Panel on Climate Change projects a temperature increase of around 2.7 °C by 2050 (for the current emissions trajectory, RCP 8.5), and even more importantly, a substantial change in continental precipitation patterns. Climate change could have a considerable impact on snowfall and snowmelt and, even though these phenomena are not spontaneously associated with the African continent, snowfall is common and frequent throughout the year in various mountain areas across the continent (such as the High Atlas in Morocco, the Rwenzori in Uganda, the Virunga, Ethiopia's highest massifs, and the Drakensberg mountains in Lesotho). Furthermore, extended periods of snow cover and even small glaciers occur in specific settings (at the highest altitudes, and in mountains at higher latitudes in Africa). As snow and snowmelt have, in turn, a considerable impact on local hydrological and climatological conditions, and as a consequence also on local communities, this study aims to estimate the present-day occurrences and future changes of solid (snowy) precipitation. Climate projections from Regional Climate Models (RCM) are required for such study as they feature an adequate representation of orography and associated meteorological phenomena (Van Vooren et al., 2019; Van den Hende et al., 2021). Additionally, high-resolution remote sensing-based snow cover observations of the recent past (such as the Theia snow collection based on Sentinel-2 data) will be used. This will allow RCM validation and production of snowfall probability maps for the present and future, including uncertainty

estimations from different model projections of the CORDEX dataset. Based on this an estimate of the impact of these changes on local communities will be suggested.

References

Van den Hende, C., Van Schaeybroeck, B., Nyssen, J., Van Vooren, S., Van Ginderachter, M., & Termonia, P. (2021). Analysis of rain-shadows in the Ethiopian Mountains using climatological model data. *Climate Dynamics*, 56(5), 1663-1679.

Van Vooren, S., Van Schaeybroeck, B., Nyssen, J., Van Ginderachter, M., & Termonia, P. (2019). Evaluation of CORDEX rainfall in northwest Ethiopia: Sensitivity to the model representation of the orography. *International Journal of Climatology*, 39(5), 2569-2586.