Critical Interconnections Between Cultural and Biological Diversity in the Congo Basin

Aida Cuni-Sanchez, Maximiliano Fero Meñe, Milena M. Beekman, Romain Duda, Simon Hoyte, Verina Ingram, Donald Iponga, Julia E. Fa, Simon Lhoest, Christian Mikolo, Léa-Larissa Moukagni, and Alice Vittoria

Contents

A. Cuni-Sanchez (✉)
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway
e-mail: aida.cuni-sanchez@nmbu.no

M. F. Meñe
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Department of Management and Conservation of Natural Environment, Faculty of Environmental Sciences, National University of Equatorial Guinea, Malabo, Equatorial Guinea

M. M. Beekman
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Department of Biology and Biotechnologies, Sapienza University of Rome, Rome, Italy

B.-I. Inogwabini et al. (eds.), *Resilience and Sustainability in the Congo Basin*,
https://doi.org/10.1007/978-3-032-02023-9_9-1

R. Duda
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Centre d'Écologie Fonctionnelle et Évolutive (CEFE), CNRS, University of Montpellier, EPHE, IRD, Montpellier, France

S. Hoyte
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Extreme Citizen Science Research Group, Department of Anthropology, University College London, London, United Kingdom

V. Ingram
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Forest and Nature Conservation Policy Group Wageningen University & Research, Wageningen, The Netherlands

D. Iponga
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Institut de Recherche en Ecologie tropicale (IRET), Centre National de la Recherche Scientifique et Technologique (CENAREST), Libreville, Gabon

J. E. Fa
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

CIFOR-ICRAF, Jalan CIFOR, Situ Gede, Bogor Barat, Bogor, West Java, Indonesia

Manchester Metropolitan University, Ormond Building, Manchester, United Kingdom

University of Gibraltar, Europa Point Campus, Gibraltar, Gibraltar

Abstract

In this chapter, we explore the interconnections between biological and cultural diversity in the Congo Basin. This chapter focuses on the worldviews, human-nature relationships, knowledge systems, livelihood strategies, and governance regimes of people living and working in the basin: farmers, pastoralists, fishermen, and hunter-gatherers, documented from a range of disciplinary perspectives. The peoples of the Congo Basin can be broadly grouped into hunter-gatherer groups of "Pygmy" ancestry, farmers of Bantu origin, and pastoralists of Nilotic origin. Worldviews and human-nature relationships differ considerably between and within these three groups, with hunter-gatherers' worldviews being more egalitarian and emphasizing unconditional sharing, which the other groups do not do. The languages spoken in the Congo Basin, which are over 400, convey detailed vocabulary and traditional ecological knowledge (TEK) systems, intricately linked to different habitats, biodiversity, and their uses and management. In

S. Lhoest
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Forest is life, Gembloux Agro-Bio Tech, University of Liège, Passage des déportés, Gembloux, Belgium

C. Mikolo
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Institute of Tropical Ecology Research (IRET), National Centre for Scientific and Technological Research (CENAREST), Avenue Houphouët-Boigny, Libreville, Gabon

L.-L. Moukagni
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Institute of Tropical Ecology Research (IRET), National Centre for Scientific and Technological Research (CENAREST), Scientific and Technical Coordinator, Avenue Houphouët-Boigny, Libreville, Gabon

A. Vittoria
York Institute for Tropical Ecosystems, Department of Geography and Environment, University of York, York, North Yorkshire, UK

Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences (NMBU), Ås, Norway

Social History of Capitalism research group, Vrije Universiteit Brussels Pleinlaan, Brussels, Belgium

many parts of the Congo Basin, though, changing social aspirations and traditions have meant that younger generations acquire less traditional ecological knowledge than older generations possessed. Traditional farming, fishing, hunting, and gathering practices are changing, driven by increased market demand for some products and globalization. These occur alongside changes in techniques used, the erosion of traditional governance systems, and weakened enforcement of customary rules, which have led to biodiversity loss, negatively impacting the food security, health, and livelihoods of the peoples depending on them. A diversity of governance arrangements and policies regulates access not only to land and natural resources, but also markets, differing in their socio-ecological impacts. In general, though, local communities have little power and agency in most arrangements, making recognizing their needs, voice, rights, and well-being imperative.

Keywords

Cultural diversity · Congo Basin · Hunter-gatherers · Bantu farmers · Indigenous and local knowledge (ILK) · Local cosmologies and epistemologies · Livelihoods · Governance of natural resources

Introduction

There are approximately 157 million people living in the six countries of the Congo Basin: 111.5 million in the DRC, 29.5 million in Cameroon, 6.5 million in the Republic of the Congo, 5.5 million in the Central African Republic, 2.5 million in Gabon, and 1.5 million in Equatorial Guinea.[1] Among these 157 million people, there is a huge cultural diversity. If we consider language as an indicator of cultural diversity, there are 273 living indigenous languages in Cameroon, 208 in the DRC, 66 in the CAR, 55 in Congo, 40 in Gabon, and 12 in Equatorial Guinea.[2] Broadly, the people speaking all these languages can be clustered into Bantu sedentary farmers (the majority), Fulani pastoralists of Nilotic origin, and "Pygmy" hunter-gatherers. In the Congo Basin, "indigenous peoples" (or "peuples autochtones" in French) mostly refer to hunter-gatherer groups, which are estimated to be 1 million (Olivero et al. 2016). These groups were historically categorized by Western explorers and scientists under the term "Pygmies," which derives from ancient Greek and refers to their short stature (Bahuchet 1993a). Actually, the term assembles several ethnic groups who speak different languages (e.g., Baka, Bayaka, Bezan, Efe, Batwa, Bambuti) and have different cultural and morphological characteristics (Verdu 2016) (Fig. 1). Formerly, most "Pygmy" ethnic groups were nomadic hunter-gatherers living in the forest, who exchanged wild meat and other wild

[1] https://www.worldometers.info/

[2] https://www.ethnologue.com

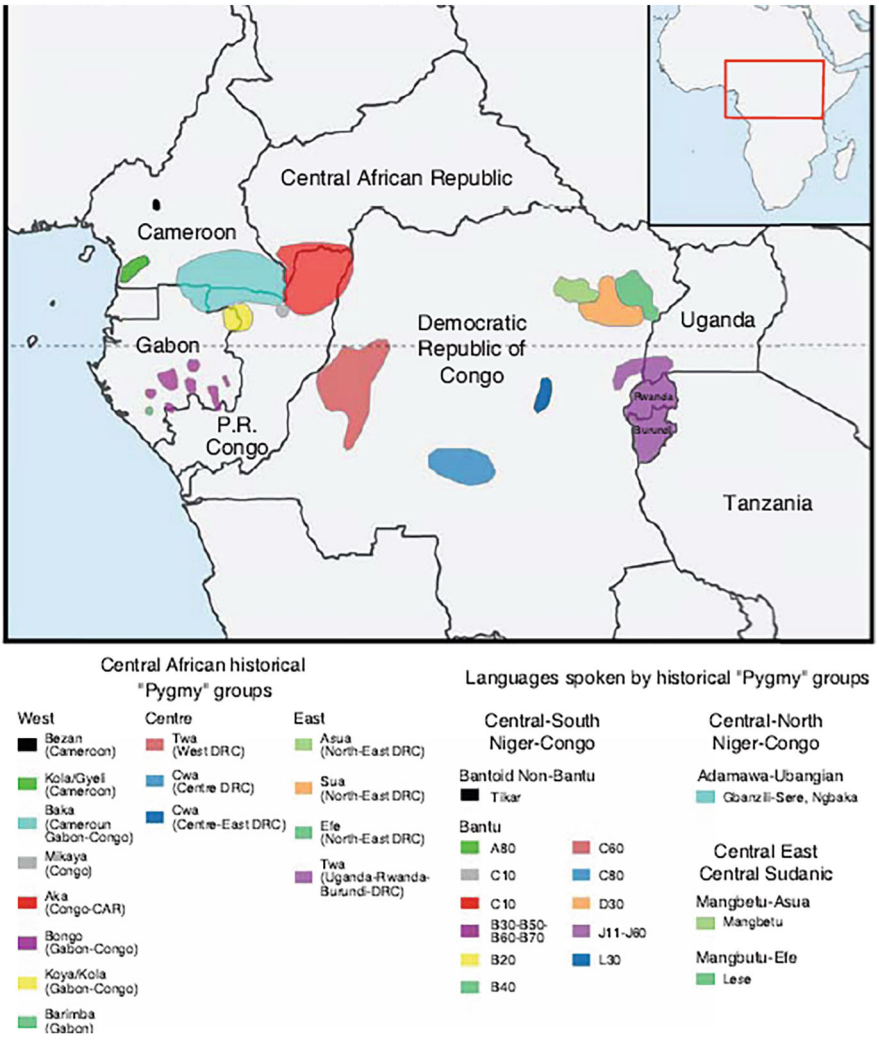

Fig. 1 Geographical location of historical "Pygmy" groups and their languages. (Source: Verdu 2016)

products for crops and other goods with the neighboring Bantu farmer communities (Bahuchet and Guillaume 1979). In the past three to five decades, however, several "Pygmy" ethnic groups have become increasingly sedentarized and involved in farming—with important implications for their diets, health, cultures, and general well-being (Dounias and Froment 2006). As the word "Pygmy" is sometimes used derogatorily—to indicate "backwardness" or being less than human—by non-Pygmies, in this chapter, we will use "hunter-gatherer" to refer to all these ethnic groups of "Pygmy ancestry."

The downside of grouping them under a common term is that it hides the differences that exist between these groups (Bahuchet 2017). Depending on the region and local history, there are major differences within these groups in terms of mobility, social organization, and subsistence. Today, however, most hunter-gatherer populations in the Congo Basin depend on agriculture for their livelihoods, either through their own production or through day labor in the fields of their farming neighbors in return for cassava tubers. It is the case for the Bakoya of Gabon, who have been sedentarized since the 1930s, and the Baka of Cameroon from the 1950s (Soengas 2009; Leclerc 2012). These latter also increasingly take up cash crop cultivation like cocoa, although it is at odds with their way of life and value system (Oishi 2012). Farming and living in bigger settlements involve more individualism compared to their collective and egalitarian approach to living (Soengas 2009). Differences also exist among different hunter-gatherer groups of any one region. In the Ituri forest of eastern DRC, for example, while Mbuti have been trading wild meat with nearby Bantu farmer communities since the 1950s, up to the early 2000s, the Efe rarely traded wild meat with nearby farmer communities (Terashima and Ichikawa 2003).

Several pastoralist groups can also be found in the Congo Basin, including the Fulani people (also called Fula or Fulbe) in Cameroon or the Banyamulenge in the DRC. Historically, the Fulani did not own land but had rights to graze their animals on the communal lands of their "host" farming communities (Mbih et al. 2018). Over the past few decades, though, the Fulani have also become increasingly sedentarized, and many have started farming (Ayodele et al. 2014). Compared to their "host" farmer communities, they tend to have no identity attachment to forests and do not perform ceremonies in them (Cuni-Sanchez et al. 2019a). The Banyamulenge, of the Fizi region of eastern DRC, are a Tutsi group speaking a variety of Kinyarwanda (Verweijen and Brabant 2017). Since the 1980s, this pastoralist group has also become increasingly sedentarized and has increased its farming activities (Katunga and Muhigwa 2014). Pastoralist groups, like Bantu farmer groups, are generally not considered "indigenous peoples" in the Congo Basin region.

Contrary to the Amazon, indigenous lands and territories have not been legally recognized in the Congo Basin countries; therefore, no "hunter-gatherer" group owns the forest where they live. There are, however, moves by COMIFAC to recognize indigenous peoples (Eba'a Atyi et al. 2022). Several groups were evicted from their ancestral lands in the name of forest conservation when national parks were created, e.g., the Twa of Kahuzi-Biega National Park in the DRC (Barume 2000). Nowadays, legal access to their ancestral lands varies between countries and regions, but overall, more remains to be done to ensure the recognition of their rights in social and environmental policies.

Cosmologies, Worldviews, and Knowledge Systems

In the Congo Basin, hunter-gatherers and farmers show both differences and similarities in terms of ways of living, cosmologies, and knowledge, all being intimately related to each other (Bahuchet and Guillaume 1979; Joiris 2003). First, differences in worldviews become evident when looking at the relation with the landscape. Farmers lay claims over areas of forest, villages, and water bodies; these claims are supported by an ideology of ownership of land, whereby traditional rights are generally passed down from father to son (Pemunta 2017). Contrary to this, hunter-gatherers' understanding of land is centered on a philosophy of guardianship and care: The forest does not belong to anyone in particular, but it is rather considered as a caring and giving mother, providing equally for all her children.

In Baka and Bayaka cosmologies, Komba created the forest for everyone to share in its abundance. This origin has repercussions on subsistence practices and resource management. In immediate-return societies, resources are acquired when needed and not accumulated (associated with hunting, fishing, and gathering activities), whereas in delayed-return societies, investment is put into future harvest (associated with agriculture; Woodburn 1982). These approaches support specific worldviews and social structures. The former, held largely by hunter-gatherers, rejects private ownership, maximizing the sharing rather than exchange of resources and avoiding accumulation as the way to achieve abundance and holistic joy—for both forest and people (Lewis 2019; Hoyte and Mangombe 2024). This sharing ethos supports egalitarian social structures and resists the emergence of inequalities in terms of age, gender, and status. The latter approach, held primarily by farming groups, places more emphasis on ownership rights and on the accumulation and exchange of resources, leading to more hierarchical social systems and fewer reciprocal relations with the forest (MacGaffey 1983). However, some farmer groups also have strong cultural connections with the forests they inhabit and perform different ceremonies in such forests to maintain "the order" in their everyday lives, such as the Oku people of Cameroon (Cuni-Sanchez et al. 2019a) or the Kuti, Kusu, and Ngengele of the DRC (Batumike et al. 2021). In some cases, these ceremonies and cultural attachment to the forest by these farmer communities have contributed to the conservation of such forests (e.g., Mt. Oku in Cameroon).

Traditional rules and taboos often guide the behaviors of both hunter-gatherer and farmer groups (Rupp 2011). These are often encoded in storytelling, which is an integral part of the culture of many Congo Basin groups. Tales most often reflect on the other-than-human world—the sun, moon, plants, and animals, through stories that give them the status of persons (Brisson 2010). Among both farmer (e.g., Fang, Bateké) and hunter-gatherer groups (e.g., Baka, Bayaka), these stories bear an important moral component, linked to sharing and social cohesion and allowing for the transmission of a wealth of ecological knowledge, cultural values, and oral history (Ondo 2013). The vast zoological and botanical knowledge across the Congo Basin is therefore inherently socio-ecological and cannot be divorced from the unique cultures from which it arose.

Many farmers and hunter-gatherer groups hold that the forest is inhabited by spirits. Far from being separate from humans, these spirits interact closely with their human counterparts, through divine healers (generally known as "ngangas"), but also in dreams and encounters during forest walks. Ancestral spirits, for example, are widely considered to inhabit forests; known for their invisibility and shape-shifting abilities, they continue interacting with the living, sharing knowledge and influencing the luck of their descendants (Ma 2021; Vittoria 2024; Hoyte 2024). Many groups, like the Baka and Bayaka hunter-gatherers, also recognize another class of spirits: forest beings that are socialized in the human sphere through singing, dancing, and play. Interacting with the invisible is intimately tied to health and well-being. These groups tie individual and collective health to ceremonies with forest spirits; farming groups, such as the Mpangu of the DRC, may directly address ancestral spirits to ensure protection and healing (Kitewo 1998).

Health and well-being are also often associated with the notion of balance in food and social life, supported by a respect for a certain number of prohibitions (dietary or behavioral; Motte-Florac et al. 1996). Nonobservance of avoidances, as well as attacks by malevolent spirits and sorcerers, might be considered as causes for certain illnesses, leading people to turn to traditional pharmacopoeia, with which they feel confident. Across the whole basin, an astounding array of medicinal knowledge is evident, not only for healing physical illnesses but also psychological troubles, restoring luck, and providing extraordinary abilities (Pathy et al. 2021; Gallois et al. 2024).

Languages and Biocultural Conservation

The Congo Basin is known to be a biolinguistic hotspot, like the Amazon Basin and Indo-Malaysia/Micronesia (Maffi 2001; Loh and Harmon 2005, 2014). Although the number of languages spoken in this region might seem high (over 400), this is all that remains of a much larger number of languages, after centuries of European colonization, formal schooling in French, globalization, mobility, and other driving forces (Bromham et al. 2022).

Nowadays, all hunter-gatherer groups of the Congo Basin speak languages adopted—in a more or less recent past—from neighboring farmer groups—so they lack a common language or language family (Bahuchet 2012). In contrast, words for naming tools used in gathering are less frequently exchanged and may result from adaptation to different ecological contexts. However, among western hunter-gatherer groups, there is a common lexicon for terms such as wild yam, honey, hunting, or elephant, which supports both the existence in the past of a common ancestry language and the important role of forest knowledge for their cultural identity (Bahuchet 1993b). Local languages may convey traditional ecological knowledge intricately linked to biodiversity, the habitat where it can be found, and its uses. Ethnoecological studies among several groups have revealed a detailed vocabulary on habitats, plants, and animals, but also on ecological interactions among them. For example, Mbuti and Efe hunter-gatherers in the Ituri Forest of eastern DRC use over

300 (Efe) and 350 (Mbuti) plant species for food, medicine, and material culture (tools, baskets, dye, etc.) (Terashima and Ichikawa 2003). Notably, differences in plant use can be found between villages of the same ethnic group, with only about 30% shared use of species (Terashima and Ichikawa 2003). Hunter-gatherer groups also use numerous plant species for hunting and fishing. The Baka of southeastern Cameroon report uses of 176 plant species in various hunting and fishing practices, most frequently as hunting luck, psychoactive stimulus for improving the dog's scent and capacity for hunting, materials for traps, and remedies for attracting animals and for making the hunter courageous (Fongnzossie et al. 2023). The Baka also show great knowledge of wildlife: They have at least ten terms for specific types of gorillas, depending on sex, age, and companionship status, and most of the knowledge is consistent with modern primatologists' findings (Oishi 2013).

While ethnobotanical knowledge of hunter-gatherers has been widely acknowledged, remarkable knowledge on plant uses has also been documented for Bantu-speaking farmers. For example, the Lega farmers of eastern DRC reported 287 plant species as useful, including 178 species for medicine, 38 for food, 139 for material culture, and 29 for ritual and magic (Terashima et al. 1991). The Nyindu farmers (living near the Lega) use 412 plant species, including 227 species for medicine, 45 for food, 196 for material culture, and 46 for ritual and magic (Yamada 1999). Some Bantu farmers also hold great ethnoecological knowledge about fish. For example, the Bakwelé of southeastern Cameroon collect 97 species of fishes and have elaborated a great variety of fishing techniques that mediatize their extensive knowledge regarding fish ecology, diet, and behavior, in relation to diversified aquatic microhabitats (Oishi 2016). The fishing techniques they use include bail fishing, poison fishing (using, e.g., *Millettia sanagana* or *Turraeanthus africanus*), net fishing, barrier fishing, traps, hook and lines, longline fishing, and harpoon. Among these fishes, 46 species are subject to taboos and consumption restrictions, and some fish species also have medicinal uses (Oishi 2016).

As reported in other regions of Africa, though, knowledge of plant use among younger generations is decreasing: for example, among the Bayaka hunter-gatherers of northern Congo who are born in towns instead of forest camps (Salali et al. 2020). Intra-regional rural migration is also increasing, as people follow economic opportunities (e.g., logging, mining, or cash crops), which affects the acquisition of traditional ecological knowledge by both long-term residents and immigrant communities. Near Mt. Cameroon, long-term residents have a much wider breadth and depth of knowledge of plant species in comparison to migrant households (Laird et al. 2011). Recent work in the Lac Télé Community Reserve and Ndoubale-Ndoki (Republic of the Congo) and Okapi Reserve (DRC) has also shown that recent migrants are less likely to engage in forest-harvest-based livelihoods and harvest several types of forest foods (L'Roe et al. 2023). Each language represents an irreplaceable cultural heritage of specialized knowledge, management systems, and worldviews that are preserved and transmitted by its linguistic categories and structures, so the consequences of language loss are severe not just for sociocultural entities but also for ecological ones.

Biocultural Diversity, Lands, and Livelihoods

Agriculture and Agroforestry

Traditional agricultural systems of the Congo Basin are generally based on slash-and-burn practices and contain a mix of cultivated and managed food, medicinal, and ritual species. Useful wild tree species are often saved during land clearing for farming, and sometimes, seedlings of such useful trees are transplanted from forests to enrich farms. Cassava or manioc (*Manihot esculenta*) is the primary staple crop for most contemporary communities in the region, although plantain (*Musa* spp.) and maize (*Zea mays*) are also often cultivated together. Because of the trees left or planted during land clearing, some of these farms can be considered agroforestry systems, especially those where oil palm, cacao (*Theobroma cacao*), coffee (*Coffea canephora* var. *robusta*), or the semidomesticated bush mango (*Irvingia gabonensis*), the African plum (*Dacryodes edulis*), and kola nuts (*Cola* spp.) are abundant (Sonwa et al. 2007; Lescuyer et al. 2024, chapter 10).

Due to increasing populations and land scarcity, fallow periods in slash-and-burn farming systems are being reduced, as well as the number of trees on farms, which negatively affects soil fertility and crop yields. In most of the Congo Basin, agriculture is not mechanized, and no animals are used to plough or provide compost to enrich the land—although mechanization is increasing in flat regions of, e.g., southern Cameroon. Currently, most small-scale cash crop plantations operate under land tenure insecurity, meaning they are cultivated on land that farmers customarily "own," but to which they have no legal title. New initiatives to secure land tenure, such as legalizing customary tenure and "household agroforests," could be further encouraged, as well as new forms of social forestry designed to protect land used for shifting cultivation and cash crop production (Vermeulen and Julve 2022).

For many Bantu farmer groups, a "nice farm" or a "nice cocoa plantation" is source of pride and their heritage, related to wealth and prestige, and it is an asset to pass to descendants (e.g., for the Bakossi in Cameroon, Cuni-Sanchez et al. 2025). Several Bantu communities place a high value on the microclimate regulation forests provide, as they "bring good rains for our crops" (e.g., Oku in Cameroon, Tembo and Shi in the DRC, Cuni-Sanchez et al. 2019a, b). They also acknowledge the importance of forests and fallows for soil formation and control of soil erosion and, therefore, good crop yields.

The Congo Basin is a center of genetic diversity for crops such as palm oil (*Elaeis guineensis*), the Robusta coffee variety (*Coffea canephora* var. *robusta*, first discovered in the late nineteenth century in the DRC), and some yam species, although the two most cultivated yam species—the white Guinea yam (*Dioscorea rotundata*) and the yellow yam (*D. cayenensis*)—originated in West Africa. With regard to wild yams (*Dioscorea* spp.), these remain primordial sources of carbohydrates for many hunter-gatherer groups in the region. Wild yams also play a key role in their symbolic perception of the forest. The Baka of southern Cameroon accurately distinguish and name the 14 wild yam taxa found in their area, which they classify distinctively into edible from inedible species (Fig. 2, Dounias 2011). The Baka practice "paracultivation" of some of these wild yam

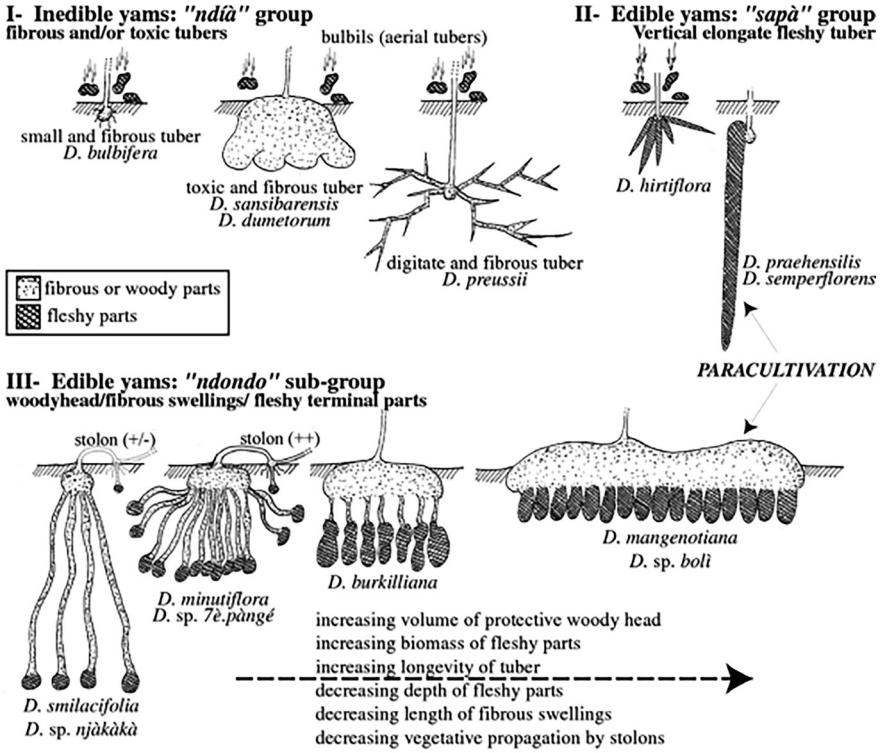

Fig. 6. Tuber morphology.

Fig. 2 Wild yams (*Dioscorea* spp.) species identified by the Baka hunter-gatherers of southeastern Cameroon. (Source: Dounias 2011)

species, by not just "unplanned" dispersal of *Dioscorea* spp. tubers discarded during cooking, but also their para-cultivation by reburying tuber parts with the intention of promoting their regeneration (Dounias 2011). Conscious and unconscious dispersal of oil palm (*Elaeis guineensis*) seeds by both farmers and hunter-gatherer groups is also thought to have influenced the distribution and abundance of this species in the wild. Such examples show how local communities of the Congo Basin have been modifying forest ecosystems, not just negatively (deforestation, degradation) but also positively, co-creating them (sensu services to ecosystems, Comberti et al. 2015).

Hunting

For many rural communities in the Congo Basin, wild meat (commonly referred to as bushmeat) is the primary source of protein (Fa et al. 2003). Often the sole provider

of essential nutrients such as iron and fat (Siren and Machoa 2008; Golden et al. 2011), it plays a critical role in food and nutrition security, directly influencing health and well-being (Fa et al. 2003). Beyond its nutritional value, wild meat consumption also contributes to psychological well-being. Periods of "meat hunger," where access to wild meat is limited, can lead to psychological distress, manifesting as anxiety, fatigue, or even depression (Pagezy 1982; Garine and Pagezy 1990). In southeastern Cameroon, distinct ethnic groups have unique terms to describe this condition: "kbokaku" among the Bangando (Kimura et al. 2012), "zoo" among the Bakwelé (Oishi 2014), and "pene" among the Baka and Bayaka hunter-gatherers (Bahuchet 1992; Brisson 2010).

Wild meat also holds profound cultural and social significance, shaping personal and relational well-being. Hunting skills and experience symbolize prestige, while spiritual and cultural connections to wildlife influence traditions and beliefs. Additionally, social norms surrounding the sharing of wild meat reinforce communal ties both in rural and urban contexts (Van Vliet and Mbazza 2011; Dounias and Ichikawa 2017; Duda et al. 2018). Cultural drivers play an important role in the increasing demand for wild meat in urban areas, as it is perceived by urban people and elites as a sign of prestige and as more tasty, healthy, and nutritious compared to domesticated animals (Van Vliet and Mbazza 2011).

Historically, hunting techniques vary widely among ethnic groups, even within the same region (Fa et al. 2021). In the Ituri Forest of eastern DRC, the Mbuti hunter-gatherers primarily use nets, though they occasionally employ bows for arboreal monkeys and spears for large animals like bush pigs. In contrast, Efe hunter-gatherers rely solely on bows and spears, never using nets (Terashima and Ichikawa 2003). Similarly, Pouvi farmers in central Gabon favor bows with poison arrows, while the nearby Bateké farmers rely on fire and extensive netting (Walters et al. 2015). Traditional hunting is often governed by strict cosmologies, rituals, and taboos, with certain species protected due to spiritual beliefs. For example, the Baka of southeastern Cameroon avoid hunting gorillas, believing them to be reincarnated people. In contrast, Bakwelé farmers refrain from hunting the yellow-backed duiker (*Cephalophus silvicultor*), considering them reincarnated Baka (Oishi 2013).

Enforcement of these rules remains deeply embedded in spiritual beliefs, with sorcery believed to cause illness, bad luck, or even death to violators. Direct punishments, including slavery or death, may also be imposed by the owners of hunting territories (Walters et al. 2015). These traditional practices and specific hunting techniques continue to contribute to sustainable wildlife management in some communities. In urban areas of the Congo Basin, wild meat consumption persists for various reasons, including affordability, taste preference, and social status. Among wealthier urban dwellers, consuming wild meat is often seen as a symbol of prestige and a way to maintain a symbolic connection to the forest (Van Vliet et al. 2015; Ichikawa et al. 2016). However, increasing urban demand, combined with a shift toward more efficient hunting methods such as metallic cable traps and shotgun hunting (e.g., among the Baka in Cameroon, Duda et al. 2018), has fueled unsustainable harvest rates. The erosion of traditional governance systems

and weakened enforcement of customary hunting rules (Walters et al. 2015) have further exacerbated this trend, leading to what is now referred to as the "bushmeat crisis" (Nasi et al. 2008; Ichikawa et al. 2016).

This crisis extends beyond biodiversity loss, threatening the food security and livelihoods of those who depend on wild meat for survival (Fa et al. 2015; Duda et al. 2018). Addressing these challenges requires a balanced approach, considering conservation and local communities' food and income needs, ensuring that wild meat remains a viable and sustainable resource for future generations.

Fisheries and Aquatic Management

Freshwater fish is also an important source of protein, micronutrients, and income for many rural and urban households across the Congo Basin. While some fishing methods are passive, opportunistic, and can be carried out by one person, many others require active collective management of habitats and deep knowledge of hydrological patterns and of fish behavior (Comptour et al. 2016). Examples of habitat management to attract fish include constructing artificial floating prairies and shelters, dams or fish weirs, or digging ponds to trap fish in the dry season (Dounias 2011; Toko et al. 2007; Comptour et al. 2016).

Historically, fishing techniques also varied widely among ethnic groups and locations. In the DRC, for example, the Songola of the Lualaba River used 22 different fishing methods, while the Bwari of northern Lake Tanganyika used 17 different ones (Ankei 1989). Considering collective fishing methods only, the Ntombe of Lake Tumba (also in the DRC) practiced nine different types of these, including some specific to flooded forests, small rivers, larger rivers, lakes, and backwaters of the main river (Pagezy 2006). The Bomitamba of the Lac Télé Community Reserve in the Republic of the Congo still use a wide range of fishing methods, including "kokopa" (the manual drainage of ponds to capture fish historically performed using large raffia baskets held by several men), "mbilo" fishing (the strategic removal of vegetation during the dry season to facilitate the redirection of fish into designated catchment zones during rainy season), "okala" (traps targeting fish, snakes, and crocodiles), "motresse" (large nets), "ndobo" (individual hook-and-line fishing), and "eyika" baskets to trap small-sized fish along shallow banks and small ponds (only used by women) (Beekmann et al. in prep).

Fishing is not just a material practice, it is often rooted in a complex social, symbolic, and ritual construction. In many fishermen societies, waters are inhabited by supernatural forces such as water spirits, and fishermen must deal with these. Water spirits, often human-like, but also shaped like crocodile (*Crocodylus niloticus*) or large snakes, can be good and generous, providing food, good health, and protection to the human beings living around their waters, but they can also be bad and bring misfortune and take pleasure in killing people (Comptour et al. 2016; Pagezy 2006). Traditional fishing is often governed by norms, rituals, and taboos, with certain species being protected due to spiritual beliefs. Taboo fish species may never be consumed among a segment of the population (e.g., pregnant females) or by

all people, and some are used as medicine or in rituals (Ankei 1989). Enforcement of these traditional rules remains deeply embedded in spiritual beliefs, with sorcery believed to cause illness, bad luck, or even death to violators (Comptour et al. 2016; Pagezy 2006). In general, though, there has been a decrease in the practice of collective fishing strategies, driven by increased attractiveness of individual fishing methods with faster and greater economic returns on investment, difficulty of mobilizing lineage members to do collective tasks in sometimes remote locations, pond deterioration, and even fear of engaging with water spirits (Comptour et al. 2016; Pagezy 2006).

As for wild meat, increasing market demand, combined with a shift toward more efficient fishing methods such as small mesh gear (including mosquito nets), has fueled unsustainable harvest rates. The annual economic losses of increased use of small mesh gear (and related harvesting of juvenile individuals) have been estimated at USD 2.1 million for the Lake Tanganyika sardine *Limnothrissa miodon* alone (Mulimbwa et al. 2018). Although historical data on inland fish stocks is limited, it seems that there is an increasing widespread overexploitation of fish resources. A severe decline (65–85%) in multispecies catch and a homogenization (due to some species becoming rare) have been reported by local fishermen in the Kadey River (Cameroon) and the Congo River (DRC) (Castello et al. 2023). Apart from increased use of small mesh gear and poison, destruction of littoral fish habitats by sand and gravel mining, and climatic changes (declining water levels), water pollution related to artisanal mining is also known to reduce fish abundance and diversity in rivers (e.g., in South Kivu province in the DRC, Wasso et al. 2025). The erosion of traditional governance systems and weakened enforcement of customary fishing rules have most likely further exacerbated overfishing and habitat destruction.

Timber and Firewood

Timber, firewood, and charcoal are also important resources for many communities across the Congo Basin, both for household consumption and as a source of cash income. Wood fuel remains the main source of energy for cooking for households, particularly in rural areas. However, this is changing in some urban areas where gas and electricity are available (Schure et al. 2012). Local preferences for timber species vary among ethnic groups, even among those living within the same area. In Mt. Oku in Cameroon, differences in species used for construction between farmers and Fulani pastoralists are driven by the type of houses they build, with the former preferring hard-wood species and the latter *Raphia* spp. (palms) fronds, as these are easier to bend when constructing Fulani's small huts and fences for their animals. For the Fulani, their cattle hold such high cultural value that they do not separate human and livestock plant use (Cuni-Sanchez et al. 2019a). In general, greater cultural differences for timber species than firewood species have been reported (Lhoest et al. 2020; Cuni-Sanchez et al. 2019b). Preferences for wood fuel species are associated with factors such as species distribution, local knowledge, and resource availability. For example, in urban areas with large populations, such as

Kinshasa, a wide variety of species, including fruit trees, are used to meet demand from the hinterland supplying the metropolis (Schure et al. 2011). Wood fuel collection and trade are generally highly gendered, with women and children mainly responsible for collection and retail and men largely involved in charcoal production and wholesale (Ingram et al. 2014).

Several timber species with international commercial value have cultural importance for local communities. Examples include *Erythrophleum suaveolens* in parts of the DRC or *Milicia excelsa* in parts of Cameroon (de Meyer 2023). Sometimes the cultural importance of the species is so high that it prevents the species from being logged (e.g., *Dacryodes edulis*, whose fruits are edible and widely traded, Blaser et al. 2021, see below). However, this is not often the case, and instead, the high timber value overrides other uses, negatively affecting local communities' access to wild foods, medicines, or income opportunities (Blaser et al. 2021). An example of where conflicts occur between multipurpose trees, timber, food, medicinal use, and income is *Baillonella toxisperma* (moabi), prized for its timber as well as its kernel oil.

Non-wood Forest Products

Non-wood forest products are extremely important for many rural communities in the Congo Basin and increasingly important for consumers of these products in urban areas and as income sources for the many, largely unquantified numbers of people engaged in their value chains. They contribute to food security, nutrition, and health and can be an important source of cash income. Some are traded to major urban centers within and among countries, and some are exported regionally and even globally. While most species are harvested from the wild, some species have been semidomesticated by some ethnic groups, including bush mango (*Irvingia gabonensis*), the African plum or "safou" (*Dacryodes edulis*), and kola nuts (*Cola* spp.) (Leakey et al. 2004; Adebola and Morakinyo 2006).

The bush mango produces mango-like fruits, which can be eaten fresh like mangos. However, this species is mostly appreciated for its oil-rich kernels, which are roasted, pounded, and used in several traditional dishes across Central Africa. Pounded paste or cake from bush mango kernels can be stored for over 1 year without spoiling (Gallois et al. 2020). The annual harvest of bush mango nuts in Cameroon is estimated at 4000–6000 t, valued at over 8 million USD, part of which is traded to Nigeria, Gabon, and even the USA and Europe (Ingram and Schure 2010; Ingram et al. 2017). Locally, the kernels of related species are also consumed and traded: While three other *Irvingia* species are used by the Bayaka of the CAR, four more *Irvingia* species and two related genera are also used by the Baka of Cameroon (Bahuchet 1978; Gallois et al. 2020, Fig. 3). Bush mango is also the product that hunter-gatherers exchange the most with nearby farmer groups and is a marker of seasonal calendars (Gallois et al. 2020). It is so important that it is considered a "cultural" keystone species.

Fig. 3 Biocultural interactions by Baka hunter-gatherers expressed through knowledge and use of safou (*Irvingia gabonensis*) and related species. (Source: Gallois et al. 2020)

The African plum or Safou (*Dacryodes edulis*) produces a fatty, butter-like tasting fruit, which is eaten fresh, boiled, or roasted. In Cameroon, the annual trade of 11,000 tons of Safou is worth over USD 7.5 million annually, and over 100 tons are exported to Europe (Tabuna 1999; Awono et al. 2002). Some of its sister species are also widely consumed and traded in some parts of the Congo Basin: ozigo (*D. buettneri*) in Makoukou in Gabon (Yobo et al. 2020) or *D. osika* in Kisangani in the DRC (Termote et al. 2012).

Caffeine-rich kola nuts (*Cola nitida, C. acuminata*) when chewed dispel sleep, thirst, hunger, and fatigue and are very popular among hunters on long hunting trips and drivers, laborers, and students cramming for exams, as well as among Muslims in the drier regions of West Africa during the Ramadan (Adebola and Morakinyo 2006). The seeds are pounded to make energetic drinks, and in many ethnic groups, they are offered to guests as a symbol of hospitality. Bitter kola (*Garcinia kola*) seeds, used as a stimulant, aphrodisiac, and digestive aid, are also culturally important for some ethnic groups, which use them as gifts to receive visitors, and in traditional weddings and ritual naming (Adebisi 2004). The annual production of *G. kola* nuts in Cameroon is estimated at 50 tons or about USD 660,000 (Awono et al. 2016; Maňourová et al. 2019). In this country, while ethnic groups from the savanna zone mainly harvest its nuts, ethnic groups from the forest zone mainly

collect bark and roots, and the uses differ between farmers (Fang and Bassa) and hunter-gatherers (Baka) (Yogom et al. 2020).

Beyond wild fruits and nuts, wild leafy vegetables, wild species, medicinal plants, mushrooms, and edible caterpillars are also of key economic importance. The bark of the African Cherry (*Prunus africana*)—which has multiple medicinal uses, including treating benign prostatic hypertrophy—has a long history of international trade. Over 3000 t were exported annually from Cameroon alone in the past, with a retail value of over USD 18 million (Cunningham et al. 2016). The leaves of *Gnetum africanum*, a vine consumed as a vegetable, are also widely traded in the Congo Basin, with over 2500 people working in the value chain in Cameroon and Nigeria (Ingram et al. 2012).

Many of these highly valued non-wood forest products providing species have multiple uses, and some also have timber value. In Gabon, a 2009 Forestry Decree banned the logging of five of such species (bush mango or *Irvingia gabonensis*, ozigo or *Dacryodes buettneri*, *Poga olesosa*, *Tieghemella africana*, and moabi or *Baillonella toxisperma*), to ensure local communities' access to such resources in logging concessions (Iponga et al. 2018). Some authors, though, argue that other important species with high timber value should have been included, such as the Gabon hazelnut (*Coula edulis*). The importance of considering the impacts of logging caterpillar-hosting species such as sapelli (*Entandrophragma cylindricum*) and tali (*Erythrophleum ivorense*) has also been highlighted (Muvatsi et al. 2018). Indeed, for the Bayaka hunter-gatherers, harvesting caterpillars is so important that it has its own season called "*Kongo*" in their annual seasonal calendars, even for sedentarized groups (Boyette et al. 2022).

The increasing demand for both timber and non-wood forest products, like bush mango kernels, in urban centers in and outside Africa, leads to unsustainable gathering methods, such as felling trees laden with ripe fruit (Ingram et al. 2017). As for hunting and fishing, market demand, low levels of law enforcement, and a lack of other income generating alternatives may drive local communities to over-exploit their non-timber forest resources, while simultaneously impoverishing their diets and negatively affecting their livelihoods (Ingram et al. 2017; Gallois et al. 2020).

Governance and Policymaking

Reflecting the ecological and cultural diversity of these ecosystems, there is a diversity of governance arrangements and policies that regulate access not only to land and natural resources, but also the markets for products and services. Laws and regulations govern many of the ecosystems and their most well-known products (such as timber), on paper, but the capacity, ability, and willingness of governments to implement and enforce laws on resource exploitation have been shown to be often ineffective. This is particularly the case for non-timber products, charcoal, and wild meat and recently created ecosystem service markets such as carbon and intellectual property (Brandt 2014; Piabuo et al. 2021; Schure et al. 2015; Mavah et al. 2022).

Unevenly applied and top-down, unilaterally international agreements such as FLEGT (Tegegne et al. 2022; Trefon, 2017; Nago and Ongolo 2021) and the EU Deforestation Regulation (McDermott et al. 2024) have also been difficult to apply in the Congo Basin.

In many rural areas of the Congo Basin, traditional (or customary) authorities still have significant influence over land tenure and govern access to ecosystem products, for example, by who, when, and where specific resources can be harvested (Ingram 2017; Majambu et al. 2019). Cultural norms such as taboos and prohibitions also play a major role in limiting access, although these are changing, especially for resources which have high economic values (such as wild meat) and near urban markets (Tegegne et al. 2022; Ingram 2017; Assembe-Mvondo 2009). In the past decades, new institutions have been created to govern particular ecosystems or resources, led by project-related civil society organizations and enterprises. These increasingly take on roles traditionally reserved for governments. Projects and programs have created short- and longer-term rules, standards, and practices governing landscapes, resources, and products (Ingram 2017). They are generally conceived and implemented by nongovernment organizations and donor organizations, sometimes in partnership with the private sector, and often alongside market-based institutions using value chain approaches such as Forest Stewardship Council and Rainforest Alliance certification (Cerutti et al. 2017; Ingram 2017) and payments for ecosystem services, such as REDD+ and carbon credits (Reyniers 2021; Molua 2023). Project and market-based governance arrangements generally create multiple, layered, plural governance arrangements that intersect with statutory forest, agriculture, land use, and trade regulations, with both positive and negative social, economic, and ecological impacts.

Corruption is persistent and prevalent and forms a parallel, shadow arrangement alongside statutory laws and market-based arrangements in the timber (Gan et al. 2016; Assembe-Mvondo and Kan 2022; Trefon 2010; Piabuo et al. 2021), non-timber, and charcoal value chains (Tieghouong et al. 2015; Ingram 2017; Schure et al. 2015). It should be noted that often actors with little voice in formal governance arrangements (such as communities, informal, and small businesses) create their own messy, "bricolaged" governance arrangements, such as for timber and charcoal (Ingram 2017; Schure et al. 2015; Karsenty 2019). Governance based on "exclusiveness" (i.e., where other actors are excluded from accessing resources and markets—such as in kola nut and *Raffia* spp. value chains) can lead to sustainable forest value chains and livelihoods in the long term (Ingram 2017) but exclusivity is often perceived as contrary to development rhetorics about inclusion (Mavah et al. 2022; Ingram 2015).

The different governance arrangements and combinations affect the livelihoods of those involved in the market value chains, from harvesters to consumers, as well as the ecosystems where products are harvested and their sustainability, in different ways, both positively and negatively (Ingram 2017; Cerutti et al., 2017). Governing ecosystems—increasingly seen from an economic perspective and termed "bioeconomy"—is also challenged by actor fragmentation, limited organization among value chain actors, and the absence or overlap of responsibilities, policies, and institutions.

Conclusions and Recommendations

The many interconnections between cultural and biological diversity, with ethnic groups' and individuals' worldviews and identities being strongly bound to land and natural resources, indicate that the legal recognition of their rights to access and govern land and resources and their voice in social and environmental policies is essential. Despite the legal frameworks outlined in chapter ▶ "Dimensions of Conservation Areas and Other Land Uses", more statutory acknowledgement of customary rights to land and resources could be transformative in promoting local governance—particularly for specific ethnic groups, whose traditions, views, and practices, such as nomadism and forest dwelling, are not considered in current legal frameworks.

The strong links between language and biodiversity are important but threatened by the erosion of traditional knowledge and use of languages, suggesting that policies and practices documenting and promoting the use of local languages to allow their associated rich meanings regarding biodiversity to be more widely understood are needed.

The multifaceted ways that biodiversity diversity supports agriculture, agroforestry, fishing, hunting, timber, and non-wood product–based livelihoods indicate that documenting, preserving, disseminating, and celebrating these links are critical, alongside stronger good governance through statutory, customary, and voluntary market-based arrangements. As ethnic groups and languages traverse administrative borders, as do trade and knowledge flows, regional policies are recommended, particularly when they are well embedded and effectively implemented nationally.

Competing Interest Declaration The author(s) has no competing interests to declare that are relevant to the content of this manuscript.

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