2025 Congo Basin Assessment Report

Congo Basin Resilience and Sustainability: From the Past to the Future

Science Panel for the Congo Basin

EXECUTIVE SUMMARY

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About the Science Panel for the Congo Basin (SPCB)

The Science Panel for the Congo Basin (SPCB) is the first of-its-kind independent scientific panel dedicated to synthesizing existing knowledge of the status of, and threats to, the Congo Basin and its ecosystems. As the world's second largest tropical forest, the Congo Basin is providing key ecological services at local, regional, and global scales that are both critical for human well-being on the African continent and for limiting the global impacts of climate change - and yet remains largely under-researched and chronically underinvested.

The SPCB is led by and comprised primarily of leading scientists from the region. It was established in 2023 alongside the Congo Basin Science Initiative, a complementary platform to promote long-term investment in science in the Congo Basin. Both initiatives reply to calls from regional environment ministers for increased investment in capacity building and science, and implication of science as a foundation for policy making for the sustainable development of Congo Basin countries.

The Panel is supported by a technical secretariat at the United Nations Sustainable Development Solutions Network, convener also of science panels for the Amazon and Borneo.

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Foreword

I am honored and profoundly moved to write the foreword to this historic report of the Science Panel for the Congo Basin. The Congo Basin deserves every superlative that we can muster, and the Science Panel has done justice to this remarkable part of humanity's biological heritage. As this report makes profoundly clear, the roughly 3.56 million km^2 of the Congo Basin is home for 130 million people in Central Africa, the habitat for tens of thousands of species, and a vital regulator of the Earth's climate and biophysical systems at continental and planetary scale.

The Science Panel for the Congo Basin is itself a remarkable creation, following in the path of the Science Panel for the Amazon. Both Science Panels and their third companion, the Science Panel for Borneo, are built on one main idea. The vital expertise regarding the history, management, and sustainable future of the great rainforest biomes lies with the scientists of each region, of course, in partnership with the global scientific community. The Science Panels seek to empower each region's scientists to take the lead in proposing science-based solutions for the sustainable management of the respective biomes. While outside experts play a highly constructive role, it is the scientists of each region who must be the guides and stewards of the rainforests. As such, the Science Panels serve directly the people and governments of the region, as well as the whole human community.

Moreover, the term "serve" is also on point, since the scientists are generously donating significant amounts of time as well as their unique expertise to this effort. A remarkable volume of work has been mobilized through the spirit of public service of the scientists involved. The Science Panel for the Congo has thereby gone a vast distance in producing the most comprehensive and up-to-date scientific study of the Congo Basin of recent years, and probably ever.

180 scientists have contributed to this report, enabling its comprehensive and panoramic perspective. This report discusses the geological history of the Congo Basin, and every aspect of the science of this wondrous ecosystem: geology, geodynamics, hydrology, climate, soils, biodiversity and its evolution, ecology, cultural diversity, land-use systems in agriculture, pastoralism, forestry, hunting, fishing, mining, and other activities, drivers of deforestation, protected areas, urbanization, and much more.

The aim of the Science Panels, of course, is not only to produce excellent science, but also excellent public policy. This report fulfills that aim. After a remarkably deep, holistic, and up-to-date scientific report on the state of the Congo Basin and the main drivers of human-induced change, this volume proceeds to holistic solutions. Our aim is not merely sustainability (in the environmental sense) but sustainable development, meaning the combination of environmental sustainability with economic wellbeing and social justice in the region. Farming, forestry, fisheries, mining, and other activities must continue to contribute to livelihoods and economic opportunity, but in a manner that is compatible with the environment, not contrary to it. With millions of degraded hectares of forest land, for example, the Congo Basin can be an enormous sink for carbon through regeneration of the forests. With the right incentives, through carbon markets and other mechanisms, the Congo Basin should receive tens of billions of dollars for carbon storage that recovers degraded lands, builds new livelihoods and strengthens biodiversity. The wisdom of the Science Panel is to propose win-win-win solutions, whereby local communities, biodiversity, and global humanity are all beneficiaries of the ethical, science-based, and forward-looking stewardship of the Congo Basin. The Science Panel for the Congo Basin will be a key leader in that grand initiative, supported by the wisdom in this volume.

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Science Panel for the Congo Basin

Congo Basin Resilience and Sustainability: From the Past to the Future

The 2025 Congo Basin Assessment Report is a collective multidisciplinary work by 180 scientists active in the region. It was brought together by the Science Panel for the Congo Basin (SPCB), hosted by the United Nations Sustainable Development Solutions Network (UNSDSN), and was inspired by the Science Panel for the Amazon. SPCB was created at the One Forest Summit in Libreville in April 2023 and formally launched eight months later at COP28 in Dubai.

This assessment report features 39 chapters in four sections. Section 1 demonstrates the Congo Basin's role as a regional entity in the earth system, a continental scale "green engine" that cools land surfaces through evapotranspiration and drives atmospheric moisture recycling, serving as a critical natural life support system for the African continent. Section 2 describes human interaction with the Congo Basin ecosystem from Prehistory to 1992, the year of the Rio Earth Summit, a period that witnessed the emergence of humans as a dominant disruptive force in the Earth system. Section 3 documents social-ecological transformations and the first steps towards sustainable development in the region following Rio, where for the first time the Congo Basin leaders engaged the region on a more sustainable development pathway. Finally, Section 4 represents a solution space where sustainable pathways for the Congo Basin forest ecosystem are identified, discussed and compiled into a theory of change for the sustainable development of the region that improves quality of life and prosperity, maintains ecosystem services and natural capital, and promotes climate resilience.

In this executive summary, we present the 16 key messages that emerged from the report, referring the reader to the chapters where supporting materials can be found. The picture that emerges is the first comprehensive assessment of the geological, ecological and socio-economic processes that have shaped the Congo Basin we see today, one of the most significant and biodiverse forest ecosystems on the planet. If preserved and exploited sustainably, the Basin represents a critical Nature-Based Solution for sustainable development, conservation and climate resilience in Africa. The authors also highlight the potentially dire impacts of allowing unsustainable practices to degrade and destroy the Congo Basin forests. Finally, we provide a list of key knowledge gaps and research priorities that emerge from the report.

The Congo Basin

The Congo Basin, as defined by the members of the Science Panel, covers an area of 3,462,806 km^2, representing the world's second largest tropical rain forest ecosystem. It is composed to a large extent of the lowland wet and dry Guineo-Congolian rainforests (covering 28% and 16% of the total area respectively), along with extensive swamp (13%), mangrove (0.3%) and Afromontane forests (2.2%), bordered to the north and south by a transitional rainforest and secondary grassland mosaic (39%), as defined by White (1983)(Figures 1 and 2).

The outer limits of the biome today are somewhat subjective, because they represent a transition from wetter to drier forests, a boundary that is continually changing as a function of climate variability and human activities. The Basin encompasses extensive areas in six nations: Cameroon, Central African Republic, Democratic Republic of Congo (DRC), Equatorial Guinea, Gabonese Republic and Republic of Congo, and smaller areas in a further six: Angola, Burundi, Nigeria, Rwanda, South Sudan and Uganda (Figure 1). The eastern limit corresponds to the eastern edge of the Afromontane forests of the African Rift Valley, while the western limit is the Cross River in Nigeria.

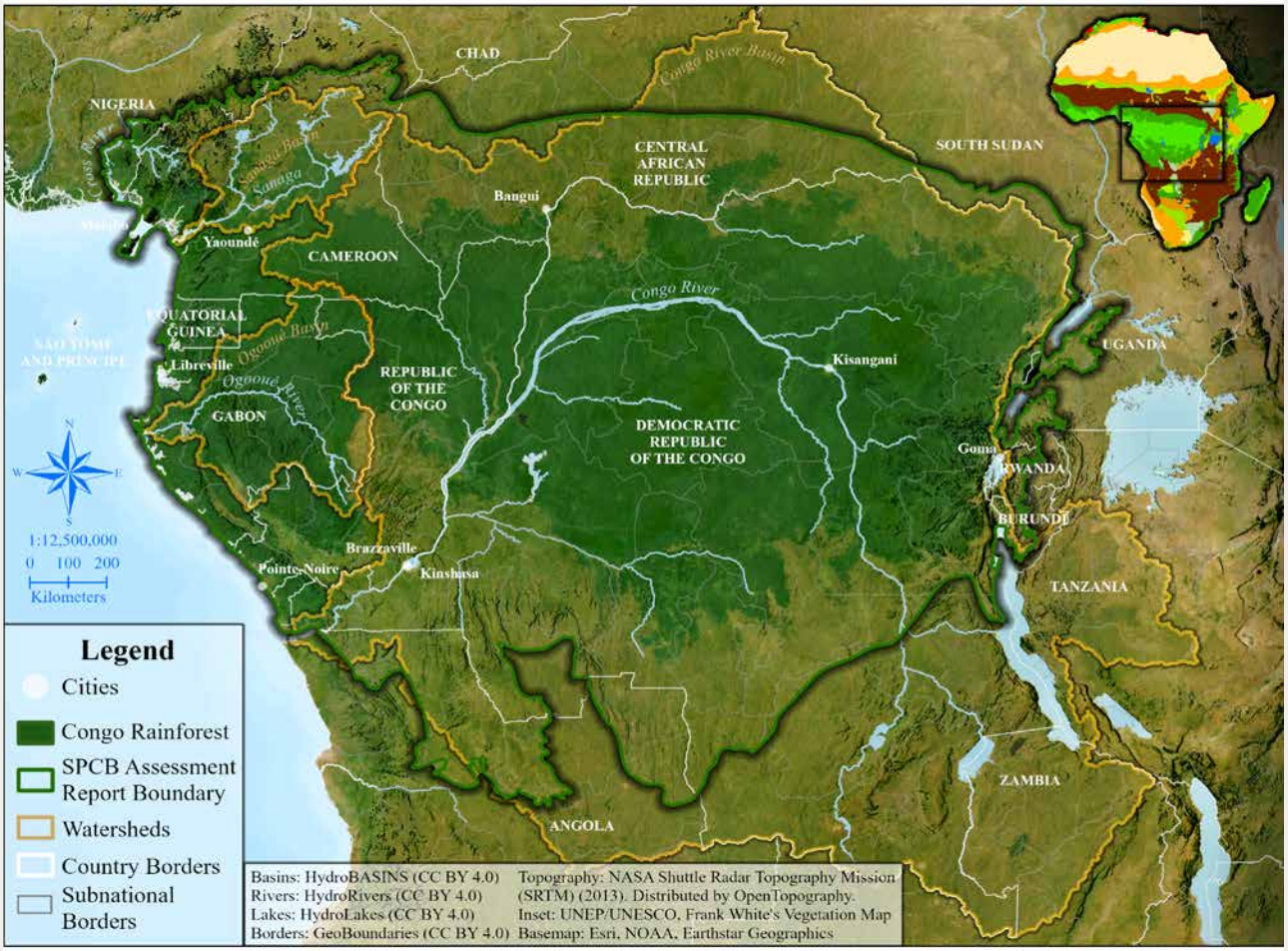

FIGURE 1 The geographic limits and major rivers of the Congo Basin as defined by the Science Panel for the Congo Basin.

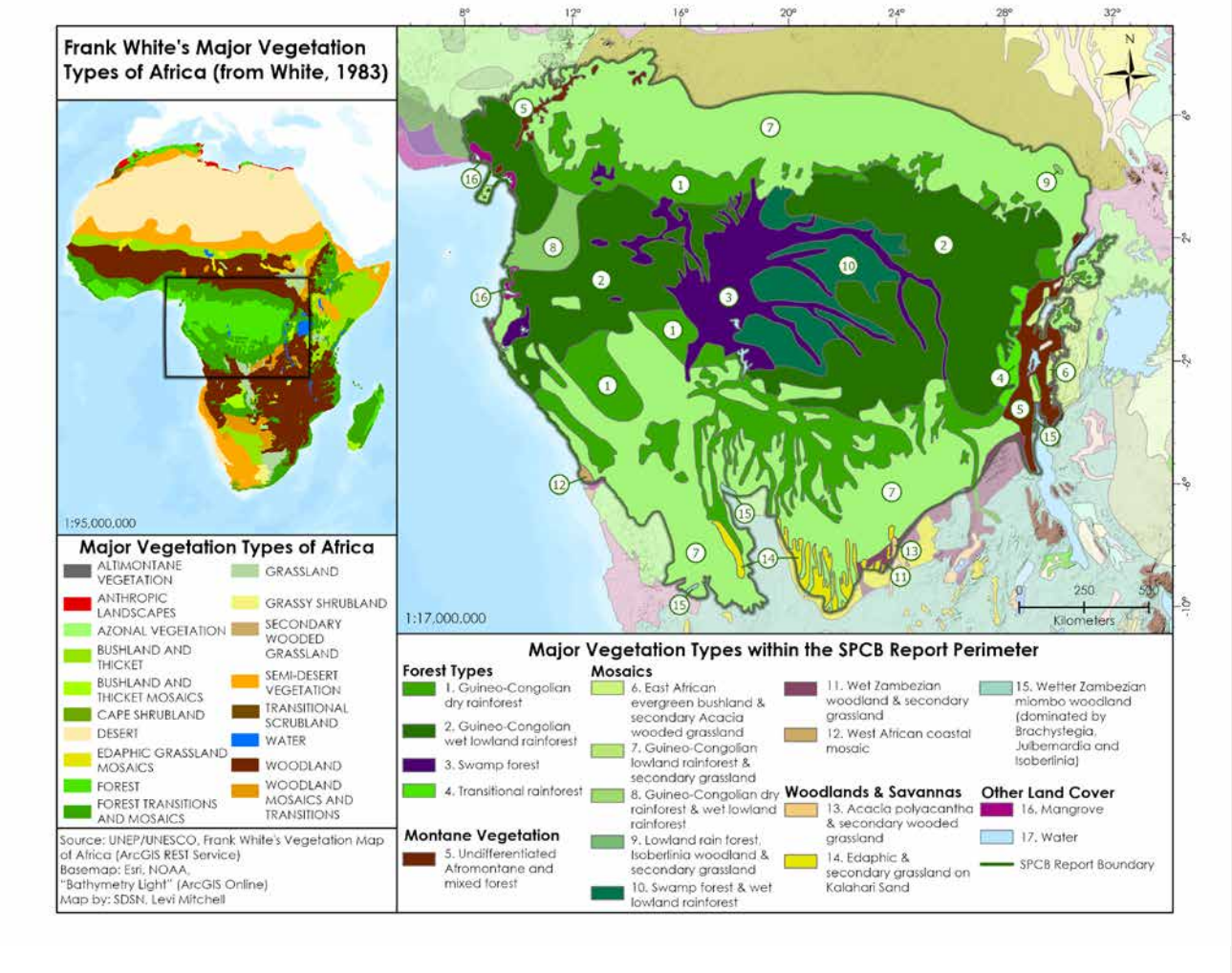

FIGURE 2 The geographic limits of the Congo Basin showing the principal vegetation classes based on White, (1983).

As defined by the Science Panel, the Congo Basin includes approximately 70% of the Congo River catchment, as well as all of the Ogooué and the Sanaga watersheds. The portion of the Congo River watershed flowing northwards through extensive areas of Miombo woodlands in Angola, DRC, Zambia and Tanzania has an important impact on the hydrology, climate and ecology of the Congo Basin and is discussed in some of the chapters of this report.

Some biogeographic analyses support an extension of the western limit to the savanna corridor of the Dahomey Gap in Benin and Togo, while others favour the Sanaga River in Cameroon. The Science Panel opted for the Cross River, in part to create a link to the magnificent forests of West Africa, deserving of their own science panel initiative and symbolically to include the entire range of all gorillas (Figure 3), iconic species classically associated with the Congo Basin.

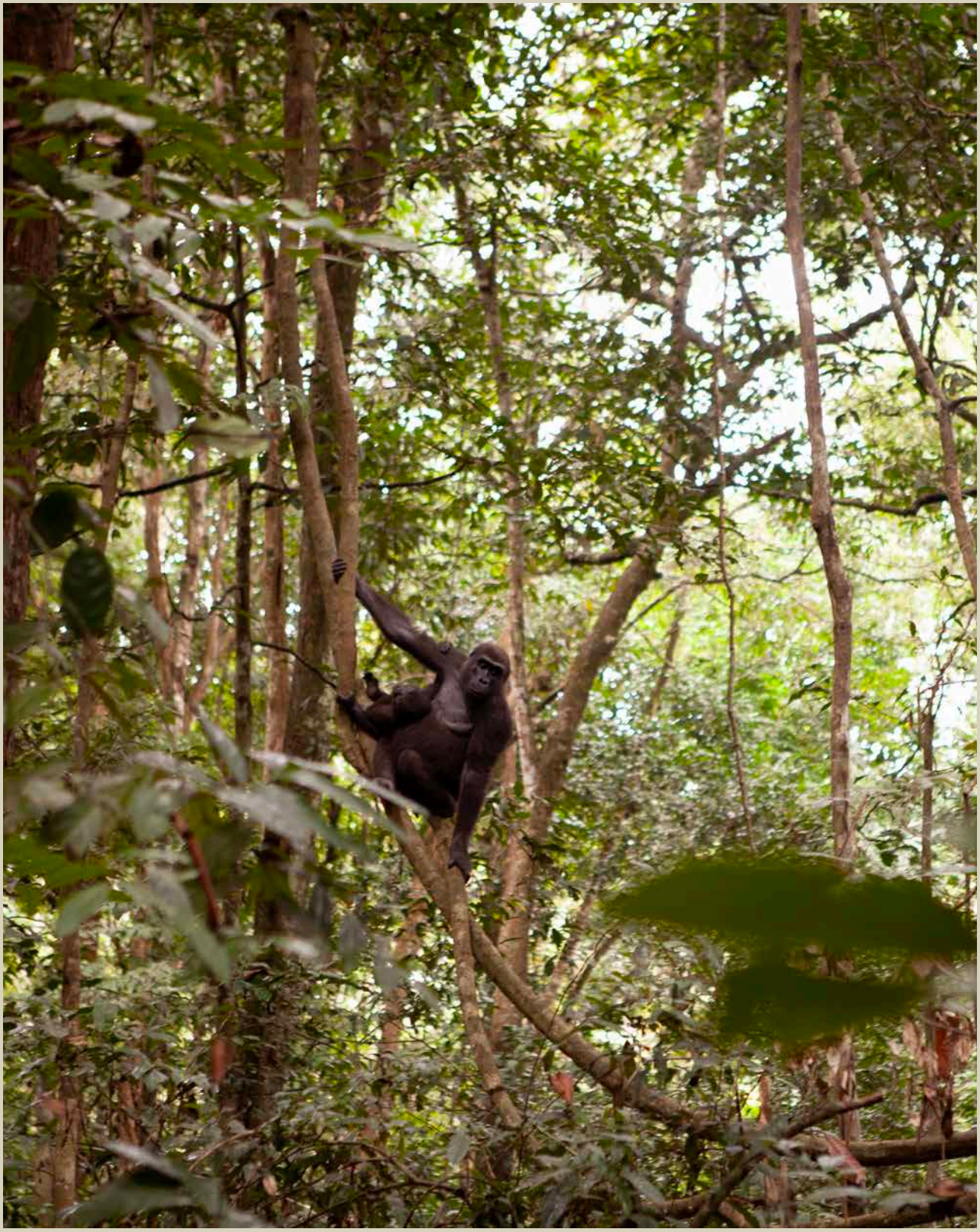

FIGURE 3 A western lowland gorilla. Photography by Josh Ponte.

BOX 1 Overview of Key Messages of the 2025 Congo Basin Assessment Report:

Section 1: The Congo Basin as a regional entity in of the earth system

KEY MESSAGE 1: The Congo Basin is the green heart of Africa sustaining ecosystem services that are critical to the continent at large.

KEY MESSAGE 2: The Congo Basin is the largest tropical carbon sink on Earth and influences both regional and global climate.

KEY MESSAGE 3: The Congo Basin is one of the most biodiverse ecosystems on Earth.

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Section 2: Human interaction with the Congo Basin from prehistory to 1992

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KEY MESSAGE 6: The Congo Basin's ancient kingdoms fostered regional and global trade networks.

KEY MESSAGE 7: The Congo Basin experienced deep and lasting negative social and ecological impacts of colonialism.

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KEY MESSAGE 9: The Congo Basin has seen transformative change since 1992.

KEY MESSAGE 10: Novel approaches to environmental stewardship and sustainable use are urgently needed, building on already emerging paradigms.

KEY MESSAGE 11: The Congo Basin has solutions within reach but these need strategic investments by governments, private sector and the international community.

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KEY MESSAGE 12: Sustainable development of the Congo Basin is dependent on effective governance.

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KEY MESSAGE 16: The Congo Basin stands at a decisive crossroads.

SECTION 1

Science Panel for the Congo Basin

The Congo Basin as a Regional Entity in the Earth System

Photography by Josh Ponte.

KEY MESSAGE 1

The Congo Basin is the green heart of Africa sustaining ecosystem services that are critical to the continent at large.

The geology, equatorial location and extensive forests of the Congo Basin make it a critical component of Africa's climate and hydrological systems; a continental watershed. It is the great "green heart" of Africa, pumping water, the lifeblood of the continent, thousands of kilometers all the way to Egypt and other water stressed countries of the eastern, northern and western Africa. Its forests act as a continental-scale "green engine", cooling land surfaces through evapotranspiration and driving atmospheric moisture recycling. Approximately 60-70% of the rainfall that falls within the Congo Basin is recycled regionally, maintaining a continuous flow of moisture inland from the Atlantic Ocean. These processes generate significant rainfall both within the basin and far beyond, including the Sahel and the Ethiopian highlands

1.1 The Congo Basin's geological origin was as a large, low-lying area in the middle of the African tectonic plate. Originally part of the west Gondwana supercontinent (Figure 4), the Congo craton, which underlies most of the region, formed on a foundation of some of the Earth's oldest rocks, dating to about 3 billion years. Over hundreds of millions of years tectonic forces split Gondwana, resulting in the opening of the Atlantic Ocean, shaping mountain ranges around the edges of the Congo craton and forming an intracratonic basin, where layers of mud, sand, and other materials accumulated. The central part of the basin became a wide, flat depression surrounded by higher ground, where the extensive swamp forests of the Congo Basin occur today. Over millions of years, the surface of the land was eroded, creating thick layers of soil and minerals, including a wealth of commercial deposits. Although the Congo Basin has been geologically stable for a long time, occasional shifts in the Earth's crust have reshaped its rivers and landscapes, giving the region its current form. **(CH01)**

1.2 The Congo Basin has a warm and humid equatorial climate. Rainfall follows a clear seasonal pattern, with two rainy seasons and two drier periods each year, though it remains relatively wet throughout. Moist air from both the Atlantic and Indian Oceans is drawn inland, bringing rain that feeds the forests and rivers. Large-scale air movements, including easterly winds high in the atmosphere, help control when and where the rain falls. The dense forests play a key role in recycling moisture back into the air through evapotranspiration, generating 60-70% of the region's rainfall. The Congo Basin also plays a crucial role in shaping the climate and hydrology of the broader continent. The shallow overturning circulation, which develops over the Basin, transports moist air northward during the Sahelian rainy season (June-September), feeding deep convection that triggers rainfall. Similarly, in East Africa, the Congo Basin's moisture recycling interacts with regional circulation patterns to influence rainfall distribution across equatorial regions, including the Ethiopian Highlands. These dynamics make the Congo Basin one of three global centers of tropical atmospheric heating (alongside the Amazon Basin and the Pacific Ocean) that actively shape tropical and subtropical atmospheric circulation systems – a critical "water tower" and "climatic engine" of Africa. Over long periods, the Congo Basin's climate has shifted in response to changes in ocean temperatures and Earth's orbit, leading to phases where forests expanded or shrank, sometimes giving way to expansive savannas during drier periods. **(CH02, CH03, CH04, CH05 – Figure 5)**

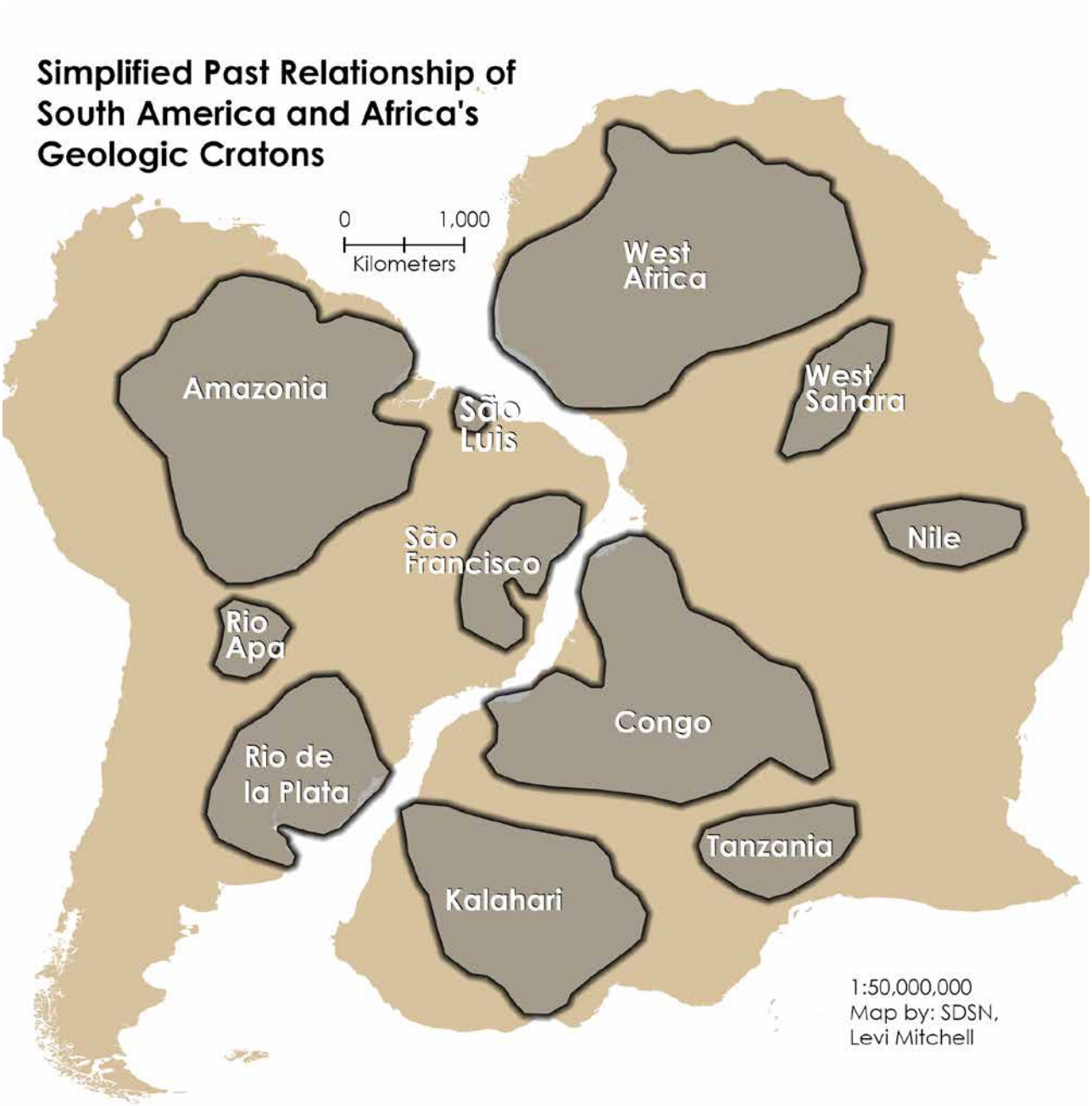


FIGURE 4 The historic positions of the African and South American continents and Cratons as Pangea began to separate in the Jurassic, around 180-200 million years ago. The Congo craton underlies much of the modern Congo Basin.

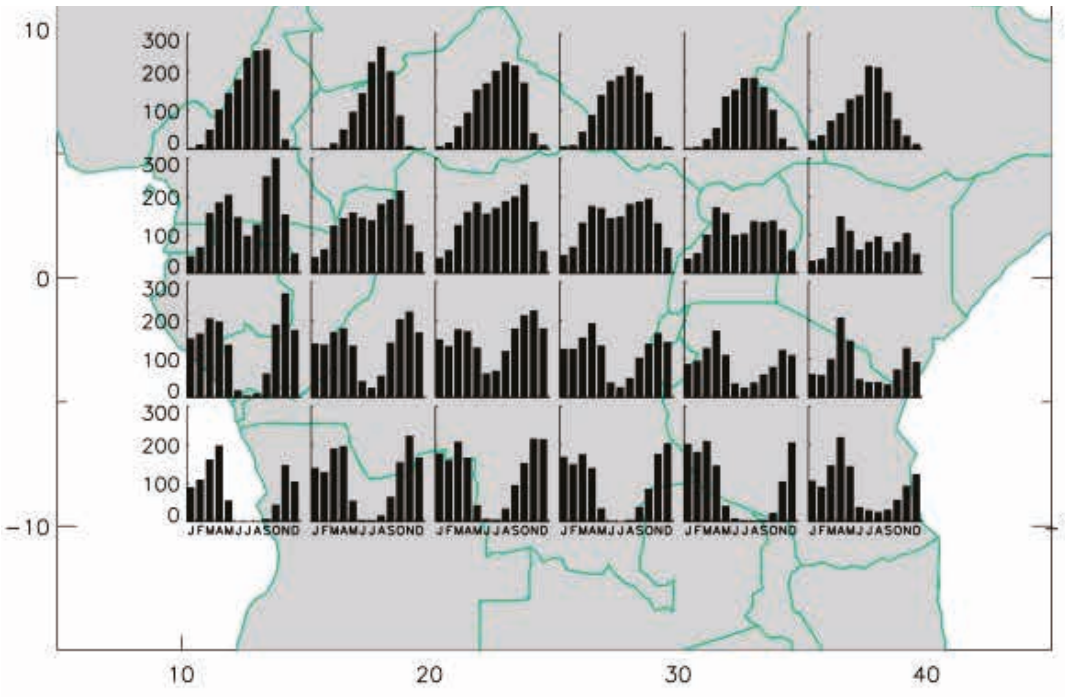


FIGURE 5 The seasonal cycle of rainfall, with bar graphs indicating mean rainfall in each month (CH02).

1.3 The Congo River runs over 4,700 km and drains an area of 3.7 million km^2, of which 2.7 million km^2 (73%) fall within the Congo Basin Forest Biome. It has the second-largest river discharge on Earth (after the Amazon), contributing about 13% of global riverine freshwater input to the oceans. Fed by numerous tributaries from surrounding highlands, the river flows through a large central depression known as the Cuvette Centrale, creating an extensive network of rivers, swamps, lakes, and peatlands. The basin's flow patterns are shaped by its bowl-like topography, with water from the northern and southern regions converging in the center, before making its way westward to the Atlantic Ocean. The river's unique arc-shaped path, crossing the equator twice, balances flows from both hemispheres while the basin's wetlands, peatlands, and floodplains, absorb and slowly release water, further stabilizing river flows, providing a steady supply of water throughout the year. Two other major rivers, the Ogooué and the Sanaga, drain independently into the Atlantic Ocean but are contiguous with the Congo watershed and are intrinsic components of the broader Congo Basin hydroecological mosaic. **(CH02, CH04, CH05)**

KEY MESSAGE 2

The Congo Basin is the largest tropical carbon sink on Earth and influences both regional and global climate.

The Congo Basin is a key regulator of the global carbon cycle, acting as one of the largest and most stable tropical carbon sinks on Earth. Its vast lowland rainforests absorb significant amounts of atmospheric CO_2 through photosynthesis, sequestering approximately 0.66 tonnes of carbon per hectare each year into intact forests. In addition to its forests, the Basin's peatlands, particularly in the Cuvette Centrale, store around 30 billion tonnes of carbon. These peatlands and forest soils lock away carbon accumulated over thousands of years, playing a crucial role in offsetting global carbon emissions. Furthermore, the Congo River system transports large amounts of organic carbon from terrestrial ecosystems to the Atlantic Ocean, influencing carbon fluxes on a continental scale. The Basin's continued function as a carbon sink is significant for moderating global atmospheric CO_2 concentrations.

2.1 In contrast to the Amazon, the Congo Basin's intact lowland rainforests have maintained their capacity to absorb carbon dioxide over recent decades, with long-term plot studies showing that they continue to act as a net carbon sink, despite global climate stress, which has resulted in decreases or reversals in carbon sequestration in other rainforest regions. These forests store large amounts of carbon in their aboveground biomass, averaging around 180-200 tonnes of carbon per hectare in intact areas (Figure 6). Carbon uptake is not uniform across the Basin but varies with forest type, soil properties and ecological processes, including interactions with large herbivores like forest elephants that shape forest structure, biomass density, and disturbance. In recent decades carbon emissions due to deforestation have increased, reducing the net absorption to about 600 million tonnes of CO_2 per year. **(CH08, CH15)**

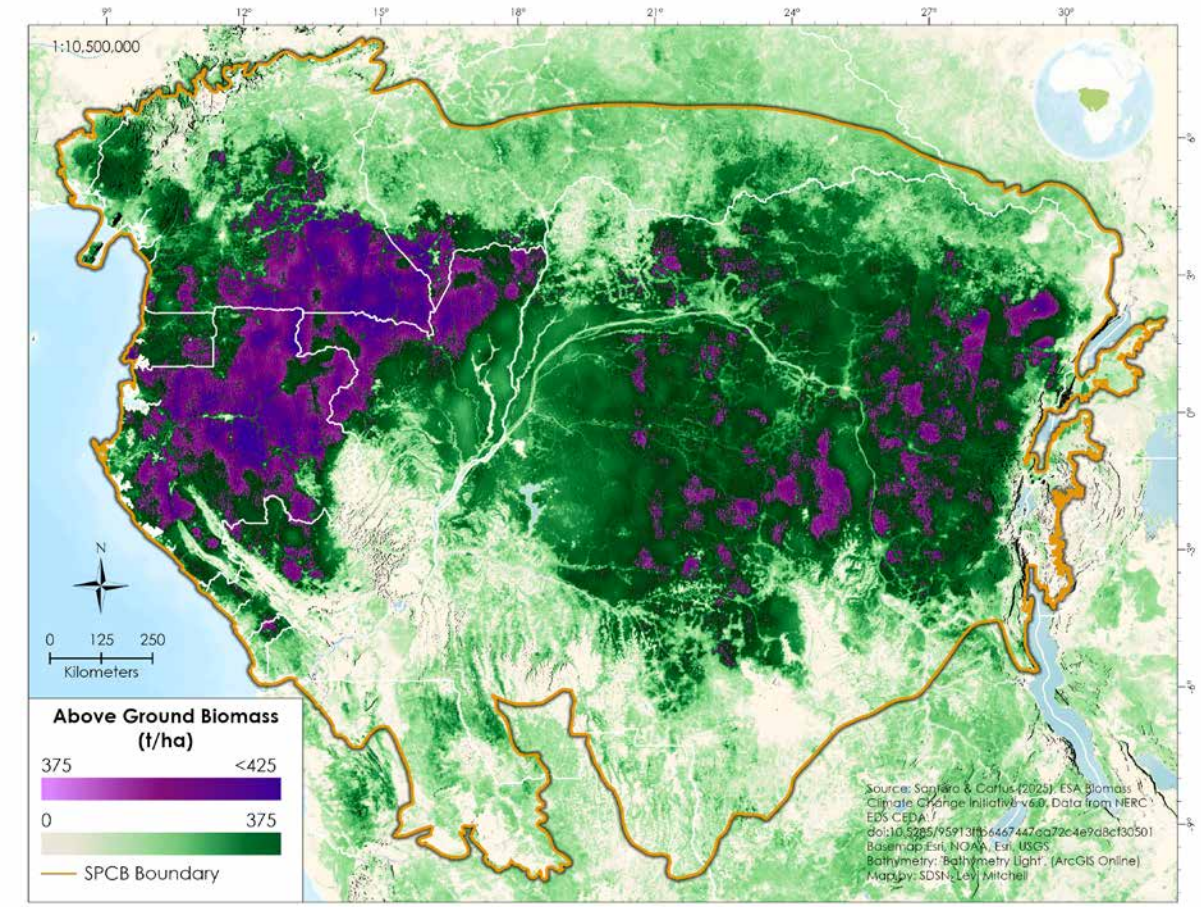


FIGURE 6 Biomass distribution across the Congo Basin.

2.2 The Cuvette Centrale peatlands, covering about 145,500 km², store around 30 billion tonnes of carbon, equivalent to several years of global fossil fuel emissions. These peatlands are among the most carbon-dense ecosystems on Earth, with carbon stocks reaching up to 3,970 tonnes per hectare, accounting for about 28% of tropical peat carbon. Formed over thousands of years through slow accumulation of organic matter in waterlogged conditions, these peatlands act as long-term carbon reservoirs. Their stability is highly sensitive to hydrological conditions, but their current intact state contributes substantially to global carbon storage. Non-peat forest soils in the Congo Basin are also estimated to hold large reservoirs of soil organic carbon, equivalent to or slightly greater than the carbon stored in the forest trees. **(CH03, CH08, CH15)**

2.3 The Congo River exports approximately 12 million tonnes of dissolved organic carbon and 2 million tonnes of particulate organic carbon (POC) annually, making it the second-largest contributor to oceanic carbon export after the Amazon. Seasonal flooding, wetland dynamics, and sediment transport processes modulate how much terrestrial carbon reaches the ocean, while also facilitating CO_2 outgassing along river surfaces, thus playing an integral role in the global carbon cycle. **(CH04, CH05, CH08)**

KEY MESSAGE 3

The Congo Basin is one of the most biodiverse ecosystems on Earth.

The complex geological history, warm wet equatorial climate and extensive lakes and rivers make the Congo Basin one of the most biodiverse places on Earth. Its vast lowland rainforests cover approximately 1.8 million square kilometers, but there are also extensive savanna mosaics, montane and swamp forests and the world's largest tropical peatland complex, located in the Cuvette Centrale. This mosaic supports an extraordinary biological diversity, including over 10,000 plant species (30% endemic), more than 400 mammal species, 1,000 bird species, and 700 fish species. The biodiversity of the Congo Basin supports critical ecosystem services and is deeply intertwined with the cultural diversity of its human inhabitants, making it both a biological and biocultural reservoir of global importance. Locally it supports the livelihoods of about 80 million people while at least a further 300 million rural Africans benefit from the wider ecosystem services that depend on the Congo Basin ecosystems.

3.1 The Congo Basin is one of the planet's most ecologically complex regions, characterized by its vast lowland rainforests, stretching across 1.8 million square kilometers and by a varied mosaic of other interconnected ecosystems. These include fire-adapted savanna landscapes, cloud-draped Afromontane forests, seasonally flooded swamp forests, and the immense peatlands of the Cuvette Centrale, which hold one of the largest tropical carbon reserves globally. This patchwork of habitats is shaped by variations in elevation, soil type, water availability, and past climatic shifts, creating an environment where distinct ecological communities thrive side by side. Such environmental diversity supports intricate ecological processes, from large-scale atmospheric moisture recycling to microhabitat specialization within forest understories. **(CH03, CH07, CH08).**

3.2 Reflecting this ecological variety, the Congo Basin hosts an extraordinary wealth of species. Its flora includes over 10,000 vascular plant species, with nearly a third found nowhere else on Earth. Its fauna includes a unique, intact large mammal community including four great apes, our closest ancestors (Eastern and Western gorillas, chimpanzees and bonobos), and other iconic species, such as forest elephants and okapis, and a myriad of lesser-known small mammals, amphibians, fish, birds, reptiles and invertebrates still being catalogued by science. The region's rivers, floodplains and wetlands sustain high fish and aquatic diversity, with many species uniquely adapted to the Basin's dynamic hydrological regimes. Biodiversity is not evenly distributed but is linked to the subtle environmental gradients across the Basin, where evolutionary processes have fostered high endemism in isolated or specialized habitats, reinforcing the Basin's role as a global biodiversity stronghold. **(CH03, CH08)**

KEY MESSAGE 4

The Congo Basin is home to a rich and ancient cultural diversity.

The Congo Basin is a rich socio-ecological system. Human interaction with the Congo Basin's ecosystems dates back at least 650,000 years, with early hominin populations adapting to its dense forests, rivers, and savannas through hunting, gathering, and small-scale forest use. Genetic evidence suggests that the ancestors of present-day hunter-gatherer groups diverged from the ancestors of other human populations around 70,000 years ago, making them among the earliest lineages of Homo sapiens to inhabit the Congo Basin. These communities developed intricate ecological knowledge systems, creating detailed classifications of plants, animals, and landscapes, passed down orally through storytelling, songs, and rituals. Today's forest hunter-gatherers preserve many of these ancient biocultural traditions, making the Congo Basin not only a biodiversity hotspot but also a living repository of humanity's earliest forest-based lifeways.

4.1 The relationship between the Congo Basin's biological diversity and the cultural richness of its human communities is equally profound. From Bantu-speaking farming societies to forest-dependent hunter-gatherer groups such as the Bagyeli, Baka and Bayaka, these communities possess detailed ecological knowledge systems passed through oral traditions, songs, and rituals. Their languages encode complex taxonomies for plants, animals, and landscapes, reflecting a deep, place-based understanding of their environment. These knowledge systems have historically guided sustainable resource use and landscape management, intertwining cultural identity with ecological stewardship. Consequently, the Congo Basin stands as not only a biological reservoir but also a living biocultural heritage site, where the preservation of biodiversity is inseparable from the survival of the region's cultural traditions and knowledge systems. **(CH05, CH06, CH07, CH17, CH33)**

4.2 Archaeological evidence shows that the Congo Basin has supported human occupation for hundreds of thousands of years, with the earliest records suggesting hominin presence at least 650,000 years ago. Early hominin groups fashioned pebble tools, points, and microliths, leaving a record of adaptation to the changing forest and savanna ecotones. *Homo sapiens* communities practising a hunting, gathering, and fishing lifestyle spread through the region. Over millennia, networks of exchange and contact produced the rich cultural and linguistic diversity that endures today, with more than 600 languages spoken across the Basin. Far from being a pristine wilderness untouched by humans, the Basin's forests, wetlands, and savannas have been long shaped by continuous human interaction, where traditional knowledge systems and subsistence practices are intimately linked to the region's biodiversity and ecological processes. **(CH06, CH07, C17, CH33)**

4.3 Traditional ecological knowledge extends beyond mere identification of species to include an understanding of ecological relationships, such as the seasonal movements of animals, the medicinal properties of plants, and the spiritual significance of certain forest locations, such as sacred forests, which are widely prevalent throughout the basin. This oral transmission of knowledge ensures that ecological literacy is embedded within cultural practices, with stories and rituals functioning as living manuals of forest stewardship, crucial for maintaining sustainable use of natural resources. **(CH07, CH17)**

4.4 Despite pressures from external influences and increasing sedentarization, forest hunter-gatherer groups like the Bagyeli, Baka, Bayaka and Mbuti continue to rely on hunting, gathering, and forest knowledge for their livelihoods. Their cosmologies, which view the forest as a sentient and nurturing entity, foster practices of reciprocity and respect for ecological balance. As such, these communities serve as custodians of cultural practices that are intimately tied to the survival and health of the Congo Basin's ecosystems, embodying one of the world's last living examples of ancient human-forest relationships. **(CH06, CH07)**

SECTION 2

Science Panel for the Congo Basin

Human Interaction with the Congo Basin from Prehistory to 1992

Photography by Josh Ponte.

KEY MESSAGE 5

The Congo Basin has a long history of agriculture and metalworking.

From about 4,000 years ago onwards the Congo Basin saw a gradual shift from exclusively hunter-gatherer to early agricultural societies, with the introduction of pottery and polished stone tools. With the arrival of iron and with Bantu-speaking communities moving in from the north, there was an increasingly marked impact on the Congo Basin forests from 2,500 years ago onwards. Various traditional methods of ecosystem regulation, including sacred forests and taboo species were employed by these peoples.

5.1 From around 2000 BC, a decisive transformation occurred. Farming and metallurgy expanded southwards and eastwards into the forest, carried by Bantu-speaking communities. Horticulture of yams, bananas, and millet combined with pottery and iron tools to permit clearance and more permanent village settlements. These shifts marked the beginning of large-scale anthropogenic impacts on the Congo Basin's ecosystems. Farmers used slash-and-burn cultivation to create clearings, while iron smelting demanded large quantities of charcoal. By roughly 2000–1000 years before present, forest fragmentation and widespread secondary growth became visible in palynological and charcoal records. Iron production sites attest to an embedded demand for wood fuel, linking metallurgy directly to deforestation. Thus, well before the colonial expansion, human societies had become ecological engineers, creating "cultural forests", shaped by their selective management of useful species. **(CH06, CH10, CH13, CH20)**

5.2 During the early period of agricultural development, food systems went beyond cultivation. Fishing, hunting, and gathering supplemented agriculture. Fishing in rivers, lakes and the ocean provided a key source of protein, with seasonal bans used by communities to allow stocks to replenish. Hunting of wild meat provided both subsistence and prestige value. While overhunting became a crisis in later centuries, it had already influenced the distribution and abundance of species in precolonial times. However, many societies practised forms of conservation rooted in cultural and spiritual beliefs. Totem species, sacred groves and areas were left untouched, seasonal bans regulated fishing and hunting, and initiation rites restricted access to parts of the forest, allowing ecosystems to recover. **(CH11, CH15)**

KEY MESSAGE 6

The Congo Basin's ancient kingdoms fostered regional and global trade network.

By the last millennium, polities (kingdoms) had emerged in some areas, and the region was linked to wider regional trade networks. The arrival of European explorers and traders from the 15th century onwards resulted in increased trade, while new technologies such as guns resulted in increased ecological impact, although traditional values and cultural ecosystem management techniques continued to operate. New diseases introduced at this time decimated human populations, initially in coastal regions, later penetrating into the interior of the Congo Basin along trade and logistical routes.

6.1 By the last millennium, the Congo Basin was linked into wider regional trade networks. Kingdoms such as the Kuba, Kongo and Lunda built centralised structures, often with towns or capitals that anchored regional trade. Long-distance exchange integrated hinterlands into Atlantic, trans-Saharan and Indian Ocean trade circuits. Forest and savanna products - ivory, hardwoods, copper, iron - were exchanged, often at great ecological cost. Enslaved people were exchanged too, at great human cost. The intensification of hunting for ivory, particularly, reduced elephant populations in several areas, demonstrating the pressures that global demand could exert. **(CH15, CH17)**

6.2 The arrival of Europeans on the coast from the 15th century resulted in new dynamics. Atlantic commerce in ivory, ebony, pepper, rubber precursors and enslaved persons intensified the exploitation of natural resources. The introduction of firearms altered hunting efficiency, exacerbating pressures on elephants and other megafauna. The arrival of European traders and the subsequent growth of trade routes and infrastructure into the Congo Basin resulted in epidemics of diseases to which people had not previously been exposed. Millions perished from diseases such as bubonic plague, smallpox, syphilis, cholera, measles and chickenpox, compounding the social impacts of the slave trade. **(CH07, CH15, CH17, CH20, CH21)**

6.3 Pastoralism, though concentrated north of the Basin's dense forests, also had a role. Cattle herders moving into savanna margins have shaped the ecologies of grassland and forest edges through grazing and fire use, not always in a negotiated coexistence with farming and fishing communities, adding a further dimension to landscape management. **(CH12, CH18)**

KEY MESSAGE 7

The Congo Basin experienced deep and lasting negative social and ecological impacts of colonialism.

The period marking the colonial conquest of Africa and the industrial frontier, from the 19th to mid-20th century, led to an era of huge social and ecological damage. Large-scale forced relocation of villages completely changed the human landscape with profound implications for the Congo Basin's ecosystems. Country borders were decided arbitrarily without taking sociological realities into account (Figure 7). In some cases, these borders separated populations belonging to the same tribe into different countries (e.g. Cameroon, Gabon, Equatorial Guinea). Forced labour was used to exploit mineral and timber resources, which were shipped to Europe for processing, establishing the economic reality that persists to today of Africa as a source of cheap raw materials that have developed the rest of the world. As African development came to be seen as a threat to species and ecosystems the colonial authorities imposed their view of "fortress" conservation, creating protected areas by banishing human populations through force.

7.1 The late 19th-century "Scramble for Africa" radically reshaped the Congo Basin. Subsequent colonial administrations, especially in the Belgian Congo and French Equatorial Africa, imposed concessionary systems that turned vast tracts of forest into rubber, timber, and mining zones. Villages were forcibly relocated to serve as forced labour for extraction sites, transport corridors and plantations. Colonial governments levied head taxes and conscripted labour, breaking earlier patterns of mobility and subsistence. The colonial economic model was to extract natural resources which were exported to Europe, where they fed the industrial revolution and the growth of wealth, a model that continues to this day. **(CH07, CH10, CH37)**

7.2 Mining became a cornerstone of colonial economies. Copper, cobalt, diamonds, and gold were extracted through large-scale operations, which carved out extensive networks of roads, railways, and riverine transport. Timber exploitation followed a similar path. Logging concessions supplied overseas markets, while artisanal logging fed local needs. These industries generated revenue and employment but left deep ecological and social scars, including deforestation, soil erosion, biodiversity loss and the breakdown in traditional value and environmental management systems. **(CH07, CH13, CH14)**

7.3 Colonial regimes introduced formal conservation through exclusionary "fortress" models. Parks were imposed by decree, local people were evicted, and biodiversity was preserved in enclaves isolated from human use. This legacy of dispossession created long-term tensions, even though these areas later became critical biodiversity refuges. At the same time, hunting regulations were formalized to protect game populations for colonial elites, reinforcing a vision of wildlife as both resource and spectacle. **(CH15, CH18)**

KEY MESSAGE 8

The Congo Basin's era of independence brought new political visions for development.

The period between 1960 and 1992 saw the progressive independence of the Congo Basin nations, rapid urbanisation and the emergence of a political vision championing the principles of sustainable development on the road to the Rio Earth Summit in 1992. Logging and mining remained the principal economic activities but were largely replaced in the Western Congo Basin countries by oil.

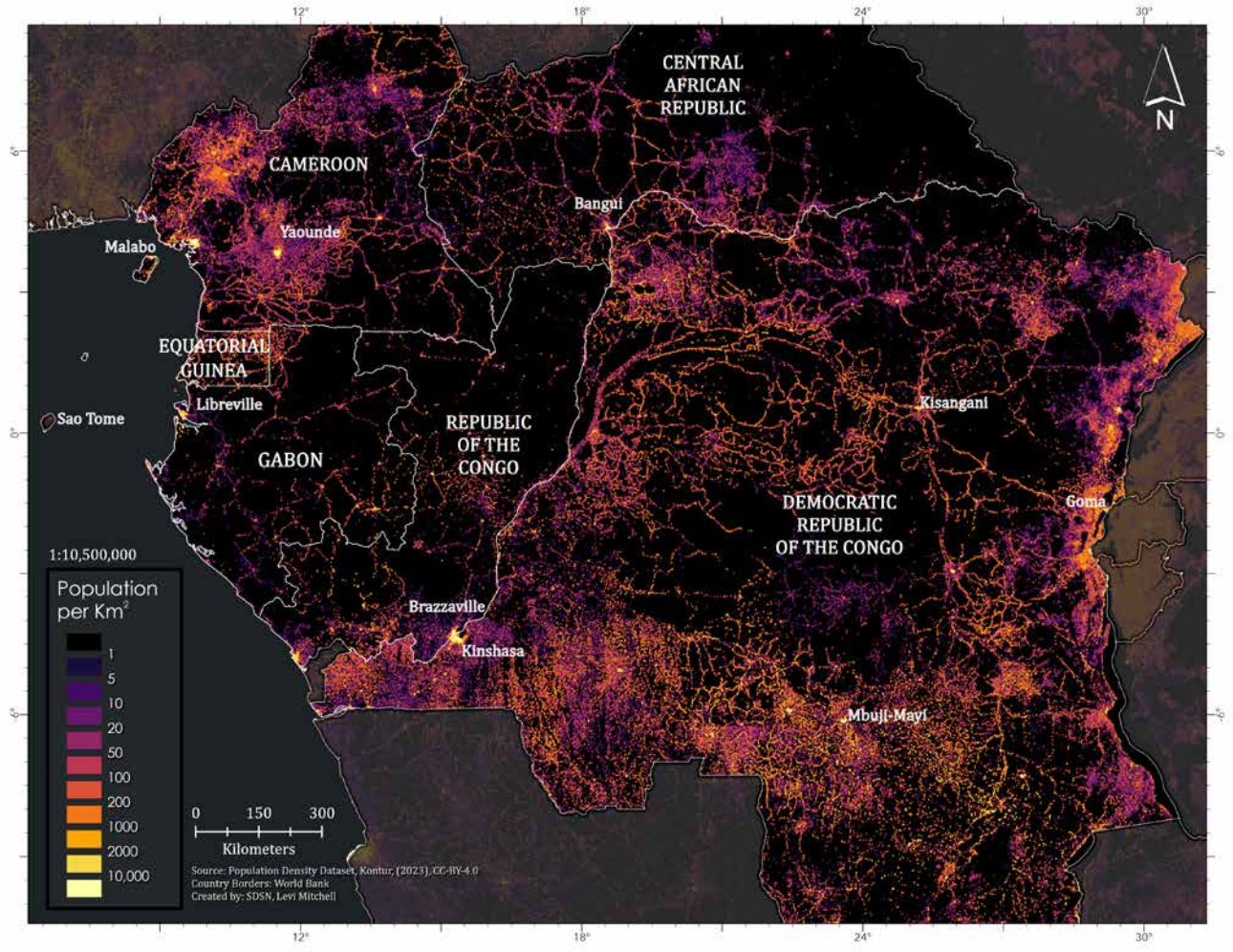


FIGURE 7 Human population distribution and major human settlement axes in the Congo Basin (2023).

8.1 The post-independence decades saw the emergence of new nation-states that inherited economies deeply tied to primary commodity exports. Urban populations expanded rapidly, as people moved from rural areas to capital cities and regional hubs in search of opportunity (Figure 7). Cities drew heavily on surrounding forests for charcoal, fuelwood, bushmeat and construction materials, extending the human footprint far beyond urban boundaries. **(CH07, CH10, CH17)**

8.2 Rural livelihoods remained centered on smallholder agriculture based on shifting cultivation, with cash crops such as cocoa and coffee woven into agroforestry systems. These systems, though more sustainable than monocultures, nonetheless drove steady forest clearance around settlement nuclei. Logging remained a dominant employer and source of revenue, with millions of hectares under concession by the 1980s, although oil revenues grew rapidly and became the main economic drivers in the Western Congo Basin countries. Though formal concepts of "sustainable forest management" were only beginning to take shape by the late 1980s, the seeds of reform were present. **(CH11, CH13)**

8.3 Large-scale movements of pastoralists into the Basin intensified from the 1990s onwards, drawn by the availability of pasture and economic opportunities and as a result of insecurity and climate change. These movements created tensions with farming communities, contributed to deforestation in some areas and reshaped landscapes through grazing pressure. Hunting and fishing likewise remained crucial livelihood activities. Yet by this period, bushmeat hunting and unsustainable fishing had become widespread, particularly around towns, resulting in noticeable declines in the populations of large mammals and fish. These dynamics were a precursor for the more acute "empty forest" and "empty lakes" crises that emerged later. **(CH12, CH15, CH20)**

8.4 By the late 1980s, ecological stress was widely acknowledged. Scientific studies emphasised the Basin's global role in climate regulation and as a biodiversity hotspot, and governments began to explore policies that would reconcile conservation and development. At the 1992 Rio Earth Summit, leaders from Congo Basin states played a key role in shaping global commitments to sustainable development, bringing both the legacy of colonial and post-colonial extraction and the enduring traditions of stewardship and ecological knowledge that had characterised the region for millennia to the table. **(CH13, CH18, CH19, CH37)**

8.5 By the late 1980s, the Congo Basin's peoples and leaders stood at a crossroads. Centuries of ecological engineering had created a landscape profoundly marked by human action, but also one recognised globally as vital for biodiversity and climate. The Rio Summit in 1992 provided the stage on which Central African voices began to articulate a new vision: that sustainable development and the preservation of Nature could be reconciled, and that the Congo Basin's long history of human–environment interaction could inform global futures. **(CH13, CH18, CH19)**

Photography by Josh Ponte.

SECTION 3

Science Panel for the Congo Basin

Social-ecological Transformations: First steps towards sustainable development

Photography by Josh Ponte.

KEY MESSAGE 9

The Congo Basin has seen transformative change since 1992.

Since the early 1990s the Congo Basin nations have experienced significant social-ecological transformations, including the beginning of the political transition to multi-party democracy and first steps towards sustainable models of development. Several leaders of the Congo Basin countries took strong positions at the Earth Summit in Rio in 1992 and acted on their commitments. Regional organisations were created and given formal mandates to coordinate forestry and climate policies. The forestry industry became subject to much stricter social and environmental governance, including certification, and in-country processing resulted in improved economic returns and increased job creation. Other sectors (e.g. mines, oil) have tended to lag behind.

9.1 The 1992 Rio Earth Summit marked a turning point for the Congo Basin. For the first time, Central African leaders took the global stage not merely as resource providers but as policy shapers, pressing for recognition of their forests as both a global common and a foundation for national prosperity. In the three decades since, Congo Basin countries have sought to balance competing imperatives: expanding economic opportunities, maintaining political stability and conserving one of the planet's largest and most biodiverse tropical forest blocks. This ambition was formalised in regional structures and agreements such as the Central African Forest Commission (COMIFAC). Protected area networks were expanded (Figure 8), community-based forest management projects piloted, and international conservation finance began to flow into the Basin. By the early 2000s, Congo Basin countries had dedicated millions of hectares to conservation, often supported by donor partnerships such as the Congo Basin Forest Partnership (CBFP). These initiatives reframed forests from simply reservoirs of timber and land to multi-functional landscapes critical for biodiversity, carbon storage, and human well-being. Yet these gains have remained fragile: natural resource dependence poses both economic potential and significant risk, with governance, institutional capacity, and political stability determining whether investment translates into sustainable growth. **(Introduction, CH18, CH22, CH 23, CH 24, CH 30, CH32)**

9.2 Forestry, historically one of the region's most destructive extractive industries, underwent significant transformations. In the 1990s and early 2000s, governments began to introduce forestry laws and land-use plans that required companies to operate under long-term sustainable management plans. Environmental and Social Impact Assessments (ESIAs) were gradually institutionalised, embedding safeguards into planning processes. Voluntary forestry and timber certification schemes emerged as tools for both governance and market access. The Forest Stewardship Council (FSC) became the gold standard, and countries such as Cameroon, Congo and Gabon emerged as leaders in Africa in certifying concessions under FSC standards.

While challenges remain in ensuring compliance and addressing illegal logging, these initiatives place Central Africa at the forefront of tropical forest management and certification worldwide. More recently there has been a move to increase local transformation and even to ban the export of unprocessed timber from the region, in order to maximise local economic growth and job creation. These reforms mark a profound shift from the colonial-era extract-and-export model towards one that aspires to reconcile economic use with ecological sustainability. **(CH22, CH24, CH26)**

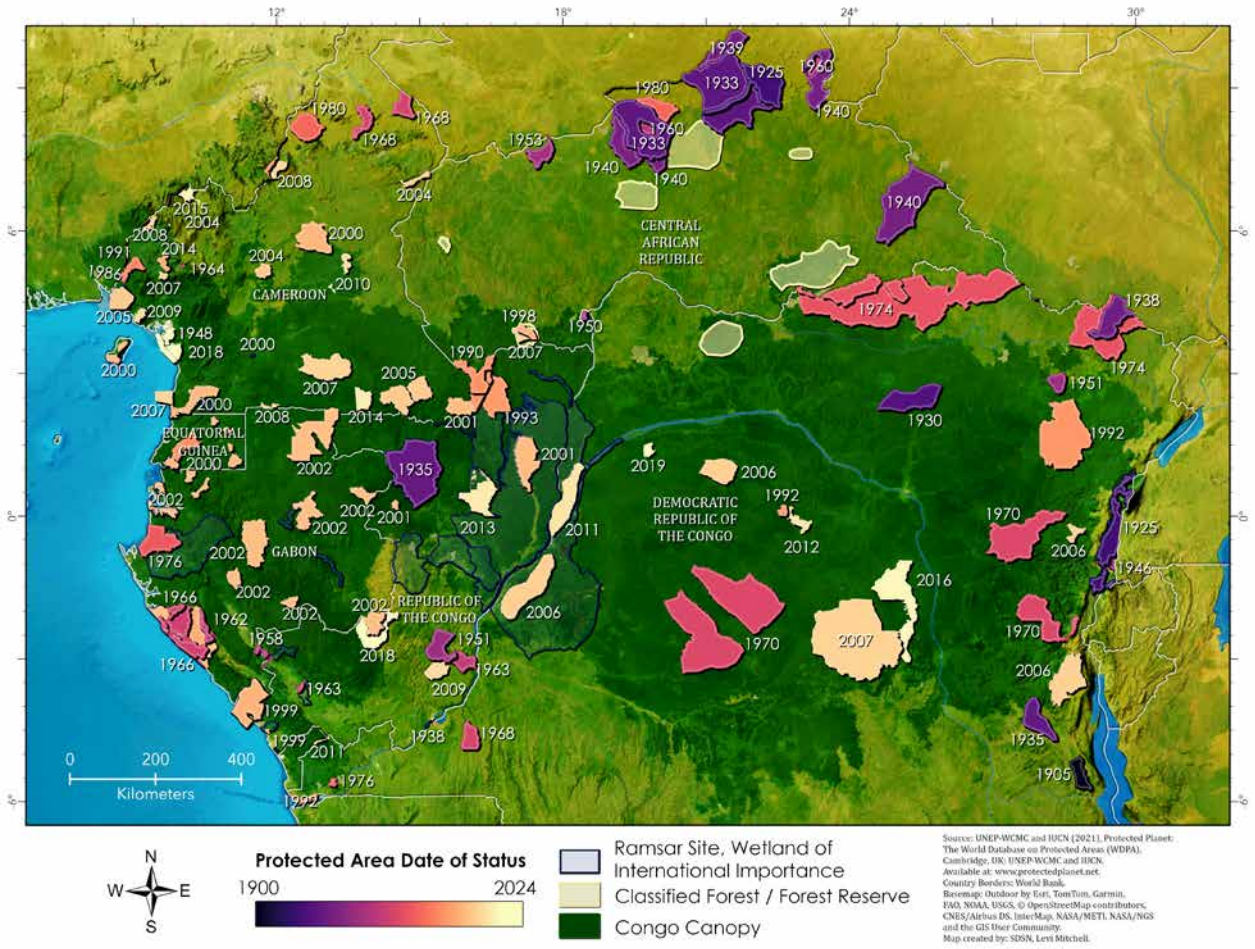


FIGURE 8 Protected areas across the Congo Basin and their years of creation.

9.3 Even as forestry has moved toward sustainability, other resource sectors have often remained firmly extractive. Mining remains a significant contributor to deforestation, pollution, biodiversity loss, and social disruption. While environmental regulations and Environmental and Social Impact Assessments are now formally required (although they are not always done according to the rules), enforcement is uneven, and artisanal mining continues to devastate river systems and forests. Industrial agriculture—particularly oil palm and rubber—has also expanded since the 1990s, often encroaching on forest frontiers and undermining biodiversity commitments. Smallholder agriculture is technologically unsupported by states, allowing widespread landscape degradation through outdated slash and burn practices to continue and intensify.

Overall, these trends illustrate the contradictions of post-Rio development: formal sustainability frameworks exist and perform well when used, but business-as-usual extractive logics also endure. Sustainable land-use planning tools are in place on paper, but weak governance, overlapping land rights, poor agricultural practices and international demand for minerals and commodities perpetuate ecological degradation. Strengthening governance and cross-sectoral institutions is vital for ensuring resource security and aligning extractive sectors with sustainable development pathways. **(CH24, CH25, CH 28, CH31)**

KEY MESSAGE 10

Novel approaches to environmental stewardship and sustainable use are urgently needed, building on already emerging paradigms.

Increasing political attention to biodiversity benefits and improved community involvement in local resource management is delivering positive results for biodiversity and sustainability, but these need to be rapidly scaled up and invested in for the long term. National governments are taking proactive stances on biodiversity and climate responsibilities, adaptation and forward planning, yet more joined-up policy on agricultural development and food systems is needed to ensure biodiversity and forest security, as well as food security and health for growing populations.

10.1 The post-1992 era has seen the expansion of protected area systems throughout the Congo Basin. Governments extended national parks and nature reserves, increasingly in line with international targets under the Convention on Biological Diversity (CBD). The Congo Basin states are among the leaders in advancing the 30×30 agenda (30% of land and marine area protected by 2030, under the Kunming-Montreal Global Biodiversity Framework), with Gabon and the Republic of Congo making especially ambitious commitments to bring 30% of their land and marine territories under protection by 2030. Protected area expansion has not only been quantitative but also qualitative. Early fortress models have gradually given way to participatory and integrated approaches, involving communities in co-management, buffer-zone planning, and benefit sharing. This represents a partial answer to the injustices of colonial conservation. Yet tensions persist. Industrial agriculture, mining, and infrastructure projects often overlap with designated protected zones and local community lands, but enforcement capacity remains inadequate to preserve environmental rights. Sustaining biodiversity clearly requires integrated land, water, and resource management, linking forest conservation with watershed protection, sustainable food systems and human well-being. **(CH23, CH24, CH25, CH26, CH27, CH28, CH31, CH32, CH38)**

10.2 Hunting and fishing remain vital for livelihoods and nutrition, but the scale and intensity of exploitation have grown since the 1990s. The bushmeat trade now supplies both urban and rural markets, with an estimated 1.6–11.8 million tons consumed annually. Inland fisheries continue to provide a crucial source of protein, particularly in the DRC, but overfishing and habitat degradation have reduced catches. Customary management systems such as taboos and seasonal bans, once widespread, have eroded under the pressures of market demand and weak governance. The "empty forest syndrome," where forests remain structurally intact but devoid of large fauna, has become emblematic of these pressures, although protected areas often still preserve viable populations, preventing extinction and species becoming lost to nations forever. Conservation projects and NGOs have sought to restore community-based management, but success is uneven, often due to the level of degradation of the wildlife communities, and to the inadequacy of alternative rural food systems. There is a growing evidence base for community management models that do deliver sustainable harvests and these could be scaled up across rural areas, but if underlying food systems are not improved, stemming biodiversity loss will remain challenging. **(CH15, CH20, CH23, CH 25, CH27)**

10.3 In Rio in 1992, climate change was recognised as an emerging threat; by the 2020s, it had become a lived reality across the Congo Basin. Between 1850 and 1992, global temperatures rose by roughly 0.4–0.5°C; since Rio, an additional 0.7°C has been added in only three decades. This has translated into longer dry seasons, more erratic rainfall and rising fire risks across the Congo Basin. These trends compound human pressures such as deforestation and mining, producing caing effects on ecosystems. Forest phenology is

shifting with consequences for animal wildlife, savannas are experiencing woody encroachment, peatlands risk carbon release, and mangroves and other coastal ecosystems face saltwater intrusion. Climate change and unsustainable land use are also worsening water scarcity and agricultural vulnerability, intensifying food insecurity in both rural and urban areas. These ecological stresses intersect with social ones: demographic growth, poverty, and unmet human development needs constrain adaptive capacity and heighten exposure to crises. At the same time, warming and ecological change contribute to disease emergence risks, from vector-borne diseases to zoonotic spillovers such as Ebola, linked to wild meat hunting.

National governments have responded with climate strategies and international commitments. Gabon pioneered national-level carbon accounting, seeking recognition for its forests as a carbon sink and developing carbon credit schemes. Congo and the DRC have integrated climate objectives into national development plans, while engaging in REDD+ initiatives and positioning themselves as key actors in global carbon markets. **(CH23, CH24,CH25, CH26, CH30, CH31)**

KEY MESSAGE 11

The Congo Basin has solutions within reach but these need strategic investments by governments, private sector and the international community.

The eradication of low value-added and illegal forms of extractive use of natural resources and the promotion of sustainable use regimes can transform their contribution to national economies and promote biodiversity, climate and human health benefits. Strengthening governance, and harnessing emerging technologies in clean energy, digital information, agriculture, timber transformation and pollution reduction could be transformational in the sustainability and economic growth of the region. Raising technical skills and capacity within Congo Basin societies, especially the youth, could put the Congo Basin on track to a better future for its citizens and environments.

11.1 The Congo Basin's societies have transformed since the early 1990s, which saw the tentative development of multi-party democracies. Populations are growing fast and urbanisation has accelerated, with cities drawing heavily on surrounding forests for energy, food, and materials. Migration and demographic growth place added strain on land and resources, while inequality and conflict in parts of the region exacerbate vulnerabilities. These demographic pressures constrain economic potential and limit the benefits of natural resource wealth, yet local communities remain crucial actors in sustaining biodiversity. Traditional ecological knowledge—though eroding—is still a foundation for rural community resilience. Policy innovations have begun to address these dynamics. Participatory forest management, community hunting concessions, and recognition of indigenous rights have been piloted across the region. While results vary, these initiatives represent a shift towards more inclusive rural resource governance. Regional integration and community-based approaches are increasingly recognised as essential for long-term prosperity and for tackling shared ecological and societal challenges. **(CH22, CH23, CH27)**

11.2 Progress towards sustainable development, including optimisation of the use of natural resources through local processing show promise but remain patchy. Business-as-usual scenarios are leading to resource depletion and lost economic potential, but they endure in many sectors and nations. Illegal logging, mining and agricultural expansion persist, due to weak enforcement, and this continues to undermine ambitious environmental and economic growth policies. Industrial agriculture often develops to the detriment of rich natural ecosystems because impact assessments are not done or ignored. Natural resource dependence continues to generate both opportunities and vulnerabilities, and the Basin's development remains contingent on political stability, institutional capacity, and governance, all of which face challenges. Advances in certified selective forestry and local timber processing show particular promise for generating economic returns and job creation while preserving forests and the ecosystem services they provide (Figure 9). The Congo Basin remains at a crossroads, with leaders articulating ambitious global visions for ecological integrity and sustainable development, while local realities often reflect entrenched extractive patterns because the local economies are isolated from the digital revolution and rely on outdated technologies and inefficient, expensive energy systems. As the world moves into the era of the Sustainable Development Goals and Agenda 2063, the Basin embodies both the promise and the paradox of sustainable development: a region of unparalleled ecological value, with governments willing to lead, but where translating ambition into practice remains an unfinished and difficult journey.

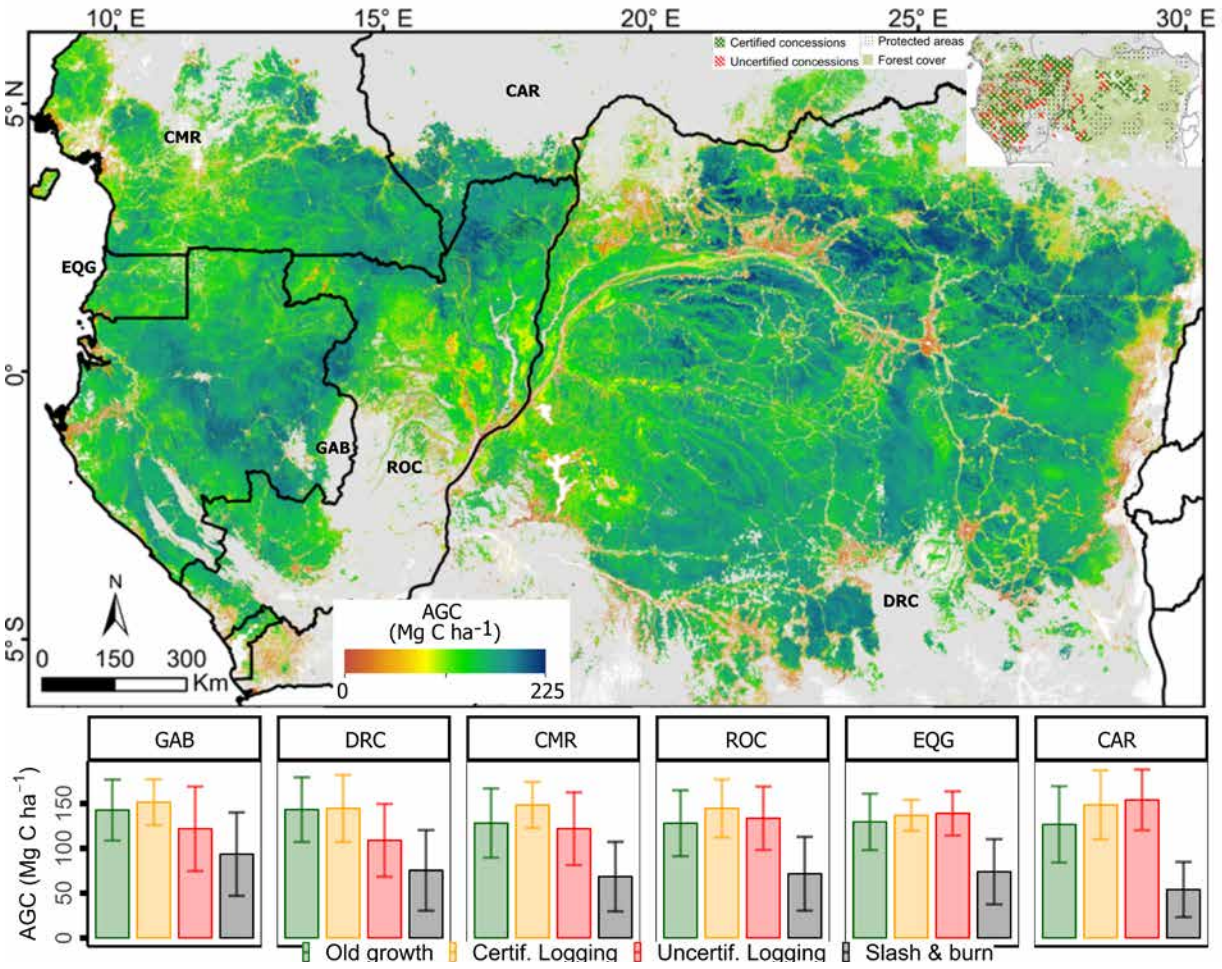


FIGURE 9 Carbon stocks across the Congo Basin ordered by land-use, demonstrating the potential of well-managed forestry to maintain and even enhance carbon stocks.

Photography by Josh Ponte.

The Science Panel for the Congo Basin First Assessment has brought together over 170 scientists who are actively undertaking research in the Congo Basin. The 2025 AR is the first attempt to synthesize existing knowledge across multiple ecological and socio-economic disciplines. Alongside this positive mapping of what we know, the Panel also captured vast and significant areas of knowledge that are still missing; that are important for the future of the people and nations of this regions; and that will be needed for climate action at regional global level. While we believe that the collective work under the Science Panel represents a significant step forward, it will be a failure if it is considered an end in itself, rather than the beginning. For this the Panel is working closely with others, especially the Congo Basin Science Initiative (CBSI) to promote investments into science, research institutions and scientists themselves to expand and deepen existing areas of knowledge.

In this context it is important and helpful to consider the Amazon experience. The Science Panel for the Amazon which released its first report in 2021 at COP26 in Glasgow built on the Large-Scale Biosphere-Atmosphere Experiment in Amazonia program. The LBA represented a 10-year, $100-million effort initiated in 1998 and comprising a total of 120 science projects with 1,700 participants, 990 of whom were Brazilians. No such initiative has been undertaken in the Congo Basin to date.


Setting the agenda in research

Comment

Congo Basin rainforest — invest US$150 million in science

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

FIGURE 10 Commentary published in the journal 'Nature' authored by several members of the SPCB and ministers from the region

This experience was also the basis for a call by environment ministers and scientists in the region issued in October 2021: "Congo Basin rainforest — invest US$150 million in science" (Figure 10), and inspired the launch of both the Science Panel for the Congo Basin and the Congo Basin Science Initiative in 2023. The initial mapping of Congo Basin researchers that was undertaken by SDSN in 2023 found that out of a total of over 400 scientists who published on the region, only a quarter of them were from the region. The vast majority of scientists working on the Congo Basin are from and based in other regions, especially in Europe and North America.

The following overview identifies some of the key cross-cutting knowledge gaps considered to be a priority by the authors of this report. While only preliminary this list is meant to present a starting point for governments, institutions and leaders in the region to review and align their existing and future resource allocations for scientific programming in the region, and collaborative programs with other parts of the world.

A: Knowledge gaps around climate, hydrology, and carbon dynamics

- Sparse long-term climate and hydrological monitoring networks
- Weak integration of land-use, hydrology, and carbon flux data into regional/global climate models
- Poor understanding of peatland and floodplain thresholds under climate stress
- Lack of dedicated climate models that reliably capture the unique meteorological characteristics of weather systems in the region e.g., cool, cloudy dry season in the western Congo Basin.

For more specific information see also Assessment Report chapters 4, 5, 9, 16, 31, and 32.

Recommendations (A): Expand integrated monitoring systems (flux towers, river gauging, climate stations) and link them with satellite data to better model the Basin's role in global climate regulation and to develop climate change models specific to the region.

B: Knowledge gaps around biodiversity monitoring and conservation effectiveness

- Limited phylogenomic and long-term ecological studies; poor tracking of species declines; lack of knowledge about critical ecological and climate induced tipping points
- Effectiveness of protected areas and other effective conservation measures (OECMs) poorly evaluated; weak metrics on connectivity and equity
- Inadequate monitoring of hunting/fishing pressures and the "empty forest" effect (understanding of how loss of fauna affects ecosystem function)

For more specific information see also Assessment Report chapters 3, 15, 18, 21, 27, and 38.

Recommendations (B): Develop robust biodiversity baselines and monitoring frameworks that integrate genetics,species ecology, ecosystem processes, and socio-economic pressures to inform conservation policy.

C: Knowledge gaps around land use, agriculture, and extractives

- Poor cumulative mapping of agricultural and mining concessions and biodiversity hotspots
- Weak evidence on sustainability of shifting cultivation

and smallholder systems under population growth and scant research on modern climate-resilient higher productivity agricultural techniques

- Limited knowledge of the natural history of targeted commercial timber species
- Lack of integrated socio-ecological studies of mining, artisanal activities, and ecosystem impacts

For more specific information see also Assessment Report chapters 10, 11, 12, 14, 24, 25, 27 and 25.

Recommendations (C) : Advance work on modern tropical agricultural systems and integrated land-use science that accounts for agriculture, mining, forestry and infrastructure impacts, and supports long-term planning.

D: Knowledge gaps around governance, institutions, and policy integration

- Policy fragmentation across forestry, mining, agriculture, and conservation sectors needs to be better documented
- Evaluation of the effectiveness and enforcement of ESIAs and other regulatory tools; and the institutional capacity to follow up on these.
- Limited understanding of the integration of customary tenure and indigenous rights in statutory frameworks.

For more specific information see also Assessment Report chapters 8, 13, 22, 24, 25, 26 and 37.

Recommendations (D): Strengthen research on governance and cross-sectoral institutions, ensuring policy coherence and integration of customary systems into national and regional frameworks.

E: Knowledge gaps around communities, equity and traditional knowledge

- Weak documentation and transmission of traditional ecological knowledge
- Poorly studied outcomes of community forestry and indigenous rights recognition
- Limited gender-and equity-focused research in forest governance and benefit-sharing.

For more specific information see also Assessment Report chapters 7,8, 22, 33, and 37.

Recommendations (E): Empower communities and smallholders through participatory governance, TEK integration, and equity-focused research that links livelihoods with forest stewardship.

F: Knowledge gaps around health, zoonoses, and One Health
Sparse baseline data on zoonotic diseases and vector ecology
Weak institutional linkages between conservation and public health sectors

- Limited research on how land-use change and climate interact to drive disease emergence

For more specific information see also Assessment Report chapters 15, 20, and 29.

Recommendations (F): Expand One Health approaches, combining ecosystem, wildlife, and public health monitoring to anticipate and mitigate zoonotic risks.

G: Knowledge gaps around finance, economics, and sustainable development pathways

- Limited research on the economics of harnessing natural resource exploitation to develop economies and create jobs
- Poor understanding of the overreliance on oil/mining revenues
- Limited local capacity for monitoring, climate/biodiversity accounting, and financial governance
- Poor quantification of the economic value of ecosystem services, low capacity on carbon markets
- Limited understanding of the likely costs of climate change and climate adaptation
- Weak understanding of how to integrate natural capital into national balance sheets

For more specific information see also Assessment Report chapters 14, 23, 24, 25, 34, 35, and 37.

Recommendations (G): The economic case for favoring sustainable development, through wise use of renewable and non-renewable natural resources in a manner to maximise economic returns and job creation while preserving ecosystem services should be a priority for economists in the region. This should include work to integrate natural capital in national balance sheets and innovative finance.

H: Knowledge gaps around technology, data, and foresight

- Poor regional data harmonisation and limited open data infrastructure
- Lack of foresight and scenario planning rooted in African institutions

For more specific information see also Assessment Report chapters 32, 35, and 39.

Recommendations (H): Invest in technological adoption, data infrastructure, and African-led foresight capacity to enable evidence-based decision-making for 2050 pathways.

SECTION 4

Science Panel for the Congo Basin

The Solution Space: Finding Sustainable Pathways for the Congo Basin Forest Ecosystem

Photography by Josh Ponte.

KEY MESSAGE 12

Sustainable development of the Congo Basin is dependent on effective governance.

To attract the responsible investors and affordable finance needed to drive sustained economic growth, continued and accelerated improvements in democratic process, governance, rule of law, justice and equity are needed in the Congo Basin nations. Political stability and elimination of illegality in the natural resource extraction industries are crucial to encourage international confidence and investment. Furthermore, integration and strengthening of local community involvement and rights in integrated spatial plans are also needed. International agreements such as the African Union's Agenda 2063, the UN Sustainable Development Goals (SDGs) can help to chart a path but need to be adapted to local circumstances through regional leadership.

12.1 The key to peace and security, sustainable development and prosperity in the region are strengthened democracies, improved governance, including governance of natural resources, elimination of illegal exploitation of natural resources and better rule of law, as well as an efficient, objective, independent justice system able to fight corruption. These vital foundations for society are crucial to tackle challenges to attract the long-term investment needed to implement local processing of natural resources and to attract finance to invest in logistical infrastructure needed to optimise supply chains and ensure profitability in the private sector. **(CH13, CH14, CH23, CH35, CH37, CH39)**

12.2 Equity must also anchor governance. Pathways for ensuring that conservation and development benefit those most directly dependent on forests include community forestry, traditional rights recognition and participatory protected area and natural resource management. Communities with secure rights are more likely to invest in long-term stewardship, as was the case in the pre-colonial past. These approaches can facilitate the integration of traditional knowledge and management systems into modern principles of natural resource governance. **(CH18, CH 21, CH22, CH26, CH37, CH39)**

12.3 A credible future depends on policy coherence. It is important to foster unity in forestry, mining, agriculture, and infrastructure where many resource ministries still operate in silos, often working at cross-purposes. Promotion of integrated planning under national land-use frameworks that recognise customary tenure, clarify rights, and reduce conflict between local communities, private operators, and state authorities is needed. Spatial planning, powered by remote sensing, GIS, and AI-driven monitoring, is a cornerstone. Congo Basin countries are now able to map forests, concessions, and protected areas with unprecedented accuracy. There is a need to avoid "paper reforms" and to support real accountability of the key components of sustainable development by embedding them in law, budgeting, and enforcement. **(CH23, CH32, CH38)**

12.4 Several global and continental initiatives are working to strengthen the shared vision for sustainable growth that is inclusive, low-carbon and biodiversity-positive, including nature's contributions to people's well-being and food security. These include the African Union's Agenda 2063, the UN Sustainable Development Goals (SDGs), the Kunming–Montréal Global Biodiversity Framework (GBF) and the 4p1000 Initiative (Soils for Food Security and Climate) among others. For the Congo Basin, this means protecting what remains as well as actively managing landscapes as socio-ecological systems that deliver prosperity, resilience, and ecological stability. Agenda 2063 places African people at the center of transformation, aiming to end poverty, silence conflict, harness youth and foster industrialisation grounded in green economies. The SDGs bring a holistic framework, linking forests to food, water, energy, and equity. The GBF, meanwhile, makes the 30×30 target, protecting 30% of terrestrial and marine areas by 2030, the global benchmark. For the Congo Basin, aligning these agendas requires weaving together forest governance, sustainable finance, Nature-Based Solution, ecosystem restoration, carbon markets and inclusive rights-based approaches. **(CH32, CH33,CH34, CH36, CH37, CH38, CH39)**

KEY MESSAGE 13

Success of sustainable development and conservation in the Congo Basin depends on new models of financing at scale.

There is a need to foster affordable, dependable finance and equitable investment in sustainable development for the Congo Basin nations, to provide dignified, sustainable livelihoods for their people, while continuing to supply the global ecological services that benefit all of humanity. Preservation and enhancement of Nature-Based Solution provides a critical foundation to boost sustainable development and climate resilience of nations and economies. The Congo Basin countries are leading the world through the development of economies that depend on sustaining ecosystem services, banishing the model of using Africa simply as a source of cheap raw materials that provision nations far from the continent, as was the case during colonial rule

13.1 There is an urgent need to banish the persistent contradiction that defines the Congo Basin economies: forests and renewable resources sustain millions and state revenues are heavily tied to non-renewables — mining and oil, which are rarely processed in the region, greatly limiting the financial returns and job creation. Traditionally these sectors have not generated sustainable financing for development or conservation because wealth was often captured by elites, or flowed outwards, leaving governments dependent on inadequate international transfers. Recently there has been progress in local timber processing, generating increased local profits, government revenues and jobs, providing a model for other sectors. Similarly, public-private partnership investment models, such as the special economic zones developed with Arise IIP in Congo, DRC and Gabon, are promising, ensuring Congo basin countries share the upside of in-country processing. **(CH24, CH25, CH35, CH38)**

13.2 Although it is rising, biodiversity and climate finance remains insufficient compared to the scale of ambition, since no solution space is viable without sustainable finance. The Congo Basin has historically received less international forest finance than the Amazon or Southeast Asia. Closing this gap requires a portfolio approach: Increased domestic budget allocations for environment and forestry; Scaling performance-based finance (e.g. REDD+); High-integrity carbon and biodiversity credits; Public–private partnerships for restoration and Nature-Based Solution. Increased investment in scientific capacity and data infrastructure: training local scientists, maintaining observatories, and institutionalising data-sharing platforms are critical to ensure that policy is evidence-driven rather than donor-dependent. **(CH25, CH32, CH35, CH36, CH37, CH38)**

13.3 Investment in mitigation and resilience to climate change is a key future solution space given that climate change is already reshaping the Congo Basin. Land-use change and climate interact to threaten forest resilience, with accelerating impacts since 1992. It is important to strengthen the leadership in high-integrity carbon markets of the Congo basin countries. Gabon, Congo, and the DRC are pioneering approaches to peatland protection, forest carbon accounting, and REDD+. Advances in remote sensing and open data can be used to increase the credibility of these markets, which rely on rigorous Measurement, Reporting and Verification (MRV) systems. There is a need for strong governance of carbon and biodiversity markets, as they have the potential to provide billions in sustainable finance, which can be reinvested in conservation, social services, and green infrastructure. Management and extractive schemes that bypass local rights are being discredited. **(CH16, CH31, CH32, CH35, CH37)**

KEY MESSAGE 14

The Congo Basin needs investment in and nurturing scientific and technical capacity and innovation.

Harnessing all possible technological advances to optimise the preservation, management of natural resources and monitoring of local and regional changes is critical for the future of the Congo Basin. It is hard to manage something that is not well understood, and many knowledge gaps remain. There is a need to promote the formal training and capacity building for scientists, sociologists, and natural resource managers to establish effective management systems that maximise ecological resilience and benefits for the region's economies and people and to promote inter-disciplinary collaboration. The Science Panel for the Amazon and its precursor, the Large-Scale Biosphere-Atmosphere Experiment Program, provide powerful models that can be adapted to the Congo Basin.

14.1 Technological advances are gradually transforming governance. Geographic Information Systems (GIS), remote sensing, and digital observatories permit improved monitoring of deforestation, land-use change, and concession boundaries. These tools reduce conflict over overlapping claims, enable governments to enforce zoning rules, and strengthen transparency for international partners. Low technology adoption and capacity gaps in many institutions hinder full use of these tools. Investment in capacity building and data infrastructure, alongside efforts to democratise access to data, empowers both central governments and local communities and civil society to fully use their potential. **(CH32, CH35, CH37)**

14.2. Some preliminary initiatives aimed at "institutionalizing" or "semi-institutionalizing" technical monitoring of resources—such as AGIOS in Gabon, OSFAC, the Forest Atlas, Global Forest Watch, and OFAC—are still in the early stages of development and broader acceptance compared to similar efforts in other tropical countries, such as Brazil. These initiatives are primarily supported by external donors and human resources, and they have not yet been fully integrated into national budgets or local and national expert/scientific networks. As a result, there is a lack of clear institutionalization that could ensure long-term sustainability.

14.3 Ultimately, the most decisive factor is knowledge. Boosting the Basin's low technology adoption rates and the insufficient critical mass of scientists, foresters and data specialists is vital. Decision-makers need to be informed of the crucial needs to leverage science, from ecosystem function to carbon accounting and biodiversity monitoring, to social science on governance. Investments in school education, universities, observatories, and knowledge transfer mechanisms in civil society will enable a steady flow of insights from research to policymakers and communities. Bridging this gap transforms science from an external donor-driven input into an endogenous force for sustainable development. We need a massive investment in research capacity in the Congo Basin comparable to the *Large-Scale Biosphere-Atmosphere Experiment Program* in the Amazon. **(CH33, CH34, CH36, CH38)**

14.4 The SPCB coordinates closely with the Congo Basin Science Initiative, a complementary platform of scientists aiming to promote long-term investment in science in the Congo Basin. CBSI's mission is to transform our understanding of the world's second largest tropical rain forest, build scientific capacity in the region, and use this knowledge to support sustainable development.

KEY MESSAGE 15

The Congo Basin depends on building resilience by investing in effective protection and restoration of its natural capital.

Africa is the continent that is most susceptible to climate change because of the vulnerability of its more arid ecosystems and lack of technological and financial capacity of adapt. The ecological stewardship and environmental resilience of the Congo Basin is critical for the region and for many other parts of Africa, whose weather patterns are impacted by moisture from the "heart and lungs of the continent", the Congo Basin rainforests. Nature preservation and Nature-Based Solution need to be integrated into ecosystem management, urban environments and national planning, to ensure maximal climatic resilience for ecosystems, agriculture and people in the coming century. This is by far the most efficient and effective way of reducing the costs of adaptation, while contributing to global climate change mitigation.

15.1 The GBF's 30×30 goal is both ambitious and urgent. Congo Basin countries are already leaders in extending protected area networks and experimenting with Other Effective Area-Based Conservation Measures (OECMs). Forestry concessions, which collectively cover vast areas of the Congo Basin, can be integrated into OECMs when managed on a sustainable basis, to increase the potential for biodiversity preservation and ecosystem resilience. The challenge is not only quantitative coverage but qualitative connectivity: linking habitats across borders and integrating conservation areas into working landscapes. Corridors that connect forest blocks, community-managed reserves and recognition of sacred groves and customary sites are essential complements to strict parks. Financing remains a bottleneck. Promotion of innovative mechanisms such as biodiversity credits, conservation trust funds, and blending climate and biodiversity finance, can close the gap, and ensure long-term sustainability of protected areas. **(CH18, CH32, CH35, CH38)**

15.2 Nature-based solutions offer perhaps the most promising bridge between ecological integrity and human development. Agroforestry, assisted natural regeneration, peatland conservation, mangrove restoration, and urban greening can deliver multiple benefits: food security, water regulation, biodiversity conservation and carbon sequestration. There is a need to embed and scale Nature-based solutions into national planning and align with Agenda 2063's goals for agriculture and energy. **(CH34, CH37)**

15.3 Restoring degraded forests, regenerating savannas, reconnecting fragmented habitats, and carefully reintroducing keystone species which accelerate natural regeneration can reverse degradation and enhance biodiversity and resilience. These efforts, when tied to Nature-based solutions and livelihoods, provide a foundation for the Congo Basin's contribution to the GBF and the SDGs. **(CH34, CH36)**

15.4 Community resilience must also be central. Traditional and local knowledge remains a living resource for adaptation and ecosystem management. Support education, intergenerational knowledge transfer, and women's leadership in forest governance to build resilience at both household and national scales while integrating local communities into natural resource management transforms them from antagonists to guardians. **(CH33)**

15.5 The COVID-19 pandemic highlighted the connections between ecosystem degradation and zoonotic diseases. Promoting the One Health framework is a vital part of the solution space in the Congo Basin, where bushmeat hunting and wildlife trade remain widespread, deforestation and environmental degradation are accelerating and access to public healthcare is scant. One Health approaches which integrate human, animal, and environmental health reduce risks while promoting sustainable wildlife governance and boost the capacity building for monitoring and early detection of outbreaks as well as promoting synergy between veterinary and wildlife health professionals to head off future pandemics at source. **(CH20, CH27, CH39)**

Theory Of Change DESIRED OUTCOME

Sustainable Development of the Congo Basin that improves quality of life and prosperity, maintains ecosystem services and natural capital, and promotes climate resilience.

FOUNDATIONS OF CHANGE

The following issues are the critical enablers if Congo Basin countries are to achieve this desired outcome:

1

Ecosystem services must be maintained and, where necessary, restored

- No unplanned deforestation and ecosystem degradation
- Sustainable extraction of renewable natural resources

2

Climate resilience promoted at local, regional and global scales through:

- Nature based solutions
- Adaptation strategies, & climate resilient urban planning
- Negotiating ambitious climate action with G20 / high emission partners
- Maintaining low carbon emissions
  a. Renewable energy
  b. Transition to green technologies

3

Optimised land use planning

- Protected areas / ecosystem services
- Subsistence and Industrial Agriculture
- Key infrastructure corridors
- Urban planning

4

Better food security through the promotion of modern, climate resilient, tropical agricultural systems in place of slash and burn agriculture

5

Healthy and well-educated populations, where gender equality and empowerment of indigenous people are effective

6

Growing economies and creating jobs for the Congo Basin's dynamic young population and optimizing fiscal revenues for government investment

7

Good Governance, Peace and Security

KEY ENABLERS

Natural Capital Valuation Systems
a. Carbon / REDD+
b. Biodiversity
c. Natural Capital
d. Ecosystem Services e.g. water

Protected Areas Networks Optimised, Managed and Funded
a. 30 x 30 targets achieved
b. Sustainable financing
c. Capacity Building

Enabling Scientific Research to play its Full Role in Society
a. Long-term monitoring of climate and biodiversity
b. Better understanding of local and regional weather patterns
c. Better understanding the impacts of climate change
d. Sustainable forestry and agriculture
e. Emerging diseases
f. Capacity building

Adoption of Technological Solutions and AI

Climate Resilient Urban Planning
a. In context of large and growing urban populations modern urban planning is critical to provide services
b. Integration of green spaces
c. Use of nature-based solutions to temperature, flooding and pollution control

Agricultural Reform and Optimisation
a. Transitioning away from slash and burn to climate resilient, carbon positive modern tropical agriculture
b. In-country processing for small-scale cash crops e.g. cocoa, coffee.
c. Careful land use planning and environmental guidelines for industrial agriculture

Effective Integration of Rural Communities into Natural Resource Governance
a. Strategic and inclusive land tenure reform
b. Participative management
c. Revenue sharing

Strengthen Legal Frameworks for Permits (Concessions) and Land Tenure

Appropriate Birth Control Programmes Culturally sensitive introduction of birth control is critical if Congo basin nations are to make their dynamic, young population a positive for development

Optimised Use of Renewable and Non-Renewable Natural Resources
a. In-country processing and value added
b. Strategic partnerships

Improved Governance and Democratic Institutions Emergence of a post-Colonial form of African / Congo Basin Democracy

Improved Law Enforcement Reduced Corruption Reduced Illegal Exploitation of Natural Resources

KEY CHALLENGES & THREATS

Climate Change is an existential threat in Africa: to agriculture, to economies, to health, to peace and security, **to the very existence of the forest.** Drives immigration from surrounding regions to the Congo Basin (e.g. the transhumance)

Limited scientific knowledge of natural and social systems

Limited capacity
a. Natural resource monitoring and management
b. Finance and economics
c. Technological solutions

Ineffective management of donor fund
a. Corruption results in funds being stolen
b. Complex donor procedures make implementation very inefficient
c. Aid money has never developed a nation

Over-dependence on export of unprocessed raw materials (minerals, timber, oil, etc.) limits economic growth and self determination

Rapid unplanned urbanization results in development of slums, exacerbating environmental challenges (pollution, flooding, impacts of climate change) and raises the costs of providing adequate services (backwards engineering is inevitably more expensive than forwards planning)

Weak involvement of rural populations / forest dwellers in environmental governance

Rapidly increasing populations
a. A young population can be an advantage but can also become a source of unrest if ambitions are not fulfilled
b. Population increase is too rapid for social and physical infra-structure to keep pace
c. Results in severe pressure on natural resources

Global Financial Systems favour developed nations.

Lack of financial resources
a. High debt loads
b. Lack of affordable finance
c. Limits investment
d. False promises from developed nations e.g. REDD+

Weak governance and corruption
a. Favours **illegal natural resource exploitation**
b. Limits quality and raises the costs of investment
c. Undermines environmental management

Insecurity

FIGURE 11 Theory of change to guide the sustainable development of the Congo Basin, improving quality of life and prosperity, maintaining ecosystem services and natural capital, and promoting climate resilience.

KEY MESSAGE 16

The Congo Basin stands at a decisive crossroads.

It is the world's second-largest tropical forest system, a vast carbon sink, and home to unparalleled biodiversity, but it is also a region of rapid population growth, persistent poverty, weak governance and competing demands for development. Strengthened governance, equity and justice; reliable finance and sustainable economies; technology and capacity; and ecological stewardship and stability are the four key foundations for the future emergence and stability of the region.

A business-as-usual path risks accelerated resource depletion, weak governance, and worsening climate impacts. In this scenario it will not be long before the region runs out of resources to extract, leaving the Congo Basin nations and peoples in a state of dire poverty and conflict, while depriving the global community at large of a critical Nature-based solution in a rapidly heating world.

The Congo Basin countries must choose a sustainable trajectory that integrates multiple possible scenarios by 2050 (Figure 11):

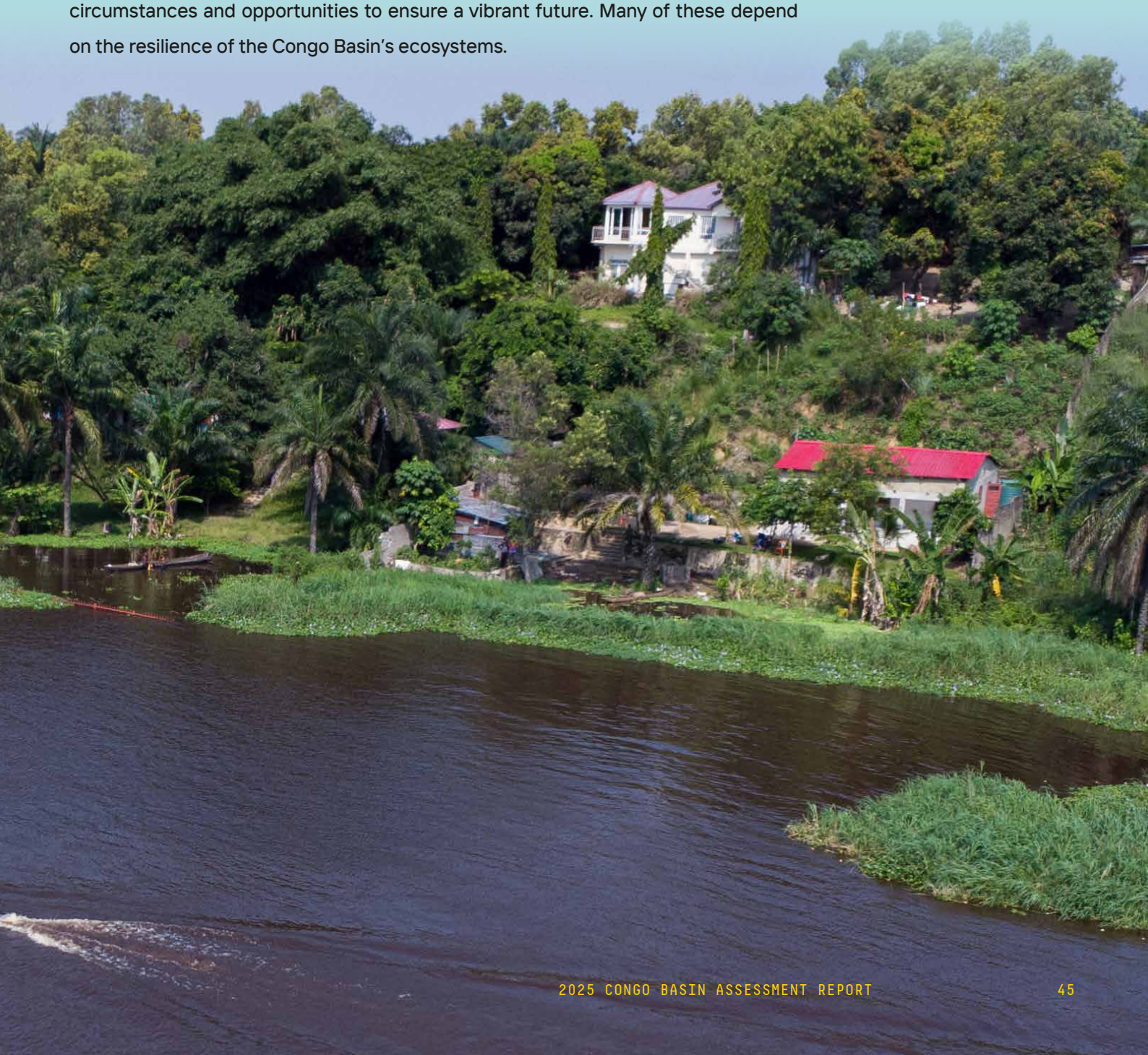
- A technology-driven path that embraces AI, advanced monitoring, and digital governance, reducing illegal logging and optimising land-use planning.
- A justice-focused path promoting climate and environmental justice, elevating indigenous rights and equitable finance.
- A geopolitical integration path that strengthens relations with international partners, reshaping trade and investment frameworks.
- A balanced, sustainable-development path that integrates environmental sustainability with economic growth, climate action, and biodiversity-positive outcomes.

Boosting an integrated approach that builds on all the positive scenarios aligns directly with The African Union's Agenda 2063, which places African people at the center of transformation, aiming to end poverty, silence conflict, harness youth, and foster industrialisation grounded in green economies. It also builds on the Sustainable Development Goals and the Global Biodiversity Framework, among others. There is still time and already some promising progress that can be harnessed to foster a pathway for the Congo Basin to lead Africa and the world in building a sustainable future. **(CH39)**

Conclusion

Photo: Adobe Stock.

The Congo Basin is a critical component of our planetary biosphere: a treasure house of biological and cultural diversity that provides key environmental services at local, regional and global scales. After centuries of extraction and degradation, there is real potential for a different future: one of genuine sustainable, locally led development for the welfare and benefit of its peoples and communities, where resources are sustainably managed and preserved and contribute to both African and planetary resilience in the face of inevitable impacts of climate change. Many challenges remain, including both needs and opportunities to reinforce good governance, strong institutions and political accountability. Science, scientific institutions and scientists themselves have important roles to play to monitor, generate evidence and inform decision making by those responsible for solving collective problems and development of transformative solutions. Africa is facing a unique set of circumstances and opportunities to ensure a vibrant future. Many of these depend on the resilience of the Congo Basin's ecosystems.



Distemonanthus benthamianus.
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