AFRICA KNOWLEDGE PLATFORM

Carbon storage in Africa

Nature-based climate solutions should look beyond forests for opportunities in open ecosystems

European Commission

Global efforts to mitigate climate change are embracing nature-based solutions. Although forest restoration is a promising way to store carbon, it should not distract policymakers from opportunities in non-forested ecosystems. This story describes how land-use decisions can enhance carbon storage in open savannas, grasslands, and shrublands.

Averting a climate emergency

In August 2021, the Intergovernmental Panel on Climate Change (IPCC) released its sixth Assessment Report . Its findings were unequivocal:

"human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred."

Mitigating climate change is more urgent than ever. One prominent solution is to use nature to mitigate the greenhouse effect.

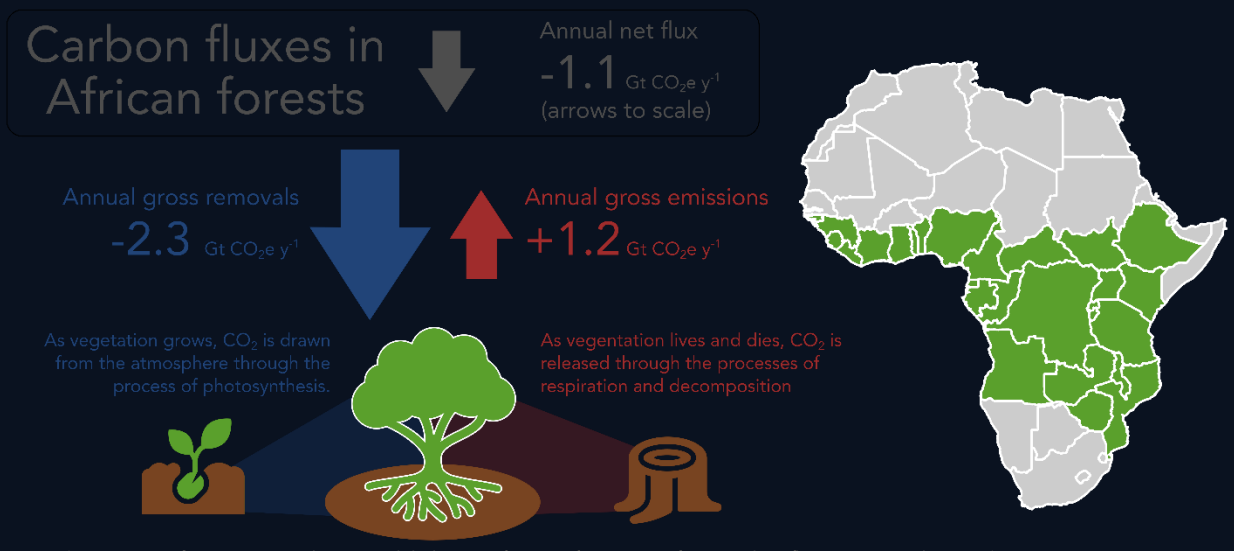
Nature's potential

Carbon sequestration is the net rate at which carbon is removed from the atmosphere. It is measured as a time-dependent **carbon flux**, which is the difference between gross carbon removals and emissions.

African forests, which are predominantly in equatorial countries, **are currently carbon sinks**. On balance, these **forests remove about 1.1 Gigatonnes of Carbon Dioxide from the atmosphere annually**.

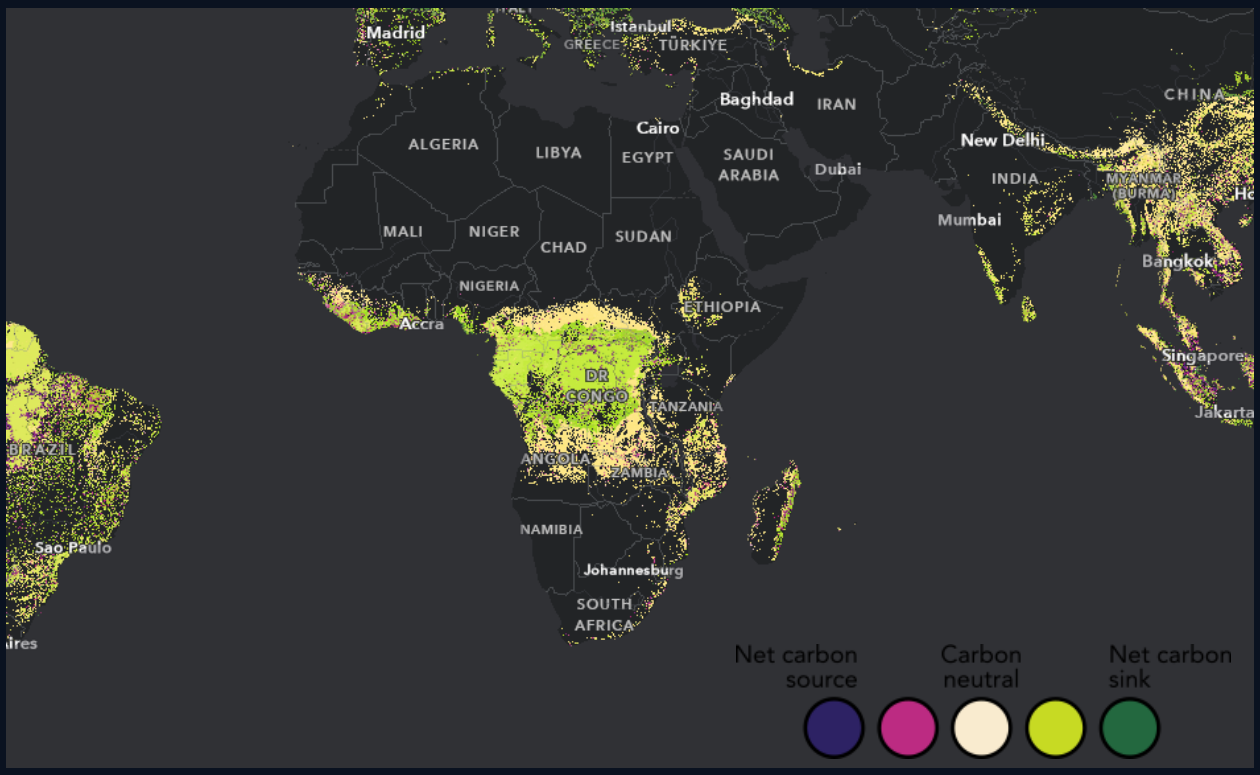
This is roughly equivalent to 20% of annual European carbon emissions or 75% of African carbon emissions (estimates from 2019 , prior to Covid-19).

All this carbon needs to be kept somewhere. **Carbon storage** is the amount of carbon that is locked up in a biological reservoir, whether as live biomass or other forms of organic matter. It is measured as **carbon stocks**.

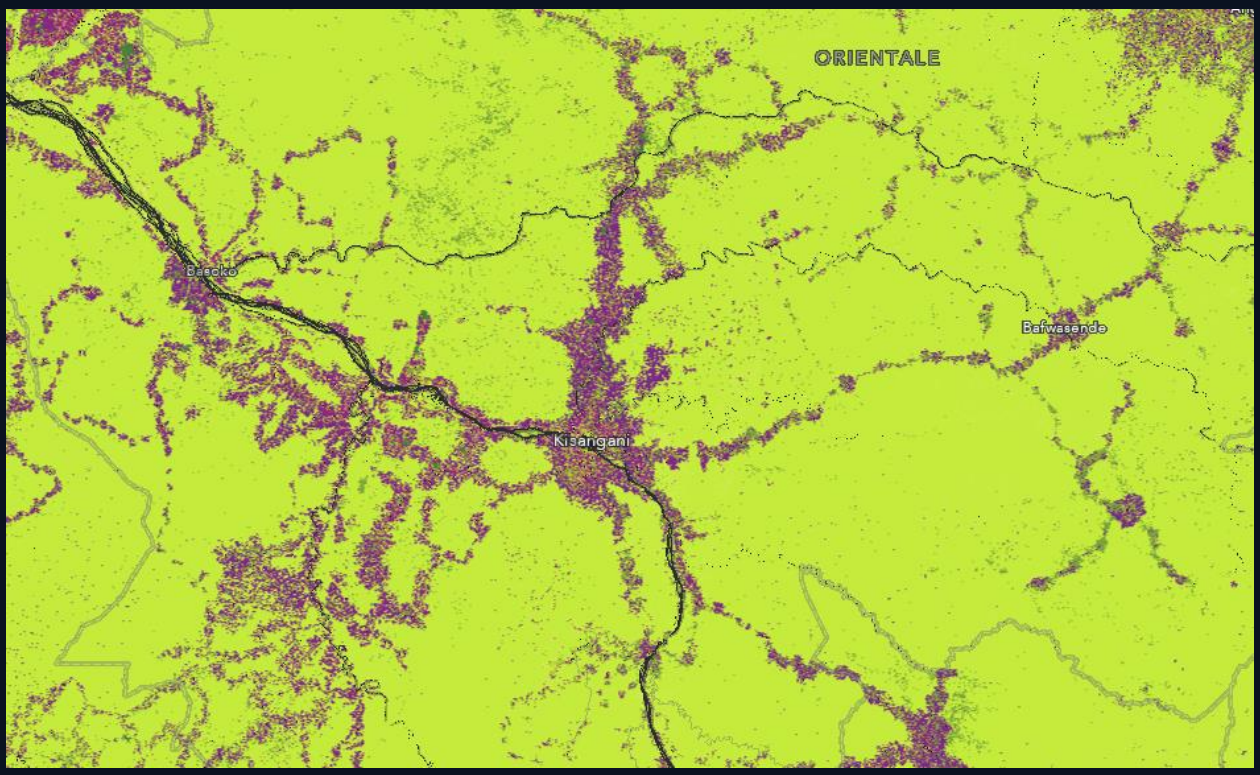


Flux estimates from: Harris et al. (2021) Global maps of twenty-first century forest carbon fluxes. Nature Climate Change, 11, 234-240.

The below map shows the **net flux of carbon sequestration for the world's forests**.



Most forests are carbon sinks, but areas with high rates of deforestation can turn into carbon sources.



The city of Kisangani in the Democratic Republic of Congo (DRC) is depicted in the above picture. This city is the second largest port in the DRC and is the furthest inland navigable point in the Congo River.

Kisangani's economy was built on timber, coffee, rubber, and cotton production. Decades of forest transformation has meant that the area around Kisangani has **switched from a carbon sink to a carbon source**.

Improving carbon sinks

There **are multiple policy options available to reverse the effects of forest transformation**. These improvements can return forest carbon sources, like those around Kisangani, to carbon sinks.

The Intergovernmental Science Policy Platform for Biodiversity and Ecosystem Services (IPBES) recently collaborated with the IPCC to produce a joint workshop report on biodiversity and climate change .

This infographic from the joint report shows how the **sustainable management and restoration of forests and their soils** can mitigate climate change, benefit people, and improve biodiversity.

Based on this potential, the Convention on Biological Diversity includes nature-based solutions in the 1st draft of the post-2020 Global Biodiversity Framework (GBF). Target 8 of the GBF aims to:

"...contribute to mitigation and adaptation through ecosystem-based approaches, contributing at least 10GtCO2-equivalents per year to global mitigation efforts..."

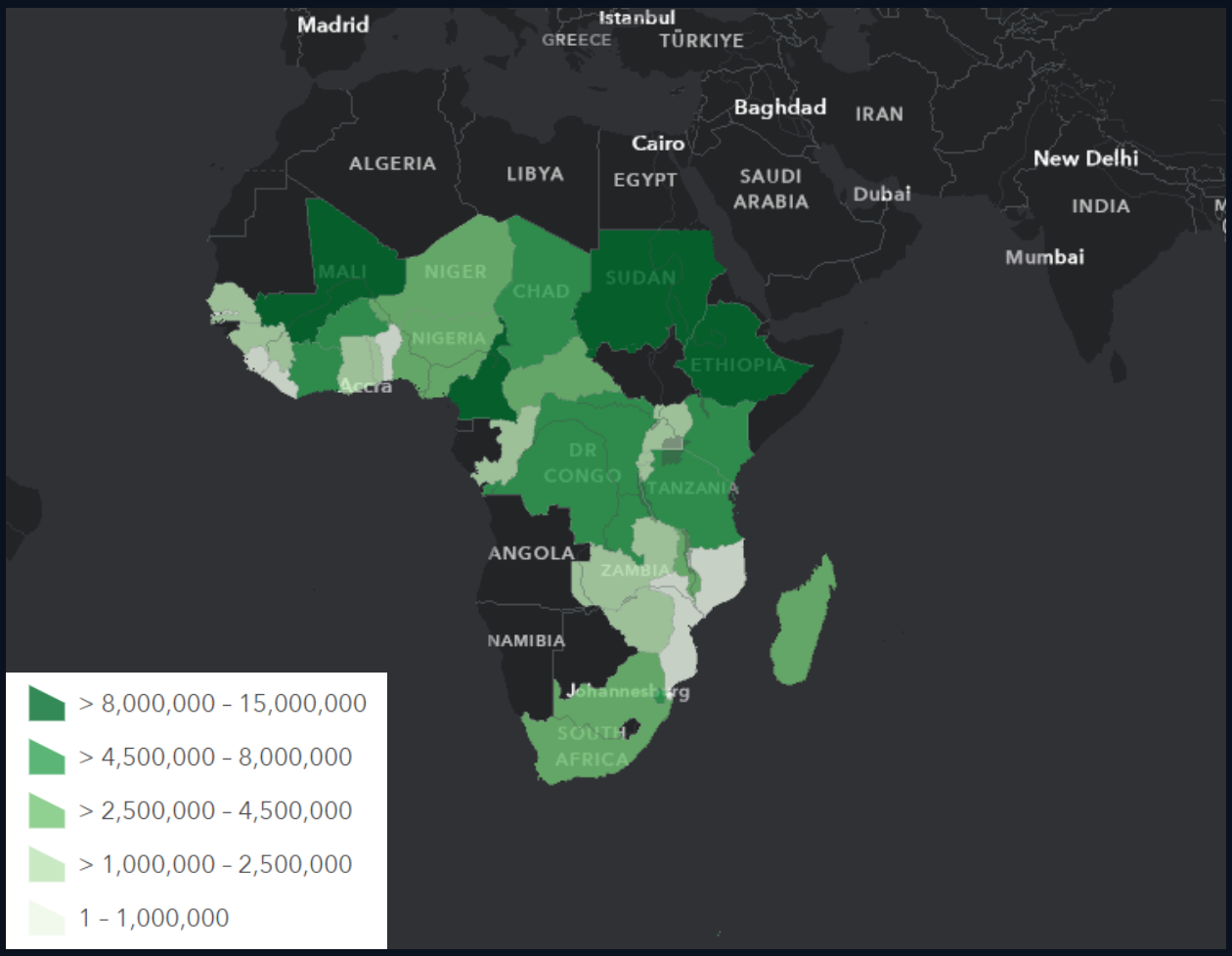
Table 3 1 Effects on biodiversity of selected (example) global climate mitigation and adaptation practices based on land and ocean management.

Practice	Summary/synopsis of overall expected impact	Mitigation potential	Adaptation potential (estimated number of people more resilient to climate change from intervention)	Biodiversity impact (positive unless otherwise stated)
A Land				
Reforestation and forest restoration		1.5-10.1 Gt CO_2e a^{-1}	> 25 million people	High
Afforestation		See —Reforestation	Unclear	Negative/low positive[3]
Reduced deforestation and degradation		0.4-5.8 Gt CO_2e a^{-1}	1-25 million people	High
Agroforestry		0.1-5.7 Gt CO_2e a^{-1}	2300 million people	High
Improved and sustainable forest management		0.4-2.1 Gt CO_2e a^{-1}	> 25 million people	High

Mitigation potential · Adaptation potential · Possible adaptation potential · Negative impacts on biodiversity · Positive impacts on biodiversity

Thirty African countries have joined the Bonn Challenge, a global initiative to restore degraded and deforested landscapes by 2030. Through the African Forest Landscape Restoration Initiative, these countries aim to **restore 100 million hectares of land by 2030**.

The below map shows countries' **commitments under the African Forest Landscape Restoration Initiative**. Deeper shades of green correspond to larger area commitments, notably in countries like Cameroon, Mali, Sudan and Ethiopia.



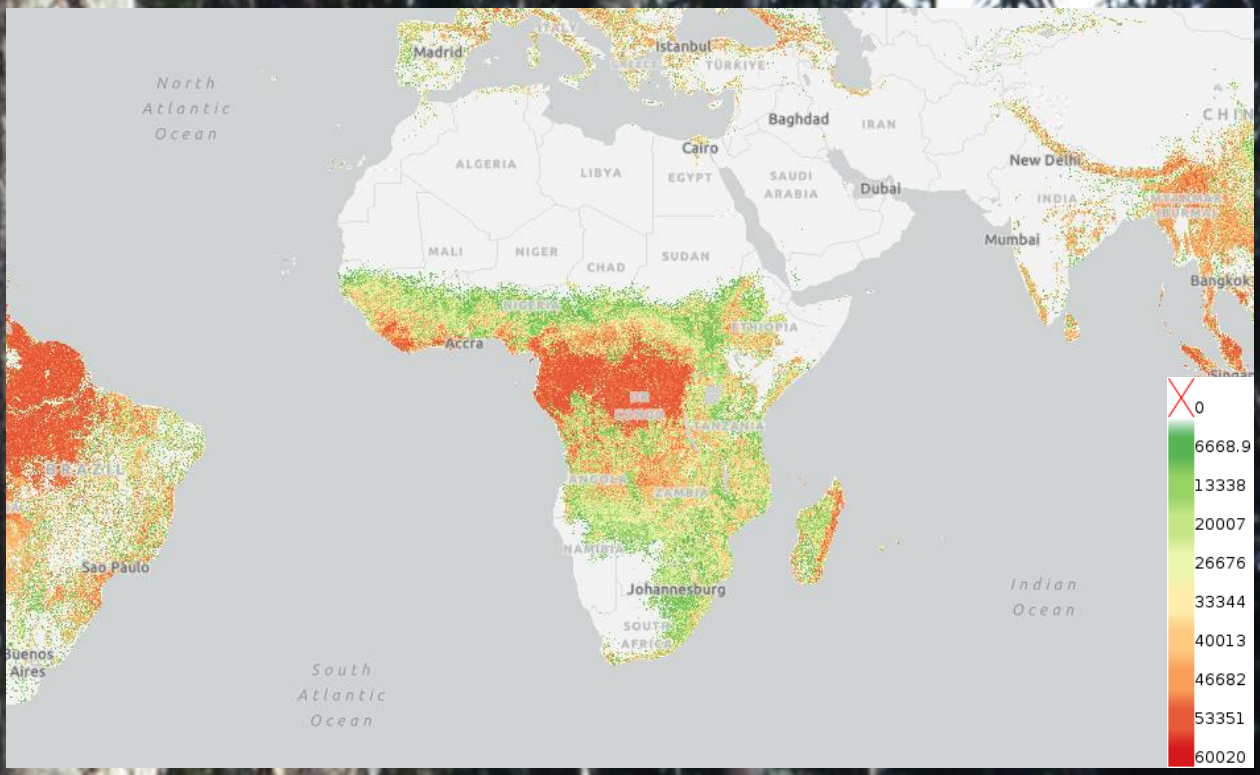
Forests as carbon stores

African forests are one of the biggest carbon stores in the world.

This map shows the **carbon stored in above-ground biomass** (tonnes of carbon per km^2) for the vegetated parts of the world. Red shades reflect higher levels of carbon, while green represents lower levels of carbon. (Data from the GlobBiomass project funded by the European Space Agency)

The forests of **central Africa store more than 50,000 tonnes of carbon per km^2**. If these forests were to be lost, this carbon could enter the atmosphere and contribute to the greenhouse effect.

It is in the whole **world's best interest that Africa's forests remain intact**. Uncontrolled forest transformation would release carbon stored as biomass, turning these ecosystems into carbon sources.



The Central Africa Forest Initiative (CAFI) was established to ensure that carbon remains stored in Africa's forests.

Central African countries develop national investment frameworks aimed at addressing all drivers of deforestation and forest degradation. Once approved, these **investment frameworks receive support from CAFI through policy reforms and large-scale projects**.

CAFI is funded by the European Commission (along with four other European states), which supports African states with projects related to agriculture, energy, land-use and governance. In return, the African states implement sustainable initiatives that retain carbon as forest biomass.

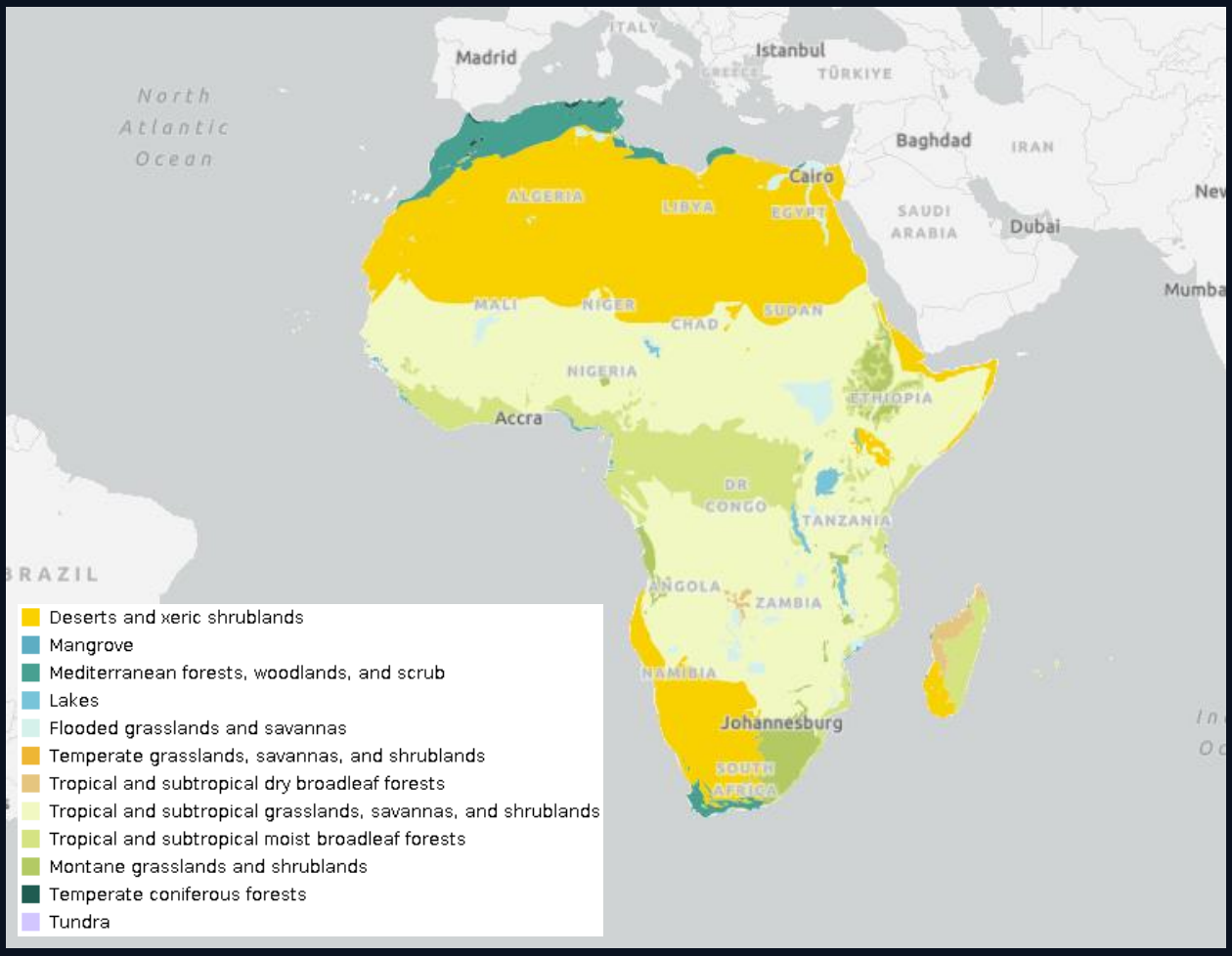
Opportunities beyond forests

Given the success of CAFI, it is tempting to implement similar initiatives across the rest of the continent.

However, most of Africa is not covered by forest.

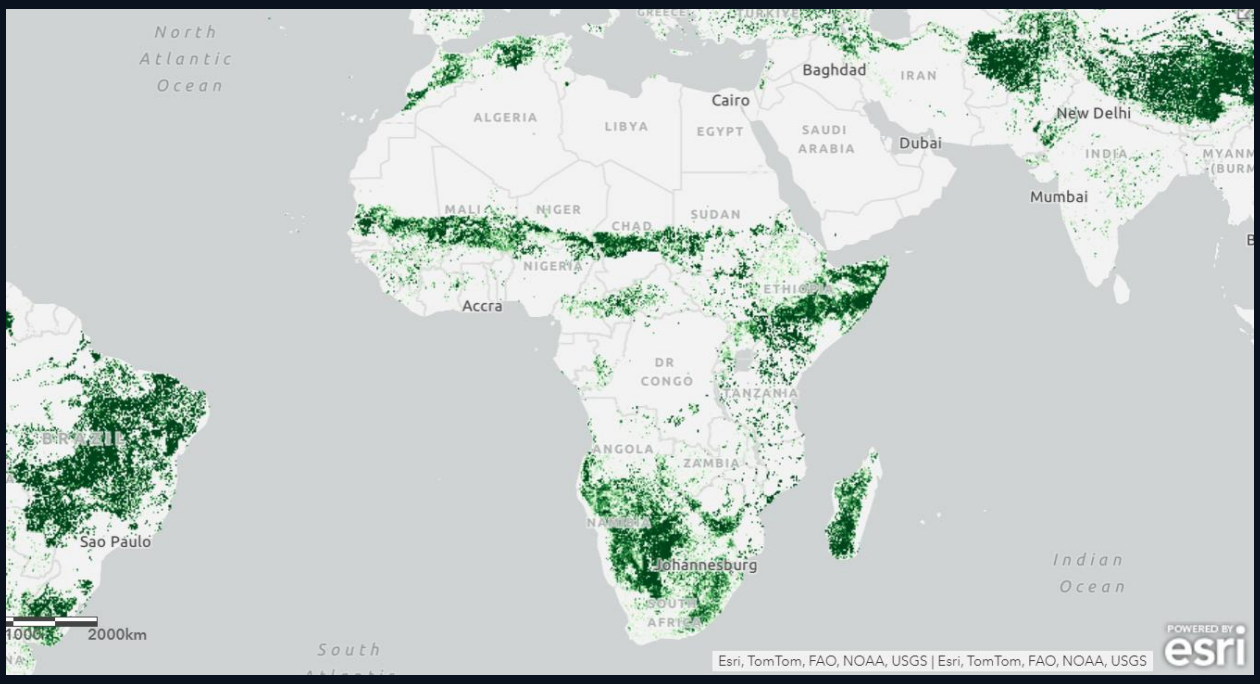
This map shows the biomes of Africa. Forested areas are limited to the equatorial zone of central Africa and the Atlantic coast of West Africa. The rest of the continent is predominately open grasslands, savannas, and dry shrublands.

Maximising the natural storage of carbon requires efforts beyond forest ecosystems.



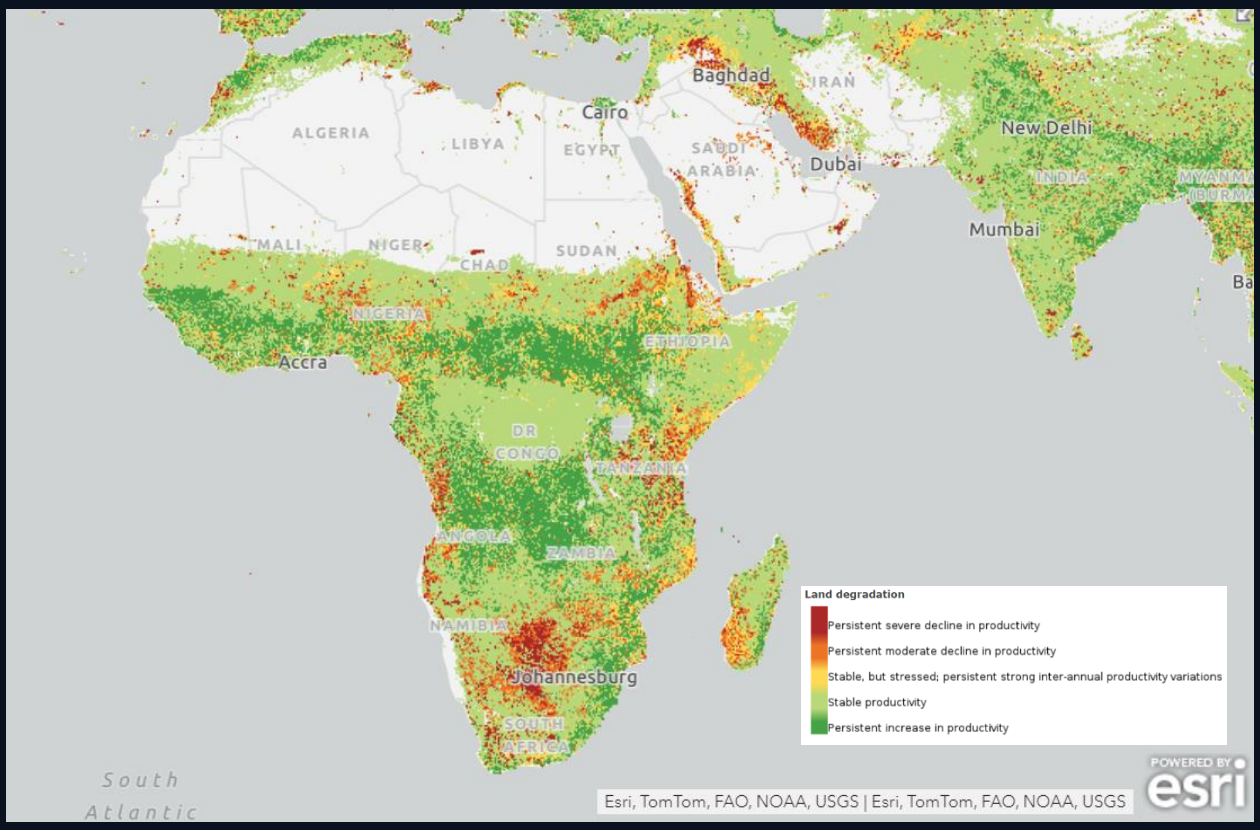
The below map shows the rangelands of the world. **These open ecosystems supply vital ecosystems services, which support the livelihoods of millions of people**. One example of such an ecosystem service is grazing for livestock. Press this button to see how livestock densities are closely related to rangelands (data from the FAO).

Cattle densities coincide with rangelands. Using the same approaches of forest restoration in these open ecosystems will jeopardise the livelihoods that depend on ecosystem services, like grazing.



The below map - from the World Atlas of Desertification - shows how **much of the degraded land in Africa occurs in open ecosystems**. The orange-to-red shades show terrestrial vegetation that is currently in a stressed or declining condition.

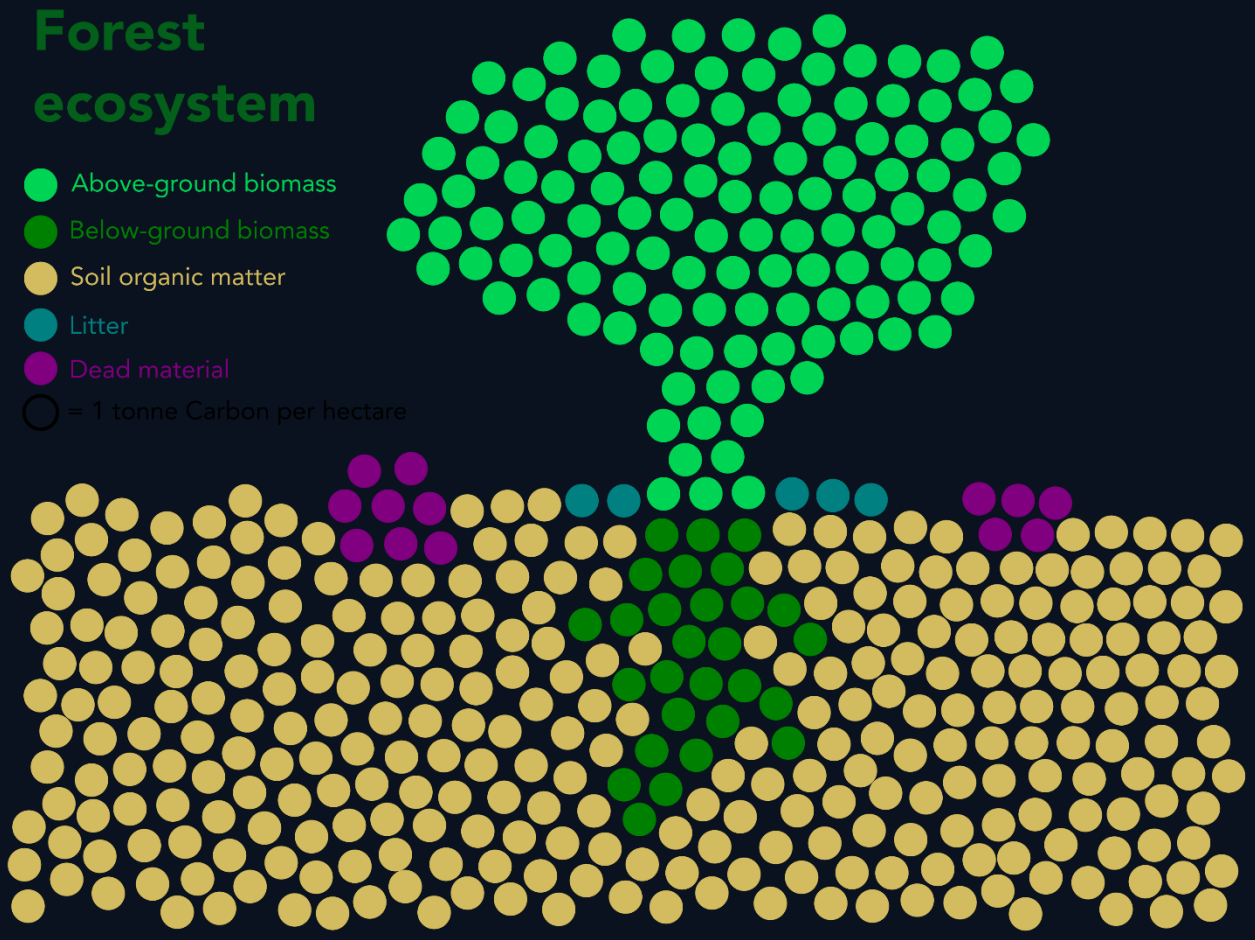
This highlights an important challenge for ecological restoration in Africa: **how can degraded land in open ecosystems be prioritised and restored in a way that contributes to carbon storage and climate mitigation?**



Carbon in open ecosystems

Where is the carbon in open ecosystems?

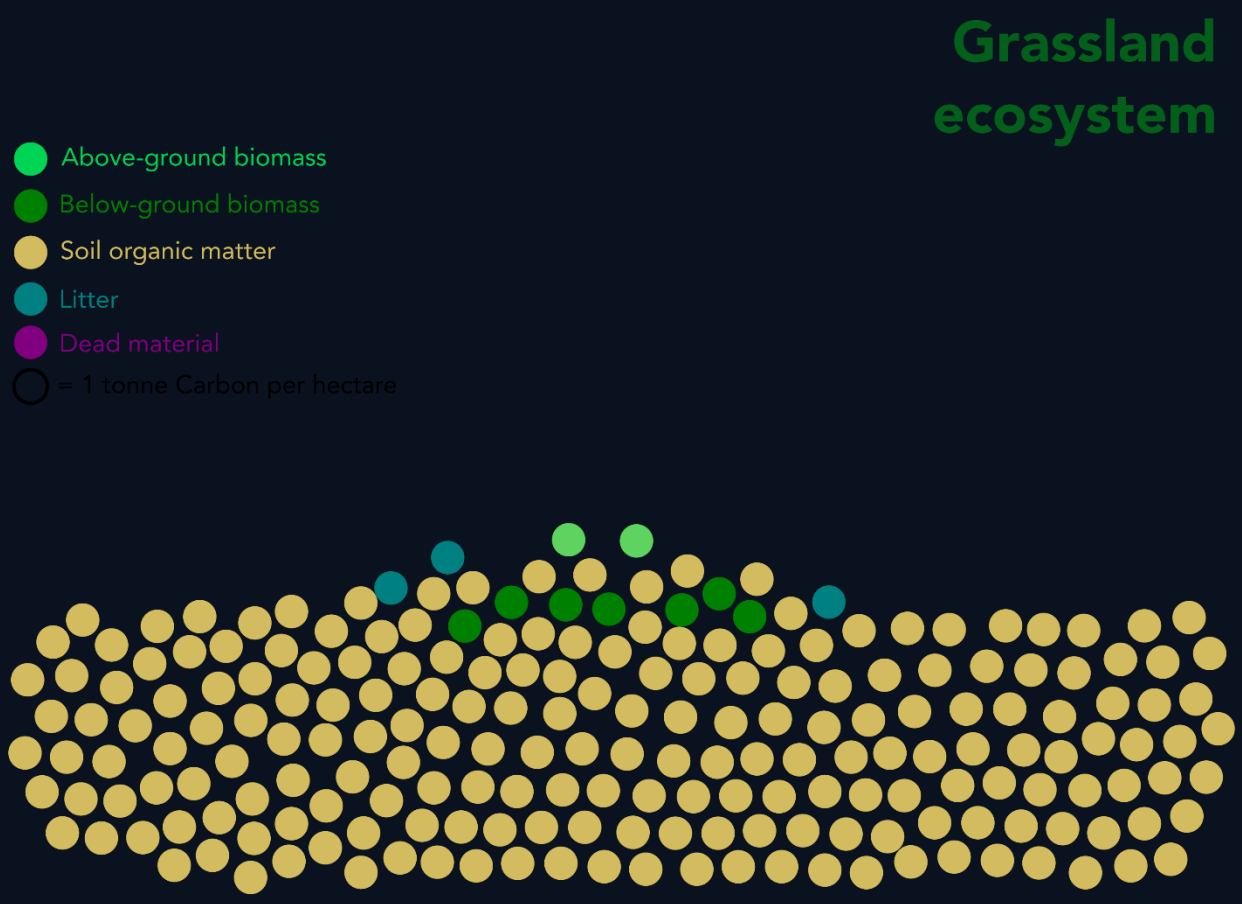
Walking through a forest, it seems obvious where carbon is being stored. The towering tree trunks and foliage are dense enough to block out the sun. But this biomass only tells part of the full story.



This infographic shows the sources of carbon in forest ecosystems. Each circle represent 1 tonne of carbon per hectare, and the different colours show the 5 biggest stores of carbon:

- **Above-ground biomass**: the stems, branches and leaves we can see when we look at a forest.
- **Below-ground biomass**: the vast network of roots that anchor trees in the landscape.
- **Soil organic matter**: active (decomposing organic matter) and stable (humus) biological material in soil, as well as soil organisms.
- **Litter**: the collection of leaves that have fallen to the forest surface.
- **Dead material**: stumps, logs and fallen trees that have yet to decompose.

Although the visible part of forests store considerable amounts of carbon, most of the carbon is stored below the soil surface. For this reason, sustainable soil management practices must be considered to preserve existing stocks from land degradation and to increase the rate of carbon sequestration in soil.



Even though open ecosystems lack the lush vegetation of forests, they still store large amounts of carbon.

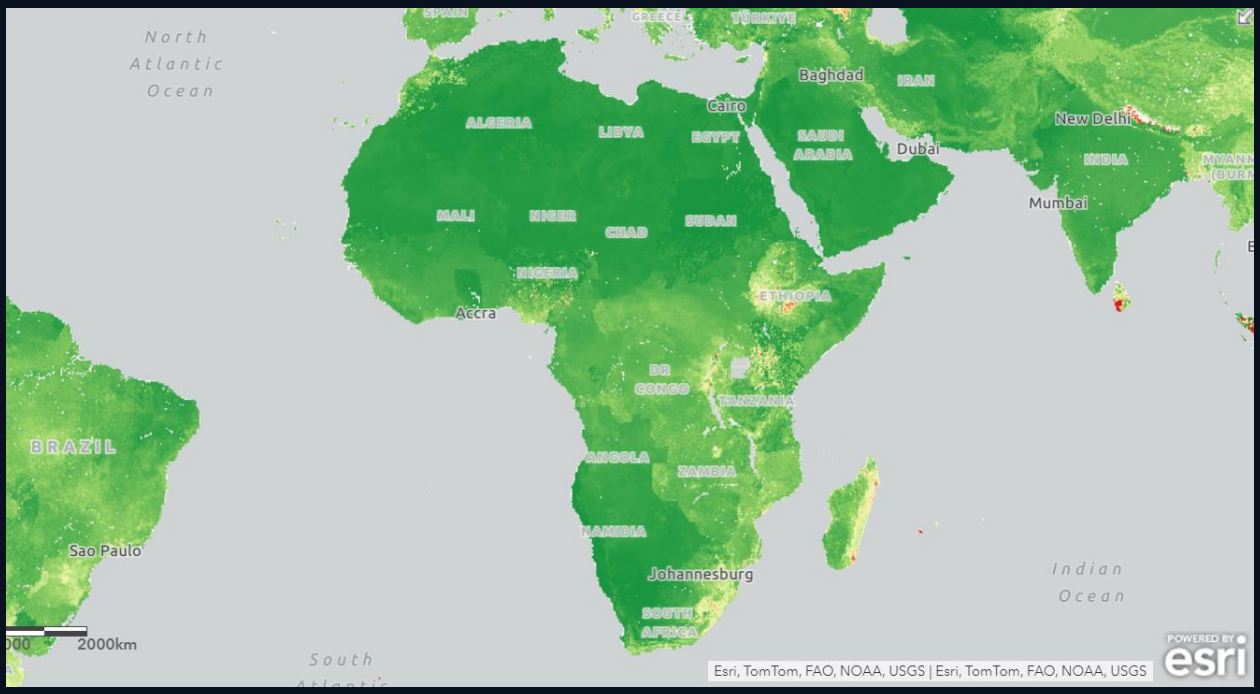
It's true that forest trees store 100 times more carbon as above-ground biomass than the same area of grassland. However, **most of the carbon in open ecosystems is stored underground as soil organic matter**.

To be precise, despite their barren appearance, **grassland soils can store 75% as much carbon as the same area of forest**. Once we add up the other benefits people gain from grasslands - like grazing, ecotourism and water supply - it becomes clear that open ecosystems have significant value for climate action.

Source: Data compiled from IPCC Guidelines for National Greenhouse Gas Inventories and Anderson-Teixiera & DeLucia (2010) Global Change Biology

Mapping soil carbon

Soil holds the secret to storing carbon in open ecosystems. **This map shows the soil organic carbon in the top 30cm of soil** (data from the FAO Global Soil Partnership).



Compared to carbon in above-ground biomass, differences in soil carbon stocks across the biomes are much less prominent. In tropical forests, soil organic matter decomposes rapidly and is taken up quickly by growing vegetation. In comparison, grassland soils can have deep organic-rich horizons. Wetland soils are particularly good at storing carbon.

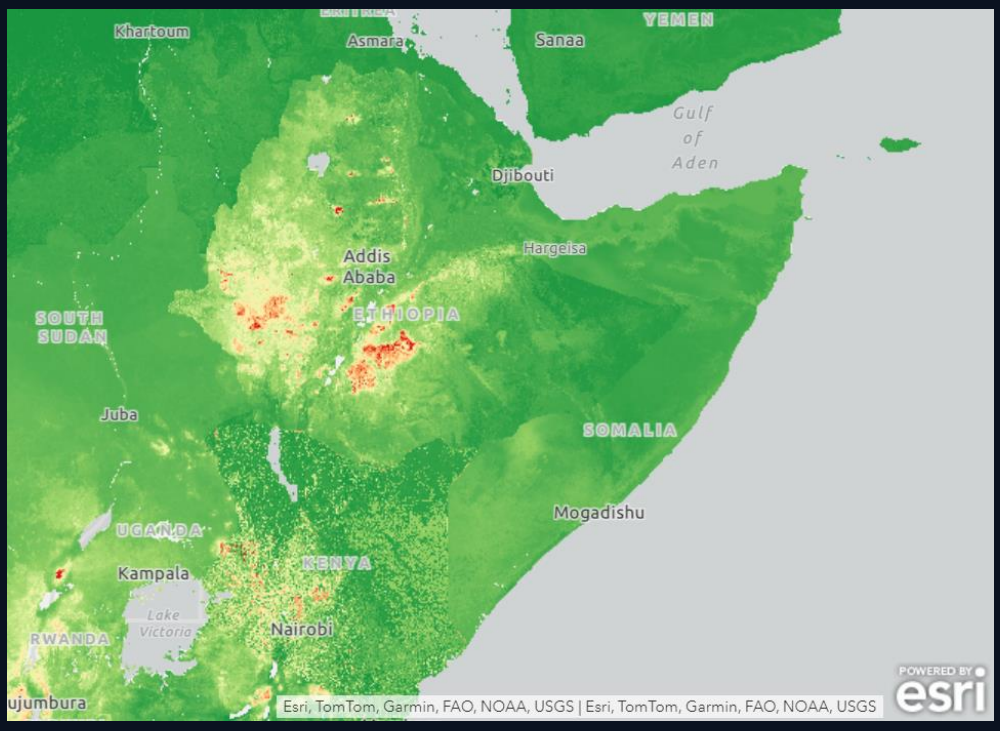
In Africa, high lying areas with complex topography often have high soil carbon. These areas typically have cooler climates, which slows down the decomposition rate of soil organic carbon. The steep slopes, however, make these areas susceptible to soil erosion.

Ethiopian Highlands

The high lying areas of Ethiopia contain high levels of clay soils that shrink and swell during dry-wet rain cycles. These soil properties, when combined with unsustainable agricultural practices, may explain why Ethiopia is among the African countries most affected by soil erosion.

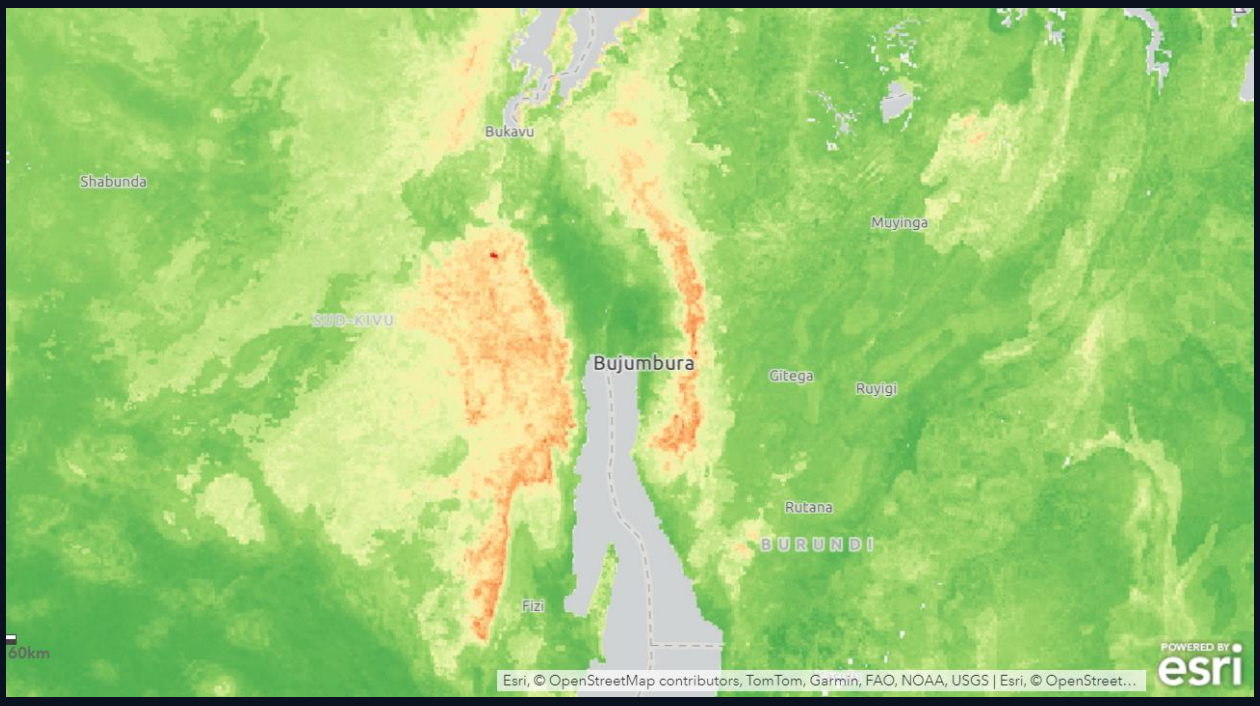
In an effort to curb land degradation in Ethiopia, the European Union co-funds the Support to Responsible Agricultural Investments II (S2RAI II) in Ethiopia Project. This project has several aims, one of which is engaging with civil society organisations on **issues of land rehabilitation and the prevention of soil erosion**.

The Ethiopian Highlands are under pressure from livestock grazing



East African Rift Valley

The Rift Valley in East Africa contains soils from volcanic deposits, which are among some of the most fertile in Africa. Fertile soils, once coupled with widespread food insecurity, are likely to experience growing pressure from agriculture in the near-term.

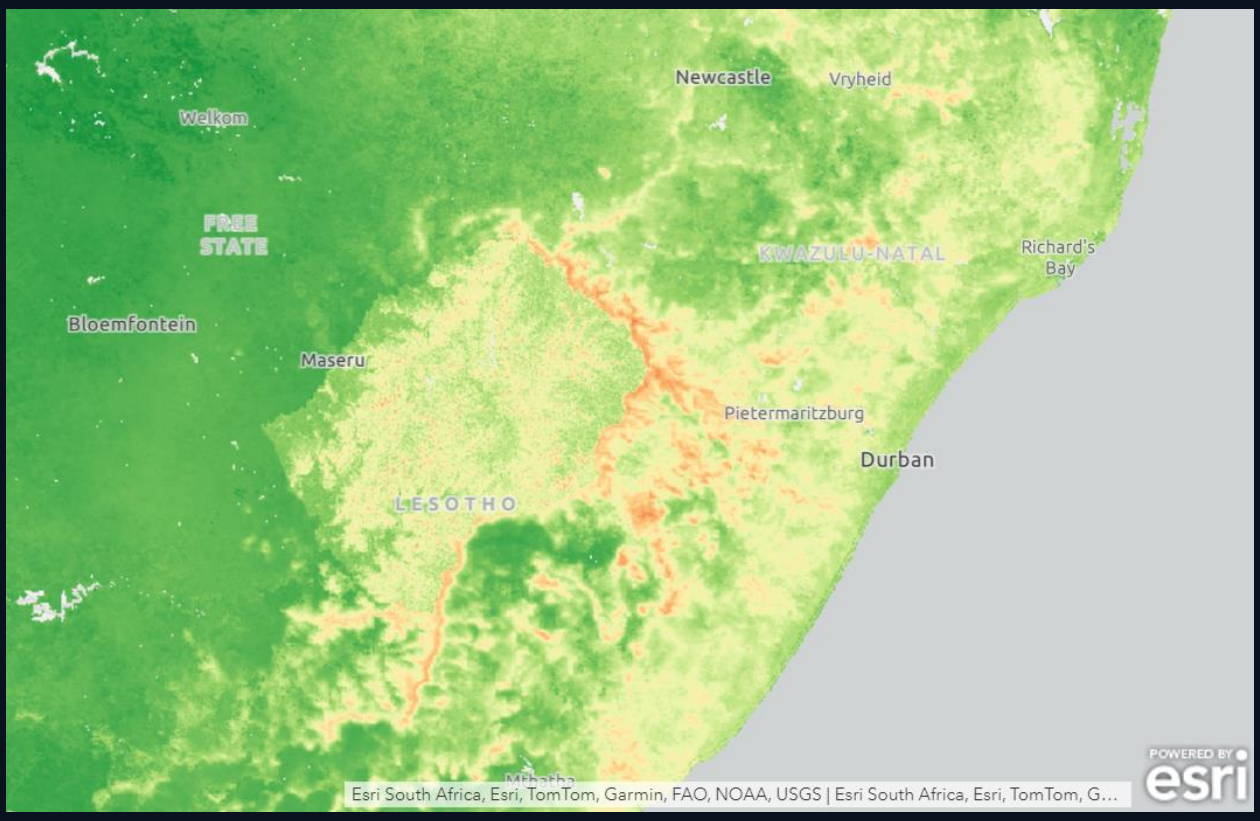


The Africa-Europe Agenda for Rural Transformation prioritises the further development of assessment tools to quantify the **climate impacts of investments in the African agri-food sector**. This will ensure that interventions to enhance food security do not inadvertently erode future climate resilience.

A typical Rift Valley landscape in Banga, Burundi

South African Drakensberg

The high altitude soils of the Drakensberg Mountains are effective carbon sinks. However, overgrazing and poor land management can turn these soils into carbon sources.

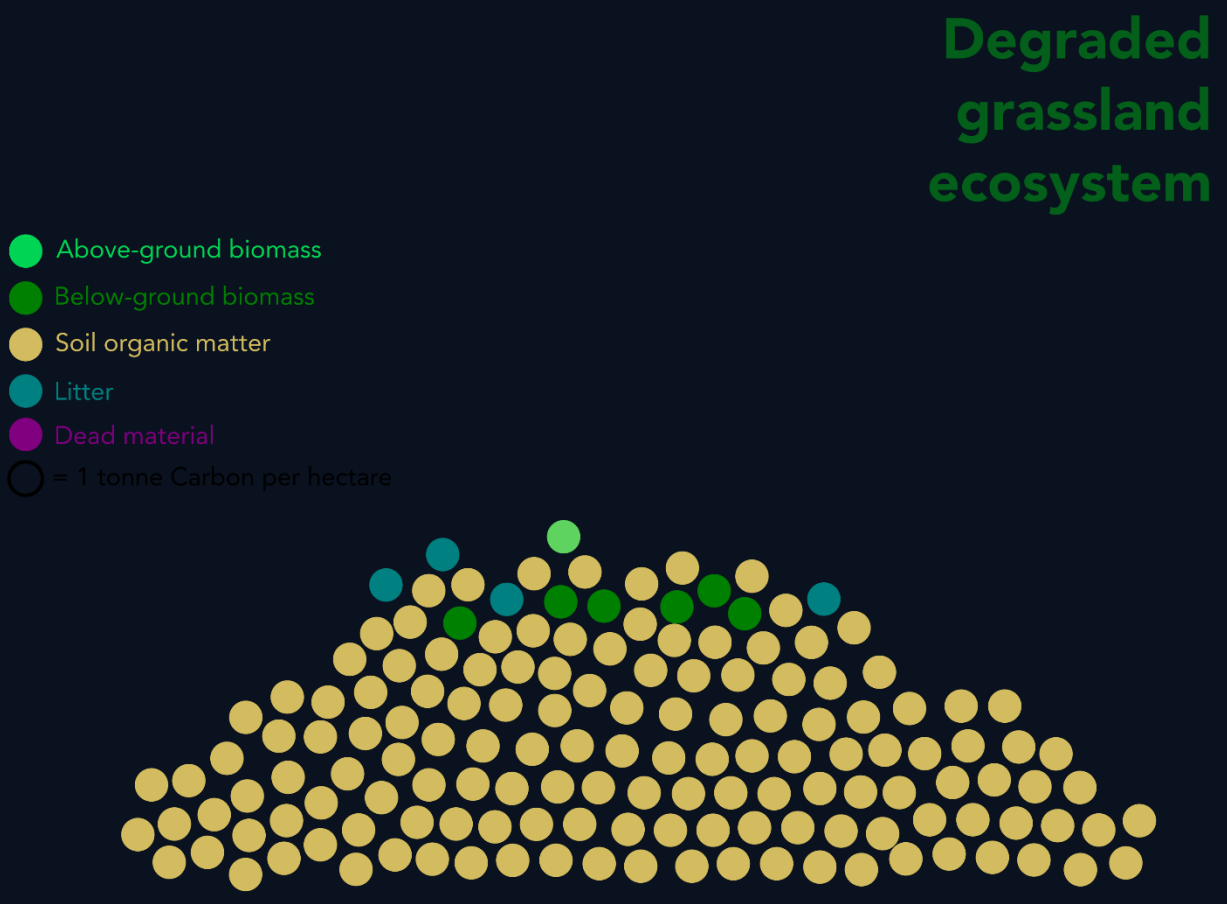


The European Union recently funded a pilot study for the United Nations System for Environmental Economic Accounting . This study showed how targeted restoration in the Thukela catchment, which has its source in the Drakensberg, could **improve carbon storage by 2.5% by 2030**.

Drakensberg Mountains, South Africa

Enhancing African soils

Soil degradation reduces the carbon storage capacity in open landscapes. **Heavy degradation can reduce soil organic carbon by 30% compared to natural baselines.**



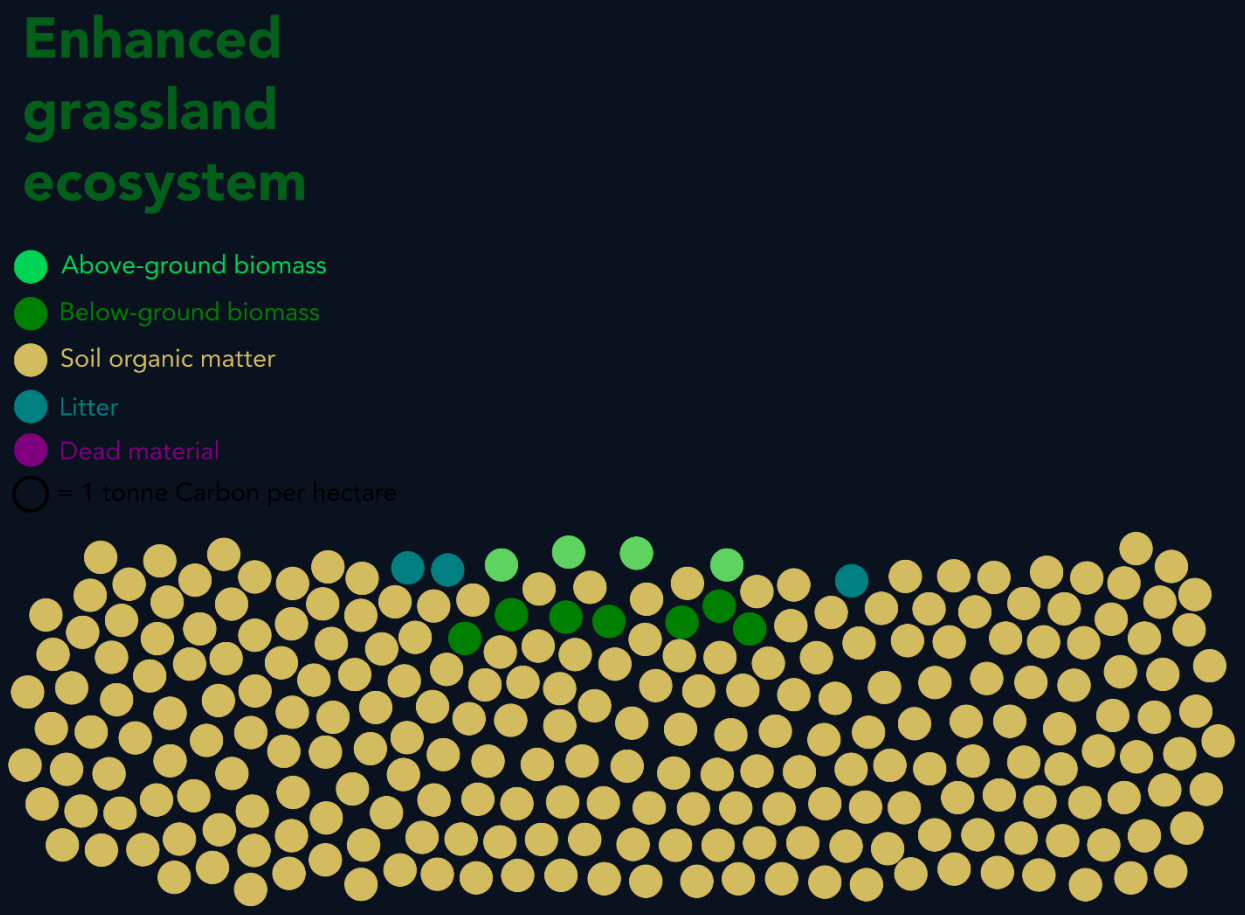
Data compiled from IPCC Guidelines for National Greenhouse Gas Inventories

Intense soil degradation like in this picture can be caused by:

- Drought
- Chronic overgrazing
- Poor cultivation practices
- Inadequate fire management

The removal of vegetation destabilises the soil and makes it vulnerable to erosion by wind or heavy rainfall.

By contrast, good land management can enhance soil organic carbon by 17% above natural baselines. This means that **effective restoration of degraded rangelands can improve carbon storage by 47%!**



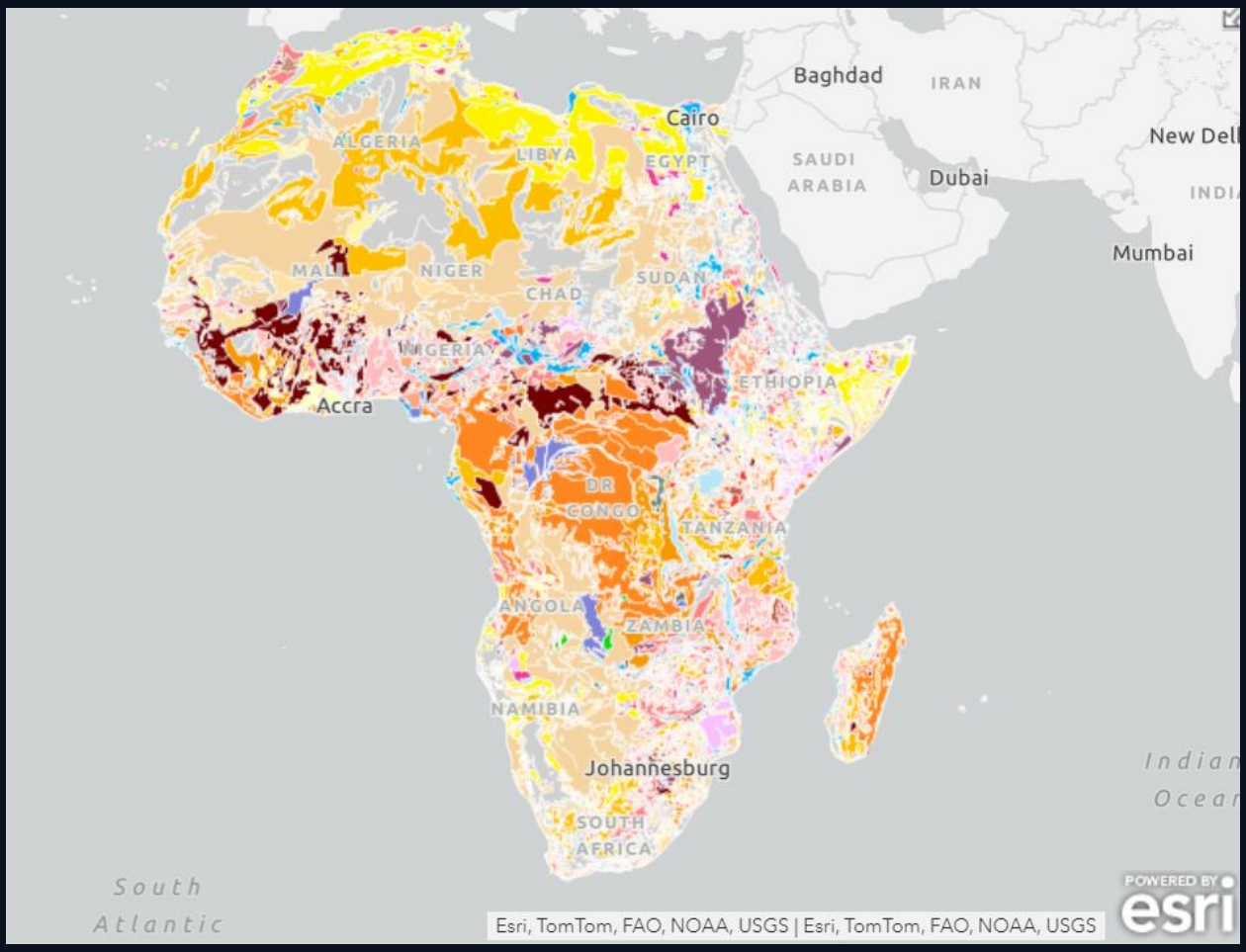
Data compiled from IPCC Guidelines for National Greenhouse Gas Inventories

Managing grazing capacity and fire frequency, and avoiding defoliation and cultivation, can turn degraded landscapes into sustainable carbon sinks to mitigate climate change.

Soil data for targeted land management

Soil has traditionally received less public attention for climate mitigation, but this is changing. The European Commission's Joint Research Centre was instrumental in developing the Soil Atlas of Africa.

The below map shows the diversity of soil types in Africa. Clearly, **it would be a mistake to treat all African soils the same way**. Land management and soil conservation strategies should be tailored to the specific attributes of local soils.



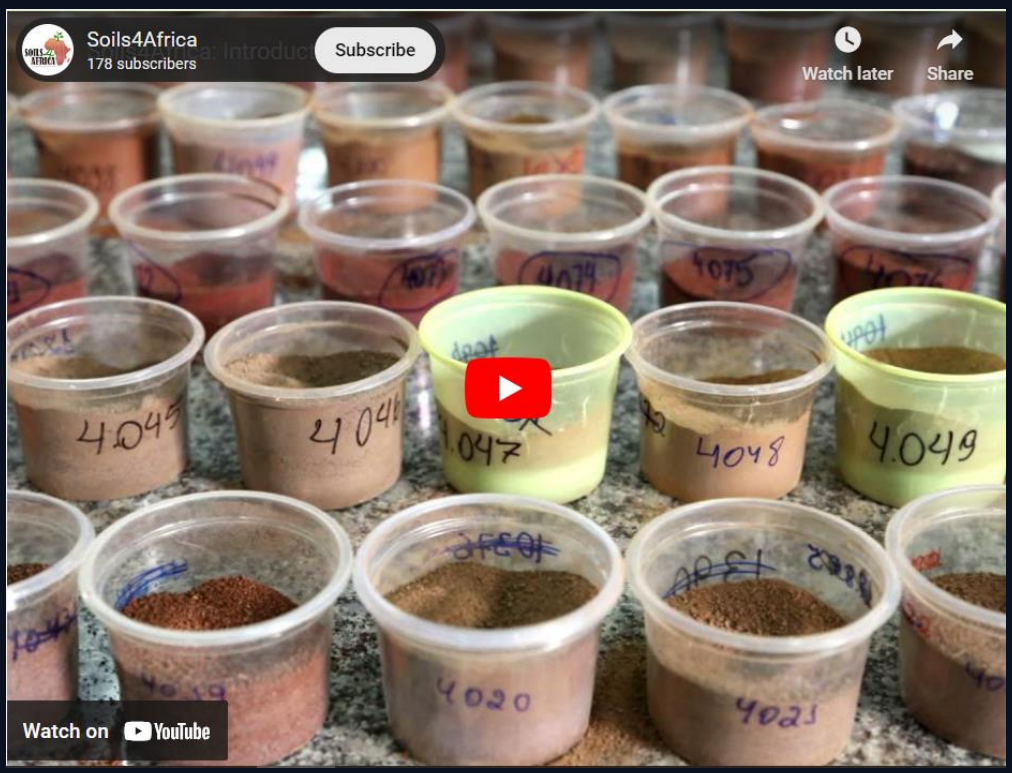
The Soil Atlas of Africa was developed after a survey of potential end-users . **Information on soil degradation was requested by 1 in 6 African survey respondents**, making it the most frequently requested topic to be included in the atlas.

Soils4Africa

Soils4Africa is a project funded by the European Commission's Horizon 2020, which aims to **establish a baseline of soil characteristics for agricultural land** through a continental soil survey.

This project includes partnerships between the European Commission's Joint Research Centre and 16 other institutions across Europe and Africa. It will extend to Africa the LUCAS (Land Use/Cover Area frame statistical Survey) methodology, which has successfully been used on European Soils.

Soils4Africa will put in place by 2024 an open-data Soil Information System to enable farmers, agri-businesses, scientists, and policymakers in their efforts towards sustainable intensification of agriculture. This will **enhance food security without jeopardising the health of African soils**.



The potential of carbon credits

In June 2021, the European Biodiversity for Life (EU B4Life) Facility hosted a seminar by Dr Tim Tear from the Biodiversity Resource Institute. This hour-long seminar presented case studies of how land management in Africa can create new opportunities for local communities. This presentation made three important take-home messages:

1. **Soil carbon can be enhanced** by managing livestock rates and fire frequency (video time: 15.30 - 18.20).
2. Land management projects can store enough **carbon in soil to be traded on carbon markets**. This was demonstrated by a pilot study by Northern Rangelands Trust in Kenya , which generated enough revenue from selling carbon credits to offset the lost tourist revenue due to the Covid-19 pandemic (video time: 19.15 - 21.40).
3. Carbon trading projects can be set up in such away that they **attract investors, restore landscape productivity and support local livelihoods** (video time: 24.00 - 26.35).

If these lessons can be scaled up beyond the pilot scale, they have the potential to completely redefine rural development in Africa.

The Great Green Wall

Perhaps the most ambitious project to restore ecosystems to support livelihoods, combat desertification and mitigate climate change is the Great Green Wall initiative . This initiative aims to restore the Sahel Region from Senegal in the west to Djibouti in the east.

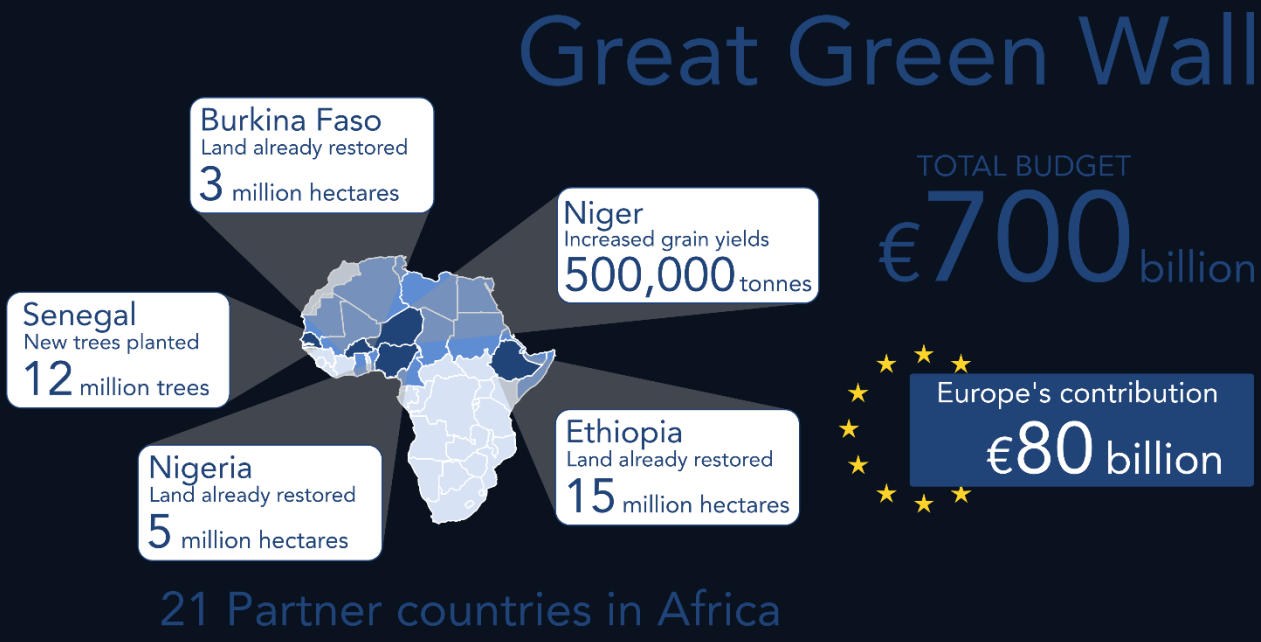
The Great Green Wall aspires to restore 100 million hectares of degraded land by 2030 and in the process store 250 million tonnes of carbon. These efforts will create 10 million green jobs in a mostly impoverished region while also enhancing land productivity and food security, creating economic opportunities, and combating the need for migration as the only means to a better life.

The European Commission committed to supporting the Great Green Wall initiative between 2007 and 2030. To-date, the initiative has brought remarkable success in several of the 21 African partner countries.

A recent study showed how **investment in the Great Green Wall will pay for itself after only 10 years** because every $1 spent on restoration would generate $1.20 under the base scenario. However, these returns vary geographically and may be hindered by violent conflicts.

Building on this success and meeting the post-2020 Global Biodiversity Framework's goal to remove 10Gt CO2-equivalents per year using ecosystem-based approaches will require creativity and new solutions.

While forest ecosystems will remain pivotal to mitigating climate change, European and African policymakers should **embrace the mitigation opportunities in open ecosystems**. This potential can only be realised by acknowledging the importance of land management and soil conservation.



Future Europe-Africa partnership

In her address at COP 26, Ursula von der Leyen , president of the European Commission, said:

"The EU has been committed to the development of the Great Green Wall since its start. I am pleased that a number of countries have taken ownership of the Great Green Wall initiative. And we witness an increasing participation of local communities...The Great Green Wall shows how climate action combines local action and global ambition."

Clearly, African ecosystems are globally significant in mitigating climate change. But this doesn't mean that policies from other parts of the world apply to Africa. In Europe, the EU Biodiversity Strategy for 2030 aims to "**increase the quantity, quality and resilience of its forests**", including a roadmap for "**planting at least 3 billion additional trees in the EU by 2030**." Such an approach would be inappropriate for Africa's open ecosystems.

Rather than implementing European policies in Africa, the European community would be better off supporting African states to tailor policies to suite their own local contexts. The European Commission's comprehensive Strategy with Africa prioritises **partnerships for the green transition**; acknowledging that:

"Africa is home to vast natural capital...[which] can contribute to lasting nature-based solutions to climate change mitigation and adaptation."

Unlocking this mitigation and adaptation potential will need creative approaches to land management. Therefore, Europe should join Africa in a dialogue on how best to support nature-based climate solutions in both forests and open ecosystems.

https://africa-knowledge-platform.ec.europa.eu/

This document has been originated from a StoryMap compiled in the context of the European Commission's Africa Knowledge Platform.

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Related links

Soil Atlas of Africa

Images

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