Comment

PHIL MOORE/AFP/GETTY

A warden with an orphaned mountain gorilla in the Virunga National Park sanctuary in the Democratic Republic of the Congo.

Congo Basin rainforest — invest US$150 million in science

Lee J. T. White, Eve Bazaiba Masudi, Jules Doret Ndongo, Rosalie Matondo, Arlette Soudan-Nonault, Alfred Ngomanda, Ifo Suspense Averti, Corneille E. N. Ewango, Bonaventure Sonké & Simon L. Lewis

The world's second-largest rainforest is key to limiting climate change — it needs urgent study and protection.

Earth's second-largest expanse of tropical forest lies in central Africa, in the Congo Basin. The region supports the livelihoods of 80 million people. The rainfall that the forest generates as far away as the Sahel and the Ethiopian highlands supports a further 300 million rural Africans. These forests are crucial to regulating Earth's climate, and are home to forest elephants, gorillas and humans' closest relatives, chimpanzees and bonobos.

Such services to people and the planet are not guaranteed, given rapid climate change and ongoing development in the region. The forest's ability to absorb carbon dioxide is slowing as temperatures rise[1]. Deforestation, although lower than elsewhere in the tropics over recent decades, has led to the loss of more than 500,000 hectares of forest in 2019 alone (see go.nature.com/3dnxm9e). Without new policies, this is expected to increase.

Yet, too often, central Africa's rainforests are ignored or downplayed. The Congo Basin forests receive much less academic and public attention than do those in the Amazon and southeast Asia. Between 2008 and 2017, the Congo Basin received just 11.5% of international financial flows for forest protection

and sustainable management in tropical areas, compared with 55% for southeast Asia and 34% for the Amazon region[2].

The area is neglected even by comparison with the rest of Africa. For example, a key UK-funded programme of climate research, called Future Climate for Africa, invested £20 million (US$27 million) in modelling and four projects focused on eastern, western and southern Africa. None focused on the Congo Basin or central Africa.

The result of this neglect is clear in high-level climate assessments. Central Africa was one of only two regions worldwide without enough data for the Intergovernmental Panel on Climate Change to assess past trends in extreme heat in its 2021 Working Group I report (the other was the southern tip of South America).

We are a group of ministers who have responsibility for forests in the region, and scientists who work on the ground and advise governments. Together we call for a Congo Basin Climate Science Initiative. This should comprise a $100-million, decade-long programme of research, tied to a separate $50-million fund to train Congo Basin nationals to become PhD-level scientists. Such funding would transform our understanding of these majestic forests, providing crucial input for policymakers to help them enact policies to avoid the region's looming environmental crises.

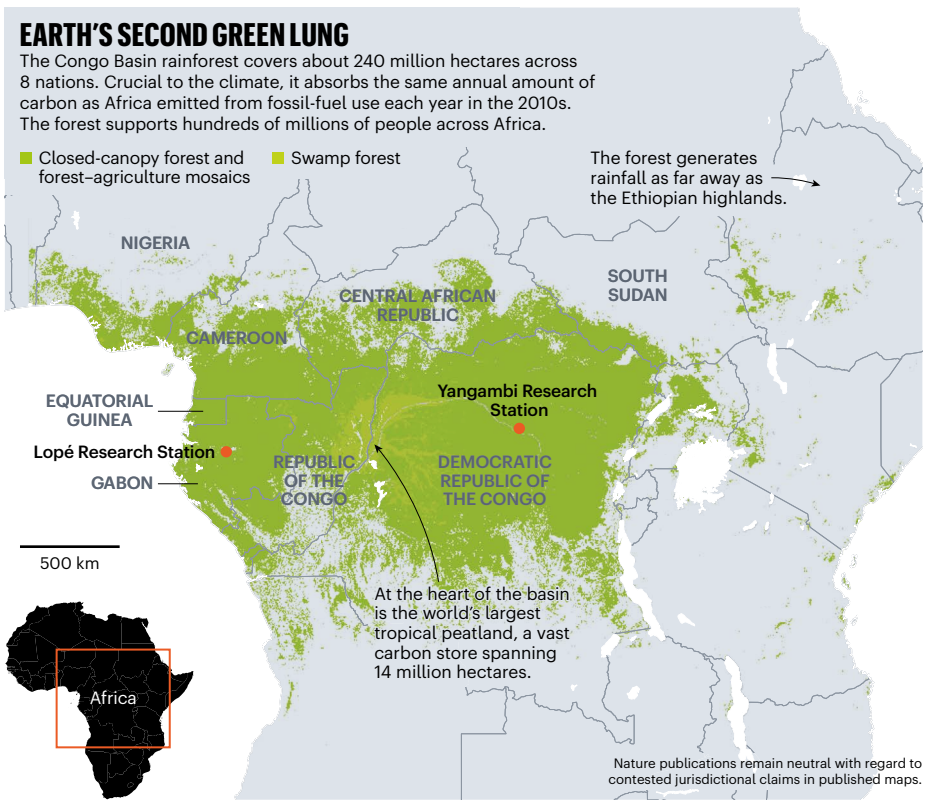
There is precedent for such a transformation. In the mid-1990s, rainforest science in the Amazon region was limited and was largely conducted by overseas scientists. Formally beginning in 1998 and led by Brazilians, the Large-Scale Biosphere-Atmosphere Experiment in Amazonia programme, known as the LBA, was a 10-year, $100-million effort. It revolutionized understanding of the Amazon rainforest and its role in the Earth system.

The LBA involved 6 years of intensive measurements and covered climatology, hydrology, ecology and biogeochemistry across an area of 550 million hectares. It comprised 120 projects and 1,700 participants, 990 of whom were Brazilians[3]. One of its greatest legacies was the creation of a new cadre of Brazilian researchers. Two decades on, Brazil is now widely acknowledged as the world's leading nation for tropical forest monitoring, and is at the forefront of rainforest science.

We should — we must — do the same for central Africa.

Known unknowns

The Greater Congo Basin covers some 240 million hectares of contiguous forests, straddling 8 nations (see 'Earth's second green lung'). Merely sampling this vast area is daunting. Access often requires days of travel in dugout canoes and long treks through the humid jungle, punctuated by wading through swamps. There is also a pervasive prejudice: too many people think working in the Congo Basin region is perilous, whether the hazards are political instability, unfamiliar diseases or dangerous animals. In reality, for the vast majority of central Africa, the risks are similar to working in the Amazon rainforest or east African savannah ecosystems.



These various challenges can be surmounted. Papers from the past few years, co-authored by many of us, highlight how important and understudied the region is. In 2017, the world's largest tropical peatland complex was mapped for the first time — an area spanning 14.6 million hectares in the heart of the Congo basin[4]. This work radically shifted our understanding of carbon stores in the region. In March 2020, an international consortium showed that Africa's rainforests annually absorb the same amount of carbon[1] as was emitted each year by fossil-fuel use across the entire African continent in the 2010s (ref. 5).

In December 2020, a striking 81% decline in fruit production over 3 decades in an area of forest in Gabon was shown to coincide with climate warming and an 11% decline in the body condition of forest elephants (they rely on fruit for part of their diet)[6]. And in April, the first region-wide assessment of tree community composition in central Africa was published[7], mapping areas that are vulnerable to climate change and human pressures.

Overall, the strikingly recent (although somewhat limited) data suggest that the tropical forests of the Congo Basin are more carbon-dense[8], more efficient at slowing climate change[1] and more resistant to our changing climate[9] than are Amazon tropical forests. But we do not know how increasing droughts, higher temperatures, selective logging and deforestation might interact — including the possibility of reduced rainfall in the Sahel[10] and Ethiopian highlands[11]. Some 2,500 years ago, vast swathes of the Congo Basin forests were lost during a period of climate stress, but researchers do not understand the historic context of that event, nor the likelihood of a repeat[12].

Little is known about the region because not enough science is done in central Africa. Remarkably, researchers still do not understand the basic principles of why different types of forest occur where they do in the Congo Basin. Climate models for this region are poor, both because of the complex interplay of Atlantic, Indian and Southern ocean influences and because of a lack of local climate data. Without more data and more specialists, it is impossible to make reliable predictions of these forests' responses to changes in climate and land use.

Next steps

Investment in basic science is urgently needed to fill these gaps. A Congo Basin Climate Science Initiative should focus on three important overarching questions: how does the Congo Basin currently operate as an integrated system? How will changes in land use and climate affect its function? And how sustainable are different options for development?

Within these broad topics are more specific questions that politicians will need answers

SOURCE: REF. 1

PASCAL MAITRE/PANOS

A child on the Mongala River in the dense forest of the Democratic Republic of the Congo.

to if nations are to achieve net-zero CO_2 emissions by 2050. One such question is how much carbon is stored in vegetation and soils. These and other quantities must be reported as part of countries' commitments to the 2015 Paris climate agreement. At present, most central African countries rely on default values, which could be way off the mark. A recent paper[13] on African montane forests largely near the edges of the basin, for example, showed that measured carbon storage values were 67% higher than the default values.

A science initiative will work only if there is enthusiasm and leadership from researchers and active support from key Congo Basin countries, alongside buy-in from funders. We envision three steps to achieve these aims.

First, scientists from the Congo region should hold a workshop with the LBA architects and participants to assess lessons from the Amazon region. This south–south cooperation would build a scientist-led framework to address the crucial research questions.

Second, a meeting of politicians and advisers from the region would facilitate discussions of the policy-relevant questions that scientists should investigate. This would be led by Cameroon, the Democratic Republic of the Congo, Gabon and the Republic of the Congo — the four nations conducting the most research in the region. The meeting will help to lock in political support across ministries responsible for forests, environment, water, climate, science and universities.

Third, partners will need to develop an overarching science programme that is acceptable to funders. Such a programme will probably include scaling up many efforts that are already under way, but which are currently insufficient in scope or unreliably funded. This would speed up scientific progress.

"The old division between ending poverty and protecting the environment no longer applies."

For example, a handful of established, long-term field sites already exist in the Greater Congo Basin, including in Lopé National Park in Gabon and in the Yangambi Biosphere Reserve in the Democratic Republic of the Congo. These 'supersites' are sophisticated field stations with full-time staff who collect reliable, long-term data sets on vegetation, animals and the physical environment, including greenhouse-gas fluxes at Yangambi. But the sites are too few in number, and they rely on the heroic efforts of local champions. There should be a dozen or so locations across the region, with consistent funding to support complex research projects.

Similarly, the African Tropical Rainforest Observation Network (AfriTRON), established in 2009, tracks every tree in permanent sample plots to estimate the carbon balance of undisturbed forests. Although this observatory has ramped up from its original 40 sites in central Africa to more than 200 today, these cover just 250 hectares of the roughly 240-million-hectare total. That is very sparse sampling from which to draw regional conclusions.

Meanwhile, the Forest Global Earth Observatory (ForestGEO), established in 1990 to understand how tropical forests maintain such a diverse number of tree species, has established just 4 sites in central Africa in 30 years, with none in the centre of the basin. There is an obvious need for expansion.

Finally, the 2016 AfriSAR airborne field campaign, a collaboration between NASA, the European Space Agency and the Gabonese Agency for Space Studies and Observation, showed how to combine different data sets to carefully map forest types and their carbon stocks in Lopé National Park in Gabon. This model could be replicated elsewhere in the basin.

All of this work will require linking theory, observations, experiments and modelling. It should attract a diversity of leading international experts to focus on Africa and provide training to Congo Basin nationals. A $100-million research programme would provide new opportunities and much-needed

career options for African scientists. The tied investment of $50 million, focused on building talent, could produce approximately 200 PhDs awarded by leading universities worldwide. This would create a new generation of scientists, including future leaders, from central Africa. The training programme would ensure the necessary step-change in science capacity, and provide opportunities for young African researchers who currently find it hard to compete for international scholarships, which are often won by students from Asia or South America.

Agreeing on open access for all the data collected, as in the LBA programme, will significantly boost the initiative's science impact.

Money well spent

This $150-million science programme over 10 years needs investors. One option would be to combine funds from governments that have made large forest- and science-related investments in the Congo Basin in the past, notably Belgium, France, Germany, Norway, the United Kingdom, the United States and the European Union. Alternatives include United Nations agencies, international climate funds and private philanthropy organizations. Such a programme should be high on funders' agendas, given the UN Sustainable Development Goals (SDGs). These include raising capacity for effective climate-change-related planning and management (SDG13), increasing financial resources to conserve and sustainably use biodiversity and ecosystems (SDG15), boosting the number of researchers in lower-income countries, and increasing research and development (R&D) funding (SDG9), all before 2030.

Global R&D funding was $2.2 trillion in 2019 (ref. 14). Thus, investing $150 million over a decade to better understand and protect the world's second-largest extent of tropical forest is modest. To put this sum in context, the US government's total projected cost for the Human Genome Project was $2.7 billion, and the European Space Agency spends approximately $500 million on its larger, long-lasting scientific satellites. The $100 million that the LBA brought to the Amazon in the 1990s is equivalent to about $160 million in today's terms.

The investment in science will pay for itself many times over. Consider just the role of forests as reservoirs of zoonotic diseases. Better forest management lowers the risk of disease outbreaks, let alone a pandemic[15].

Critics might argue that direct interventions in development aid are more urgent than investing in climate and ecological science. However, these funds are usually independent and do not compete. Furthermore, the old division between ending poverty and protecting the environment no longer applies: Africans will suffer disproportionately if temperatures are not limited as per the Paris agreement. That must include protection of the forests of the Congo Basin.

AMAURY HAUCHARD/AFP/GETTY

African forest elephants in Ivindo National Park, Gabon.

Further efforts could help to support the goals of the Congo Basin science programme. For example, there is a lack of economic models that show how standing forests can become more valuable than converted landscapes. Developing these would support policy decisions to maintain forest cover.

There are also several efforts under way to improve forest management that aim to empower local people, increase income and protect the environment. These include the transfer of land-management decisions to local populations, such as through community forestry, and creating high-value end products from selective logging rather than relying on the export of raw, unprocessed timber. A new science initiative could assess various approaches to understand what works best.

We know so little about the majestic forests of central Africa. A Congo Basin Climate Science Initiative would curb our collective ignorance. A lack of investment is the barrier to safeguarding these precious ecosystems. Surmount this, and the future of Earth's second 'great green lung' will be brighter.

The authors

Lee J. T. White is Minister of Water, Forests, Oceans, Environment, Climate Change and Land-use Planning, Gabonese Republic. **Eve Bazaiba Masudi** is Deputy Prime Minister and Minister of Environment and Sustainable Development, Democratic Republic of the Congo. **Jules Doret Ndongo** is Minister of Forestry and Wildlife, Republic of Cameroon. **Rosalie Matondo** is Minister of Forest Economy, Republic of the Congo. **Arlette Soudan-Nonault** is Minister of Environment, Sustainable Development and the Congo Basin, Republic of the Congo. **Alfred Ngomanda** is director of the National Centre for Scientific Research and Technology (CENAREST), Gabonese Republic. **Ifo Suspense Averti** is an associate professor in tropical forest ecology at Marian Ngouabi University, Republic of the Congo. **Corneille E. N. Ewango** is a professor of tropical forest ecology and management at the University of Kisangani, Democratic Republic of the Congo. **Bonaventure Sonké** is a professor of plant systematics and ecology at the University of Yaounde I, Republic of Cameroon. **Simon L. Lewis** is professor of global change science at University College London and the University of Leeds, UK.
e-mail: lwhitemfsepc@gmail.com

1. Hubau, W. *et al. Nature* **579**, 80–87 (2020).
2. Atyi, R. E. *et al. International Financial Flows to Support Nature Protection and Sustainable Forest Management in Central Africa* (Central Africa Forest Observatory, 2019).
3. Lahsen, M. & Nobre, C. A. *Environ. Sci. Policy* **10**, 62–74 (2007).
4. Dargie, G. C. *et al. Nature* **542**, 86–90 (2017).
5. Ayompe, L. M., Davis, S. J. & Egoh, B. N. *Environ. Res. Lett.* **15**, 124039 (2020).
6. Bush, E. R. *et al. Science* **370**, 1219–1222 (2020).
7. Réjou-Méchain, M. *et al. Nature* **593**, 90–94 (2021).
8. Lewis, S. L. *et al. Phil. Trans. R. Soc. B* **368**, 20120295 (2013).
9. Bennett, A. C. *et al. Proc. Natl Acad. Sci. USA* **118**, e2003169118 (2021).
10. Salih, A. A. M., Zhang, Q. & Tjernström, M. *J. Geophys. Res. Atmospheres* **120**, 6793–6808 (2015).
11. Gebrehiwot, S. G. *et al. WIREs Water* **6**, e1317 (2019).
12. Malhi, Y. *Proc. Natl Acad. Sci. USA* **115**, 3202–3204 (2018).
13. Cuni-Zanchez, A. *et al. Nature* **596**, 536–542 (2021).
14. Sargent, J. F. *Global Research and Development Expenditures: Fact Sheet* R44283 (Congressional Research Service, 2021).
15. Everard, M., Johnston, P., Santillo, D. & Staddon, C. *Environ. Sci. Policy* **111**, 7–17 (2020).

L.J.T.W., E.B.M., J.D.N., R.M. & A. S.-N. declare competing interests; see go.nature.com/3fkktdm.