Drylands

Source: Authors

KEY MESSAGES

- **There can be no climate-adapted Africa without its drylands being climate-adapted.** Drylands cover two-thirds of Africa, with three-fifths of its farming lands, and are home to two-fifths of its population. They are warming at up to twice the global average rate, putting half a billion people at risk. Many of the most pressing challenges Africa will face this century will be disproportionately concentrated in the drylands and require nuanced climate-adapted development responses that are tailored to dryland characteristics. The gravity of the problem and the specificity of the possible solutions requires dedicated focus by a dryland-specific entity or initiative, instead of dispersed efforts.
- **A positive vision of adapted African drylands is essential.** Misleading negative imagery has obscured the potential for value creation based on the endowment of space, solar energy, minerals, water resources, biodiversity, and rich cultural heritages, as well as people, including women and youth, in drylands. Recent decades have shown that livelihoods based on natural capital can deliver significant economic returns and reduce poverty locally. The key elements for successful resilience building are now well-understood but need patient investment and equitable global policies on trade and capital movements.
- **Large, coordinated initiatives are needed to take successful climate-adapted development to scale in drylands, modelled for example on the Great Green Wall initiative.** Transformational change will be achieved by applying these known approaches in new initiatives based more on labor and physical capitals (such as conservation and using tourism, renewable energy, and sustainable irrigation), and using technical and social innovation to leapfrog past development pathways, whilst remaining sensitive to local aspirations, knowledge, and values in the diverse drylands.

> **“The African continent is now the prey of droughts, of desertification, of flooding. We see our biodiversity being destroyed, we see deforestation progressing, and observe many factors harming our fragile ecosystems.”**
>
> **H.E. President Macky Sall of Senegal**
> Leader’s Dialogue on the Africa Covid-Climate Emergency, April, 2021

INTRODUCTION

Drylands are regions where primary production is generally limited by water availability.[1] They cover 46 percent of the global land area and are home to three billion people.[2] Nearly a third of global drylands occur in Africa, where they cover 19.6 million square kilometers (km^2), and nearly two thirds of southern, western, eastern and northern Africa (Figure 1). This area is home to over 525 million people in Africa (40 percent of the population), growing by about 3 percent per year (faster than the African average of around 2.5 percent), with a demography firmly skewed toward the young.

Biophysically and socially, the drylands are diverse (Table 1). Biomes range from woodlands and savannas on either side of central Africa's equatorial forests, to Mediterranean shrublands in the north and south, and enclosing the hyper-arid Sahara in northern Africa and the smaller Namib in the south. This diversity means that the details of livelihoods are very context specific, but land use is broadly dominated by nomadic, transhumant or sedentary pastoralism, rainfed cropping and agroforestry, and localized areas of irrigated farming; the livelihoods of over 200 million people in Sub-Saharan drylands depend on cropping.[3] The range of crops has tended to narrow since the colonial period, but there are still diverse uses of local biodiversity for food and medicine that are important to local economies. Economically, in some regions, tourism (often associated with conservation reserves) and mining dominate the market economy, but only a small proportion of the capital from mining is captured locally.

Drylands are generally seen as marginal environments characterized by challenging agroclimatic conditions and endowed with limited resources to support primary production activities, resulting in hotspots of natural resource degradation.[4] The drylands of Sub-Saharan Africa are the most vulnerable to food insecurity compared to other global drylands.[5] The remoteness of many drylands puts them far from centers of governance, and the rule of law is often weak. The relative remoteness from political processes also predisposes them to loss of resources to powerful and often divisive groups, and compounds the fragility of livelihood strategies, due to the social and political marginalization of many dryland inhabitants.[6] Combined with the unpredictable supply of natural resources, this increases the risk of high levels of conflict that further exacerbates the vulnerability of local dryland populations. These are negative narratives which require balancing with opportunities, but there is no doubt that drylands in Africa are home to a large share of the region's poor, as well as many of those lacking access to basic services, such as health care, education, water, and sanitation.[7]

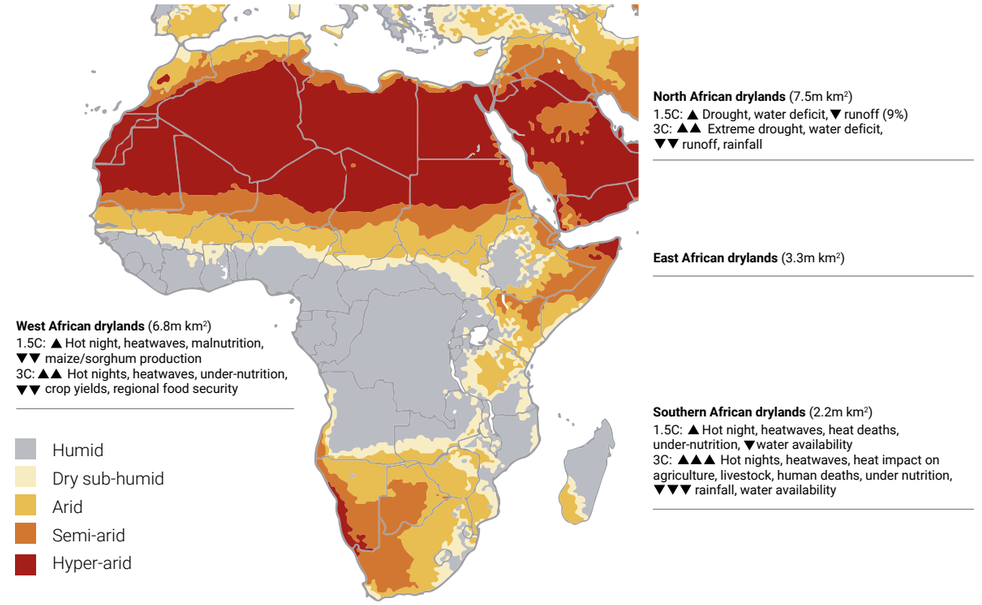
This chapter reviews the impacts of climate change in African drylands in the context of other major biophysical and social trends, proposes a positive vision for a future for drylands largely centered on climate-adapted development, and identifies key opportunities for successful adaptive actions.

Table 1: Key characteristics differentiating drylands in north, west, east, and southern Africa

North African drylands	
Area: 7.5 million km^2 (4.6 million hyper-arid), 99% of region	
Major land uses: Grassland 9%, Wooded 3%, Crops 7%, 'Barren land' 77%, Urban <1%	
Out migration 1970s/2000s: 140,000/319,000 people per year	
West African drylands	**East African drylands**
Area: 6.8 million km^2 (2.1 million arid), 53% of region	**Area:** 3.3 million km^2 (1.1 million dry sub-humid), 47% of region
Major land uses: Grassland 12%, Wooded 24%, Crops 8%, 'Barren land' 51%, Urban <1%	**Major land uses:** Grassland 25%, Wooded 44%, Crops 6%, 'Barren land' 12%, Urban 1%
Out migration 1970s/2000s: 224,000/508,000 people per year	**Out migration 1970s/2000s:** 152,000/241,000 people per year
Southern African drylands	
Area: 2.2 million km^2 (1.4 million semi-arid), 84% of region	
Major land uses: Grassland 28%, Wooded 59%, Crops 4%, 'Barren land' 7%, Urban 1%	
Out migration 1970s/2000s: 5,000/17,000 people per year	

Sources: FAO (2019). Trees, forests and land use in drylands: the first global assessment. Food and Agriculture Organization of the UN, Rome; & CIESIN (2011). Migration and Global Environmental Change. UK Government Office for Science, London.

Figure 1: Projected changes in drylands of Africa, under 1.5°C and 3°C global average rise in temperature



Source: IPCC (2019). Climate Change and Land. Special Report, Intergovernmental Panel on Climate Change, Geneva, Switzerland; & IPCC (2018). Global Warming of 1.5°C. Special Report, Intergovernmental Panel on Climate Change, Geneva, Switzerland.

CLIMATE CHANGE AND OTHER MAJOR BIOPHYSICAL AND SOCIAL TRENDS

In general, the risks of climate change to natural and managed ecosystems are expected to be higher in drylands than in humid lands.[8] Observations show that warming over drylands has already been 20-40 percent higher than in humid areas.[9] Heat waves and rainfall variability are increasing, both month to month and year to year, making cropping, pastoralism, and water management even more challenging.[10]

Looking forward, the Intergovernmental Panel on Climate Change (IPCC) projects that regional warming in African drylands may be up to twice the global average temperature rise (for instance, mean warming in southern African drylands is projected to be 3°C when global average temperature rises by 1.5°C, and 3.2-4°C if it rises by 2°C).[11] There are some differences among drylands regions (Figure 1), but in all regions the effects of a rise of 2°C or more are significantly worse than those of a 1.5°C rise. Key impacts of climate change will include reduced water availability, increased occurrence of vector and water-borne diseases, reduced crop and livestock productivity, and damage to transportation infrastructure and buildings.[12] Little overall change in the biophysical extent of drylands is expected with climate change, though they may expand in southern Africa and possibly retract a little in the Sahel.[13] However, the effects on land use and habitability for humans and livestock of rising heatwaves, extreme droughts, and water availability will change land use. In the absence of adaptation and despite urban migration, population growth means that the number of people dependent on agriculture and vulnerable to these effects is likely to increase by 40-80 percent from 2010-2030.[14]

The outcomes of climate change in African drylands are driven mainly by the vulnerabilities of its population that collectively lead to a low human development index.[15] After decades of improvement, food insecurity and undernourishment are on the rise in almost all subregions of Sub-Saharan Africa. In drought-sensitive Sub-Saharan African countries, the number of undernourished people has increased by 46 percent since 2012.[16] The year 2019 recorded a deteriorating food security situation in Sub-Saharan Africa, as well as increased population displacement and the increased food insecurity of those displaced people.[17] As a result, adaptation is essential but cannot and should not be addressed separately from Africa's development – the target must be climate-adapted development.[18]

BUILDING BLOCKS FOR A POSITIVE DRYLAND FUTURE

The African Union calls for a new African narrative, "inspired by the spirit of a vibrant Africa that drives and funds its own agenda in partnership with like-minded entities,"[19] which activates Africa's diverse options.[20] In the context of drylands, the first step towards this narrative is to envision what the African drylands and their communities could look like in a climate-adapted state (see Box 4 at the end of the chapter). An evolved version would have much greater community ownership and result from a nested process of co-creation across the diversity of African drylands and actors.

Much is understood about how to achieve sustainable land management and tree planting for land restoration, and these measures have been regarded as a surrogate for tackling many drylands resilience challenges, such as soil fertility, livestock feed, fuel wood, water recycling and biodiversity conservation. Since the 1970s, multiple agro-environmental, technical and institutional initiatives have been undertaken on this basis, but top-down interventions led and implemented by government agencies have often been ineffective,[21] undermining local equity.[22] Major UN reports show that community-based approaches drawing on local knowledge work better,[23] and use less resources, as long as local people obtain direct benefits. Many successful examples (such as the "man who stopped the desert" in Burkina Faso;[24] acacia gum plantations in the Ferlo-Sahel zone of Senegal; and the farmer-managed natural regeneration around Maradi in Niger of *Faidherbia albida*, a tree with multiple uses, especially as a food and fodder store in times of scarcity[25]) all deliver direct benefits that build the adaptive capacity of people. Key success factors synthesized by the World Bank and leading African research teams (Box 1) are now well understood, though by no means universally applied.

All photos provided by the authors

Improving the climate resilience of African dryland livelihoods depends on more than land management. There are well-established priorities for, and approaches to, improving the resilience of pastoral, agro-pastoral, and agroforestry productivity in the face of climate change, and the resilience of associated local livelihoods. Although much conventional development is focused on the narrow range of species exploited for industrial agriculture and its value chains, there are additional opportunities to apply local knowledge to grow neglected local species that are climate tolerant and get them to market, such as cassava bread in West Africa,[26] teff in Ethiopian cuisine,[27] rooibos tea in southern Africa, or the faba bean in northern Morocco. There are other livelihood opportunities based on biological resources, including payment for ecosystem services such as carbon sequestration and biodiversity protection, wild harvest of medicines, and tourism based on wildlife, culture, and landscapes.

However, real transformation for climate-adapted drylands requires a much larger shift, building on small-scale adaptation of local land-based livelihoods to create and link to new markets, engage other dryland assets at scale, and diversify into other forms of livelihood. Several key dryland opportunities need to be addressed.

> **"The Covid-19 crisis unfortunately has cast a shadow on the climate crisis, and in the meantime the impact of climate change is growing"**
>
> **H.E. President Mohamed Bazoum of Niger, Chair of the AU Climate Commission on the Sahel**
> Leader's Dialogue on the Africa Covid-Climate Emergency, April, 2021

Box 1: Key lessons for improving the resilience of dryland livelihoods[28]

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Supporting the adaptive capacity of dryland communities

- Institutional and regulatory reforms at national and regional levels often need support, such as tenure reform or devolved governance.
- Transformation in major initiatives require skills for strong participatory engagement of stakeholders by decision-makers, multi-stakeholder partnerships across sectors and levels, capacity mobilization, and engaged participatory action research to speed up learning.
- Support to bolster the capacity of local organizations, institutions, and governments is essential.
- Farmer and community-led approaches are more successful and cost less than large scale centrally managed schemes that have often failed, and they can often be better tailored to local changing environments.
- The role of youth, women, and other marginalized groups is important for equity.
- Communities must realize tangible local benefits in the short and long run.

Restoring and improving dryland resilience

- In addition to improving productivity and improving climate resilience, dryland restoration also delivers carbon sequestration and biodiversity benefits, although they are still hard to measure.
- Livestock pastoral systems can increase production and resilience through the integration of animal health, land use, and markets. There is a need to enhance the mobility of herds where feasible; develop livestock early warning systems; and to add alternative livelihoods including those based on payments for ecosystem services.
- Farming based on crop diversity can add varieties and hybrids, improve management of soil fertility and water, and promote sustainable irrigation, especially at small scale and with access to markets.
- Natural resource management should promote Farmer-Managed Natural Regeneration, especially the role of trees, and aim to add value to tree products locally to improve livelihood resilience.
- Native species are beneficial as adding species improves resilience; local knowledge and innovation can drive success in the face of local environmental changes.

Markets

To build better livelihoods, and to enhance African food security, local producers need to connect to markets in ways that retain significant benefits locally. While these can be local markets, greater benefits often come from connecting with value chains into African cities and globally. Data on the effects of food value chains in Africa is still limited and mixed,[28] but some global value chains that originate in drylands currently add very limited local value (only one percent, for instance, for cotton from Burkina Faso).[29] Other value chains are national (for instance, sorghum and millet), but profits are still essentially exported out of drylands.[30]

The case of the Ethiopian crop teff illustrates why African producers should ideally supply African urban markets (Box 2), although for new products, some of the problems can be mitigated through blended finance models that ensure significant local ownership of the profits, in production, aggregation and processing. Such models, recommended by the Organisation for Economic Co-operation and Development (OECD), are being tested by the Global Environment Facility (GEF) and other agencies and require that all lessons of Box 1 and supportive policies are implemented in a coordinated way.[31] The establishment of such value chains can create a diversity of ancillary livelihoods at all stages from land restoration through to processing, fulfilling the need for diversified new livelihoods that are less reliant on natural capital, and more on human and physical capital, in the face of rising populations and climate change.[32]

Box 2: Local crops, global markets - the case of teff

The case of the Ethiopian crop teff (*Eragrostis tef*) highlights the double-edged sword of global value chains. Teff is a non-conventional grain that is important for national food security in Ethiopia, but has reached global markets due to Africa's diaspora and its low gluten value.[34] Although domestic market can benefit poor producers,[35] the benefits of increased export revenue are captured largely by food distributors and storage operators.[36] Teff is now increasingly grown around the world (for instance in the US, Europe, and Australia), but patents on teff processing held in Europe have prevented Ethiopia from benefiting from product sales.[37] A focus on delivering climate-adapted, neglected local crops to African rather than global markets may be a more resilient strategy for new initiatives.

Photo: Dennis Wegewijs/Shutterstock

Water and irrigation

According to the World Bank, irrigation is technically feasible and financially viable on 5-9 million hectares of Sub-Saharan drylands.[38] This potential is not being used to boost agriculture and other economic sectors, whilst improving resilience to climate change and drought. These World Bank analyses show that small-scale irrigation offers the most important opportunities to improve agricultural water management in drylands, with four times the potential of large-scale irrigation. Well-managed, small-scale irrigation supported by off-grid solar energy could resolve many unused opportunities to grow food, extending growing seasons in places where dry seasons can last nine months of the year, as well as protecting against drought. Regionally coordinated small-scale irrigation schemes with distributed energy supplies, linked to grower cooperatives and market developments, will benefit many households and increase the resilience of a larger part of the population, compared to large-scale schemes based on building large dams.

Box 3: How energy access can enhance livelihoods

Using solar dryers to dehydrate cassava and increase its shelf-life enables producers to hold their harvest and sell only during peak demand to maximize earnings. This is an example of a mitigation investment in clean energy that can power adaptation through value-added agro-systems that unlock socioeconomic opportunities. Converting raw cassava to dry cassava and milling it to cassava flour (a finished product) using decentralized solar or micro-hydro-powered millers has been proven to increase incomes by 150 percent, compared to cassava that is sold raw after harvesting.[43]

Energy resources

Energy access is a key developmental challenge and opportunity for Africa, especially in its drylands (Box 3). Many African countries are still importers of energy. Rural areas have low access to electricity and a high reliance on biomass fuels, leading to wood extraction and charcoal use that exceeds tree production, especially in drylands.[39] This reduces the resilience of local communities and at the same time fails to capitalize on the energy transition. A coordinated effort to establish local grids can help dryland communities leapfrog the power supply challenges of low-density settlements. Innovative blended public-private financing, like the African Development Bank's Africa Renewable Energy Fund and the Development Bank of Southern Africa's Equity Fund for Small Projects Independent Power Producers, could be used to enable local ownership and local benefits.[40]

Potentially, these local grids could aggregate surplus production to supply the needs of African cities and (less likely) Europe. Early efforts in the form of DESERTEC, which sought to export solar and wind energy to Germany from North Africa, folded in 2014 due to a mixture of political risks and cheaper renewables in Europe (though these large-scale export ideas persist) indicating that markets within Africa are likely to be more secure.[41] In some areas, surplus energy could be aggregated to support green minerals processing from the many mines in drylands, enabling African industry to add value to its primary resources.[42]

> **If we are to allow adaptation action to improve and really be successful, we need national, whole-of-government approaches where adaptation needs are duly considered from the outset in national priority setting"**
>
> **Janine Alm Ericson, State Secretary for International Development Cooperation, Sweden**
> High-Level Dialogue "An adaptation acceleration imperative for COP26", September, 2021

All photos provided by the authors

Diversification and integration

To be adaptive and viable, the foregoing examples could benefit from multiple synergies among sectors and livelihood streams, with the potential to spin off many diversified livelihoods. Integrating livelihood systems across sectors or a truly integrated landscape management approach are not new ideas but are not widely pursued in development, which is too often sector-based.[44] Integrated landscape management can bring diverse landscape-based activities such as conservation, tourism, pastoralism, farming, water use, and energy production into regional approaches that create synergies among the land uses and help to resolve land use conflicts. With a population growing at a rate that will probably outstrip the ability of purely agricultural livelihoods to support all inhabitants, creating jobs is vital. Understanding the potential synergistic links among actions (for example, renewable energy for small-scale irrigation, as well as local energy access and telecommunications to enable marketing and early warning) can alter what may otherwise be unduly pessimistic appraisals of economic and social returns when assessed sectorally (for instance, for irrigation alone[45]).

OVERCOMING CHALLENGES

To unlock this potential to transform the resilience of drylands at sufficient scale to adapt to climate change, important challenges need to be acknowledged and addressed.

Fragmented efforts and partial solutions

Adapted drylands with resilient communities and livelihoods cannot be achieved piecemeal by sector or individual projects. The African Union highlights that fragmentation of effort is a key challenge for adaptation, especially for drylands with their limited resources, limited connectivity to agencies that might help coordination, and relatively low human capital to help network multiple initiatives.[46] There is a massive gap in adaptation finance,[47] and pan-African governance activities occur a long way from the drylands. Funding in three- or five-year project cycles damages continuity and acts against concerted scaling. Conceptualizing climate-adapted development options in silos means that synergies are missed, and financing may appear non-viable, as noted above.

Recent experience demonstrates that large initiatives such as the Great Green Wall Initiative (GGWI) provide a vehicle to bring multiple funding sources to bear in a framework that can allow the many elements of system success to be pursued together, and over longer time periods (see GGWI Insert). Despite a rocky, top-down start, the African Union today sees the GGWI as proof that Africans can set an ambitious target and progress towards achieving it, at the same time as showing the power of partnerships, local participation, and ownership.[48] Other large-scale restoration initiatives, such as AFR100, which targets US $1 billion in reforestation with support from EU countries, GEF, the World Bank, and private sector finance, could also serve as vehicles in which all of these elements are delivered as a coherent whole. Such approaches to adaptation should be extended to other opportunities in drylands at a system-wide scale, such as energy, irrigation, mining and processing, or major multi-use wildlife corridors and tourism.

Because drylands often have high costs to deliver products into more populated areas, it is important to choose initiatives that are in some way place-based. These could include, for instance, dryland tourism experiences that depend on landscapes or wild biota that only occur in drylands; irrigation possibilities that depend on water resources in drylands, that may be linked to benefits of isolation from pests and diseases; solar energy resources that can exploit space and solar intensities available in drylands; mineral resources that are physically located in drylands; or dryland cultivation of local neglected species, linked in a coordinated way to local, African urban, and global diaspora markets. These sorts of initiatives are usually developed and controlled by external sources of finance, so blended finance models need to be deployed to leverage significant local ownership of the profits, as emphasized by the OECD.[49] Supporting the capacity and engagement of youth and women is vital; this includes education of girls and recognizing that both youth and women may be disempowered without reliable access to land.[50]

All photos provided by the authors

Conflict

Many of Africa's longest running conflicts are associated with drylands, arguably because drylands are often the hinterlands of nations, being remote with poor infrastructure or in border areas where countries struggle most to maintain control over their territories and where arbitrarily drawn, post-colonial boundaries exacerbate this issue. Many Africans despair of progress whilst conflicts keep recurring; they point to the reality that, at the same time as developed countries are providing valuable support for development, through complex supply chains some are trading in what become uncontrolled arms that fuel the conflicts.[51] Conflict may be exacerbated by climate change, as well as poverty, competition for limited resources such as water, and interactions with mining. Whether each of these is causal is contentious, but each plausibly and synergistically contributes to conflict in drylands.[52] The World Bank has shown how mining can have both positive and negative impacts on local communities[53] and on local conflicts, in ways that point to potential policy responses like enhanced corporate transparency that must be at least in part enacted and enforced by the global community.[54] There is no silver bullet for ameliorating conflict in drylands, but a series of coordinated actions within a long view, such as those listed in Box 4, can gradually enable greater security.

All photos provided by the authors

Capital leakage

There are many ways in which capital is exported from drylands, undermining adaptive capacity. Genetic resources are patented in, or trafficked to, rich countries. Industrial agricultural developments may be owned internationally (such as biofuels in Mozambique drylands[55]), and they may sell into global value chains with significant capital export.[56] Land acquisitions move control of natural resources offshore, with implications for energy use.[57] In the case of mining, most benefits from extractives, in an African context, are fiscal and national, and the World Bank showed that *"the size of resource-related intergovernmental transfers to local communities has been modest so far"*.[58] This is affirmed by a more extensive World Bank analysis that also points to policy responses.[59] Although the analysis is not dryland-specific, mines occur widely in the drylands where risk factors like weak governance are high and modest changes in capital retention have proportionally large effects for the marginalized poor.[60] In practice, not only do profits often go to overseas investors, but even what stays in Africa mostly leaves the drylands.

Whether national or global, all these processes export capital that is not re-invested in drylands. The creation of value chains that keep significant control locally can help; this is done more easily when value chains are not too long, for example ending in African cities rather than outside Africa. There are now principles to guide large-scale land acquisitions in Africa, but it is not clear how well they are working in practice.[61] A more politically challenging approach is to establish sovereign capital funds that capture a part of any resource value exported from drylands.[62]

Global interactions

Whilst there are actions that African countries can take to build resilience in drylands, global support is necessary to reduce accidental and deliberate interference with local processes, and to enable equitable participation in global markets. Further work is necessary through international institutions such as the UN Convention on Biological Diversity (for fair patenting) and the World Trade Organization (for market access rules). New institutions may be necessary to oversee how multinational corporations and non-African governments affect African drylands futures, for instance through investments and related value chains,[63] transparency in resource extraction,[64] promotion of obsolete or polluting technology[65] and practices,[66] market opportunities, and to nurture the engagement of dryland economies in trade on fair terms.

Social protection

Global support will also be needed for humanitarian aid and disaster relief in the African drylands for some time.[67] Framed within support for the expansion of national adaptive safety nets, especially for lifting the poorest from poverty, contingent finance for short-run humanitarian assistance can be delivered with an eye to developing greater resilience and adaptive capacity, not merely on restoring the status quo. This requires patient investment, tailored for the diversity of circumstances, and a focus on the issues raised here that require particular responses in drylands.[68]

All photos provided by the authors

Box 4: A potential future for climate-adapted African drylands

What might the African drylands look like in 2040? This vision of the future draws on the scenarios of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.[70]

The African drylands provide all their inhabitants with key basic needs, including food, water, and energy security; shelter; access to health and education; and peace. Their environment is thriving despite climate change, with diverse, prosperous livelihoods for all community members, especially the youth and women.

Specifically, the African drylands have fully functional governance systems committed to creating unity of purpose and to developing physical and institutional infrastructure that efficiently services all citizens. A core population of farmers is producing a highly diverse, climate-adapted mix of crops, tree products, and livestock as suited to their context – in some areas, irrigated with cheap renewable energy and carefully managed water supplies. These are mostly small-holdings, with cooperatives to aggregate surplus production, and sell profitably and locally to the expanding African urban middle-class who are keen on African native products, as well as – on their own terms – to global markets.

These forms of agriculture are operating around many medium-sized dryland towns where most of the population is engaged in other livelihoods, including renewable energy, mining, tourism, manufacturing with a focus on local needs, food processing, and medicinal and textile industries, mostly locally owned but aggregated to scale. A significant service sector that ensures health and education is available within and outside the towns. It delivers use of geospatial science and technology and other digital services and supports strong peer-to-peer learning for resilient dryland systems in Africa and globally. Some dryland youth are returning to the land, many others are finding new livelihoods in the nearby towns and thus staying close to their families. Still others are linking into global markets, partly through the African drylands' diaspora. Net out-migration has stopped, with a stabilized ebb and flow of people moving between the drylands and Africa's great cities.

Countries have instituted devolved or decentralized governance arrangements that empower local decision-making within provincial, national, and pan-African objectives that are a co-creation of government policy and local input. Sovereign capital funds established outside short-term politics are reducing capital leakage from the drylands and re-investing in growing dryland environmental, social, and human capital.

A series of visionary initiatives exemplify and effect these arrangements, building on the GGWI in the 2020s that successfully delivered a regional vision of massive re-forestation, implemented under local control and supported by external capital that started as aid and loans, but became private capital for carbon and biodiversity. By the 2030s, other such flagship activities, supported by the sovereign capital funds, had been established. By 2040, these include widespread local renewable energy in lower productivity lands, locally owned but connected together through regional organizations; several significant regional irrigation districts use this energy to pump or desalinize water through cooperatively-owned infrastructure for production and marketing; a green minerals processing industry adds local value to what is mined in the drylands; and a continent-wide integrated corridor links conservation, wild harvest, culture and tourism livelihoods; all deliver core jobs and cultural confidence, as well as adaptive capacity for climate disasters.

Looking back, efforts to establish a positive future faltered through the 2020s as regional conflicts continued to flare in and around the drylands, often inflamed by financial or political interests driven by external actors taking advantage of poverty, as well as climate change. But a virtuous cycle from improving food security, declining inequality, more diverse livelihood options, as well as social safety nets that reduced the impacts of rising climate disasters, and governance systems that gave diverse dryland communities a genuine say in their own futures, meant that people felt more secure and in control, and less willing to be lured to be part of, or endure, disruptive insurgencies or petty dictatorships. As the African Union became a more effective projector of African priorities, countries globally helped by ensuring their companies and political interests did not undermine the improvements in Africa. The African Union's Drylands Assembly was established in the 2020s, drawing representatives from all African drylands; it now has a secretariat with significant analytical capability, and helps to ensure that pan-African policy is nuanced appropriately in the different drylands.

All this benefitted Africa as a whole, but its drylands particularly, as modern communications and energy lessened the effects of remoteness and lack of voice. And it benefitted the rest of the world as Africa took its place in the global economy, contributed to controlling climate change, and saw refugee flows cease.

Voice of drylands

Africa has developed a more coherent voice in the past two decades, with pan-African initiatives such as the African Union, the African Continental Free Trade Area, African Common Position in global negotiations, and the Africa Climate Change Strategy.[69] All of these have the potential to influence drylands positively, for example by opening up new markets. However, even where the challenges being faced are similar to other parts of Africa, the nature of drylands demands dryland-specific implementation. Specific institutional arrangements that provide drylands with a voice at the African level, as well as within nations, are therefore vital. This is an extension of the need for local empowerment in decision-making that has been shown to be a key success factor in restoration activities.

POLICY RECOMMENDATIONS

Large initiatives for African dryland resilience like GGWI and AFR100 currently tend to be founded around a notion of restoration, whereas climate-adapted development needs to capture transformative opportunities and value creation. Dryland regions are not places of endemic famine, shattered societies and policies, where deep transformation is impossible. In general, African drylands are well-endowed with space, solar energy, minerals, water resources in many areas, carbon storage capacity, biodiversity, spectacular landscapes, amazing cultures, and people among many other potentially positive resources. They do face many challenges – population growth, competition for land, climate change, poor governance and conflict, among others. But this should not inhibit a vision for transformation at scale (Box 4), informing realistic programs with the potential to trigger a virtuous cycle that can stabilize and improve the security, well-being, and prosperity of dryland inhabitants.

The necessary suite of interlinked actions can be summarized into a small set of elements of success (Table 2) that adaptation investment should immediately support in all interventions, including existing major initiatives. The diversity of African drylands means that all these actions require tailoring to local and national contexts, which is part of why local empowerment in the decision-making is so important. Particularly importantly, many of the key underlying challenges, such as effective local empowerment and the eventual reduction of the drivers of conflict, require that all these issues be addressed simultaneously at scale, to drive systems transformation towards improved resilience throughout the drylands.

Photo is provided by the authors.

Necessary as these immediate investments are, by themselves they are not sufficient, as the previous section showed. Several key underlying challenges, exacerbated in the drylands, also require addressing at a larger and more strategic scale to create an environment in which these elements of success can thrive and drive wider drylands resilience, and eventually reduce the pressures for conflict. To this end further key transformative interventions are needed:

- **Envision and invest in a suite of new initiatives** as additional vehicles for taking an integrated approach to development across sectors, regions, and scales. These could extend opportunities like energy, irrigation, conservation corridors and tourism, mining and processing to drylands, but must meet the principles of local empowerment within national support and environmental sustainability. They will emerge from a positive vision for African drylands as a whole (for instance, Box 4), replicated regionally.
- **Provide vital support from the global community** to achieve successful and durable adaptation in the drylands. Much of this depends on providing constructive investments and reducing the net export of capital from African drylands. Strong global partnerships must oversee how multinational corporations and non-African governments themselves affect African drylands futures through practices, investments, equitable management of intellectual property, resource extraction, promotion of technology, market opportunities, and engaging in trade on fair terms.
- **Within Africa, support the establishment and operations of an entity (perhaps as an assembly under the African Union) that can bring the voice of drylands together** to influence how pan-African policy is implemented in its drylands. This entity needs support to be replicated in each country with drylands to obtain the equivalent effect within their national policies.
- **Finally, the global community needs to be patient and humane,** continuing to invest in humanitarian and disaster assistance until the drylands obtain greater resilience, but doing so with these longer-term goals in mind. In the end this will create new, thriving markets for developed economies and lessen the migratory pressures from climate change. The adapted African drylands will be able to play their active role in an adapted global community.

Photo: client to advise dryland images source

Table 2: Immediate investment approaches for climate-adapted development in African drylands

Element	Rationale and investment
Empower the local	• Invest in the development of governance systems that empower locally-led adaptation and provide equitable tenure arrangements. • Invest in infrastructure (like communications and transport) that enables better connectivity between remote regions and political centers, reducing regional vulnerabilities, permitting adaptations, and accessing early warnings. • Prioritize vulnerable stakeholders, so as to provide the basis to address distributional outcomes and equity and improve community-level resilience.
Support and exchange local practices	• Invest in the demonstration of locally-led management practices that enable land restoration and sustainable production to be more resilient to climate change, using nature-based solutions, carbon and biodiversity credit markets, and local neglected species etc., as well as in horizontal knowledge exchange networks that speed up learning and empower peer-to-peer resilience building. • Apply participatory action research approaches to engage academic institutions in supporting local knowledge and innovation and speeding up local adaptive learning.
Create the links to markets	• Diversify adaptive livelihoods by supporting marketing of local products and innovations, especially into middle-class urban African markets, but within a balanced strategy that considers both local markets and global value chains. • Build local resilience by supporting the creation of cooperatives and other models for aggregating small-holder products and locally owned processing to add value to the products in the local economy and retain profits. This may be based on climate-adapted but currently neglected species, as well ecosystem services such as carbon sequestration and biodiversity credits, and livelihoods from other uses of local resources (such as tourism and energy systems).
Build social and human capacity	• Provide training in entrepreneurship and skills relevant to local livelihoods off the land, as well as the delivery of local services and innovations, which will provide the basis for adaptation to on-going future change. • Provide support for local champions and agents of change to drive transformation, as well as active capacity building and job opportunities for youth and women.
Take integrated and diversified approaches	• Invest directly to bring all the above elements together in an integrated way in major climate-adapted initiatives that run across sectors, peoples, and countries. • Coordinate investor partnerships to drive patient investments at large scale and over multiple funding cycles that accumulate to build resilience and reduce conflict.

In summary, transformative and targeted investment partnerships are needed to:

- **Support major initiatives that already exist,** as long-term vehicles to integrate and implement the elements of success in drylands (listed in Table 2) at scale, improving the resilience of dryland environments and livelihoods to climate change around conventional dryland opportunities based on natural capital in pastoralism, farming, forestry, and land restoration.
- **Establish a series of ambitious, cross-border decadal initiatives in new domains** where drylands have a comparative advantage, to also act explicitly as integrating vehicles to develop additional climate-adapted livelihoods based on natural and other capitals (such as conservation and tourism, renewable energy, sustainable irrigation, food processing). Support market links within regional economies and global value chains to this end.
- **Support the establishment and operations of an African drylands entity or initiative** to help ensure that policies are implemented in dryland-sensitive ways. The entity is essential to ensure a drylands voice over two-thirds of the continent; and should contain nested drylands commissions within countries.
- **Patiently support African drylands through strengthened regional and global partnerships** while they transition to greater resilience and contribute to the global economy. This support must act to reduce accidental and deliberate interference; help control capital export from drylands; ensure transparency in resource extraction; ensure transfer of appropriate technology and practices; and enable equitable participation in global trade. It must also help deliver humanitarian safety nets, and relief and recovery in the face of disasters and conflict.

An inspiring future vision for 2040 based on these major achievements, and a suite of smaller actions towards the elements of success (Table 2), will help deliver climate-adapted African drylands.

Photo: FAO - Fodder harvesting in year two of planting for land restoration (Soum province, Burkina Faso)

Action Against Desertification (AAD)

Geography: Burkina Faso, Djibouti, Eritrea, Ethiopia, The Gambia, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan; currently expanding to dryland countries in southern and northern Africa.

Adaptation measures: The program implemented land restoration activities focused on communities' livelihood improvement and adaptation needs. It established income-generating enterprises that support economic growth, land productivity and environmental protection, including the development of non-timber forest products (NTFPs) with native species that were also planted.

Key outcomes: In five years, the programme restored 63,000 ha of degraded lands using 12 million seedlings and 120 tons of forest seeds from 110 locally prioritized species of trees, shrubs and grasses for food, animal feed, medicine, honey production and other purposes. Five hundred villages were involved in restoration activities with the participation of 100,000 households. Sustainable value chains were supported in restored areas through ten non-timber forest products. Some 40,000 people benefited from training activities, and about 8 million people were sensitized through capacity building and community mobilization to land degradation and restoration issues.

Partners and funding: FAO and Africa's Great Green Wall governments and country partners, African Union Commission (AUC), Pan Africa Agency of the Great Green Wall (PA-GGW), Africa, Caribbean and Pacific Group of States (ACP), The Global Mechanism of the UNCCD, Millennium Seed Bank Partnership of Royal Botanical Garden (RBG) Kew, Service Public de Wallonie, European Union (EU) and Turkey. 2014-2020. 34 million euros.

PROJECT SUMMARY[33]

Desertification threatens more than 45 percent of the land area on the African continent, of which 55 percent is at high or very high risk of further degradation.[34] Moderate to severe degradation has already been identified in several life-supporting river basins, including in Niger (50 percent degraded), Senegal (51 percent), Volta (67 percent), Limpopo (66 percent) and Lake Chad (26 percent).[35] In The Gambia, nearly 100,000 ha of forest land had already been lost to desertification between 1998 and 2009; while in Burkina Faso, from 1984 to 2013, bare soil and agricultural lands increased by 19 and 90 percent, respectively; while woodland decreased by 19 percent, gallery forest by 19 percent, tree savannahs by 5 percent, shrub savannahs by 45 percent and water bodies by 31 percent.[3637]

Studies forecast higher temperatures, increasing frequency of heatwaves and increased aridity for countries in Sub-Saharan Africa, which, in the absence of adaptation or other coping mechanisms, is projected to reduce the cropland by an average rate 4.1 percent by 2039, with 18.4 percent of the cropland likely to have disappeared by the end of the century.[38]

FAO has been supporting the on-the-ground implementation of Africa's Great Green Wall since July 2014, through the Action Against Desertification (AAD) programme. The programme initially involved six countries and supported rural communities, governments and civil society groups in restoring degraded land and sustainably managing agro-silvopastoral landscapes to enhance adaptation of local communities and their production systems. Building on the successful results, since 2018 AAD has been expanded to five other Great Green Wall countries: Djibouti, Eritrea, Mali, Mauritania and Sudan in the Sahel. It has also provided support to Southern African Development Community countries and to countries in northern Africa through a South-South cooperation approach. The large scale restoration model led by FAO in support of the Great Green Wall advances multiple sustainable development targets and addresses climate change adaptation and mitigation by integrating agriculture, forestry and other land uses, in alignment with the participating countries' climate strategies.

Since its launch, AAD has put biodiversity and local communities' interests and adaptation needs at the center of its innovative large-scale restoration approach. The local biodiversity of the Sahel is a key element for building communities and landscapes adapted to climate change, as the dryland dwellers rely on a wide range of plant and animal products for household consumption and sale, and such products often contribute significantly to household economies. Furthermore, FAO targets restoration[39] across the whole value chain, from seeds and land to end products and improvement of livelihoods.

The restoration approach entails, first and foremost, consulting communities to understand what they want to restore, where and which plants they consider important to replenish in their landscapes; then, planting the right species in the right places. The consultations make use of traditional knowledge of native species and ecological analyses of the area to determine which species are well adapted to the local conditions and therefore should be restored.

At the end of this process, communities had prioritized 110 plant native species of trees, shrubs and grasses that serve multiple purposes, including food, animal feed, medicine, veterinarian and honey production, among others. More than one million farmers in these communities were equipped with training in seed collection, handling and resource management, seedling production, establishment of village nurseries, planting and seeding, and managing and monitoring their restored land. Owing to the changing climate and variability in the region, the initiative has implemented a number of restoration techniques to build resilience, such as land ploughing

for maximum rainwater harvesting before planting and direct seeding in order to help minimize drying of the soil, improve soil permeability and provide better chance for seedling growth; and planting only once the first rains have settled in, as opposed to immediately after the first rainfall.[40]

The restoration model combines plant science, local knowledge, community mobilization and mechanised technology. Communities were simultaneously supported to develop sustainable value chains for ten non-timber forest products (NTFPs), including gum arabic, Balanites oil, honey and fodder, generating income through diversification of their livelihoods and garnering direct restoration benefits. For instance, in Burkina Faso, Niger and Senegal, communities harvest planted grass fodder in restored areas as feed for their livestock and/or to sell for US$ 40/ha per season.

Based on partnerships developed through this programme, FAO and the AUC initiated the Africa Open Data for Environment, Agriculture and Land (Africa Open DEAL) to assess land use in Africa, establish biophysical baselines and define the potentials for land restoration at country and continental levels.[41] The analyses have revealed in Africa, more forests and more arable lands than were previously detected, and has revealed 7 billion trees outside forests for the first time. According to Africa Open DEAL analyses, potentially restorable lands in the continental Great Green Wall areas are estimated at 393 million ha, including 33 million ha restorable in northern Africa, 162 million ha in the Sahara-Sahel countries and 198 million ha in the Kalahari-Namib countries. Combined, that would be the equivalent size of India and represents a great opportunity for large-scale restoration interventions, bigger than anywhere else, in response to both climate change adaptation and mitigation needs.

Photo: FAO - Restored communities' plots with biodiverse native species (Burkina Faso)

Photo: WWF - Maasai cattle herders

WWF Africa Adaptation Initiative (AAI) - Supporting Climate Resilient Future for Protected Areas and Biodiversity in Africa

Geography: 13 African countries (Cameroon, Central African Republic, Democratic Republic of Congo, Gabon, Kenya, Madagascar, Mozambique, Namibia, South Africa, Tanzania, Uganda, Zambia and Zimbabwe); 4 priority landscapes: Tri-National Dja-Odzala-Minkébé -TRIDOM); Southern Kenya and Northern Tanzania (SOKNOT); Greater Virunga Landscape (GVL); Kavango-Zambezi Trans-frontier Conservation Area (KAZA) and one priority seascape: South-West Indian Ocean (SWIO).

Adaptation measures: This initiative aims to support ecosystems and communities to adapt to climate change through enabling knowledge, research, policy and financial frameworks. It has done through building WWF and partners' capacity building (more than 700 people), conducting vulnerability assessments of 263 protected areas; implementing ecosystem based and community based adaptation solutions as well as other adaptation measures: building the resilience of coral reefs and communities, supporting integrated water resources and catchment management (river-bank stabilization, drip irrigation, tree planting, soil and water conservation structures), promoting climate-smart agriculture technologies, promoting water harvesting (infrastructure, drip irrigation and solar water pumps to support water access for farming); mainstreaming adaptation within regional and local strategy/policy processes and communicating adaptation best practices.

Key outcomes: WWF AAI goal is to implement with its partners climate smart conservation programmes that will support climate resilient ecosystems and community livelihoods by 2025. The phase II (2017-2020) outcomes were: Civil Society Organisations (CSOs) engagement has led to national stakeholders undertaking demonstrable Climate Change Adaptation (CCA) policy and practice change; four WWF focal countries (Mozambique, Kenya, Uganda and Zambia) and one priority landscape

(TRIDOM) have mainstreamed adaptation in their work and implemented climate-smart conservation projects; and at least 20 percent of households in the four focal country offices have benefitted from the adaptation activities supported by this programme.

Partners and funding: Local Ministries, Civil Society organisations and Community Based organisations: Kenya Climate Change Working Group (KCCWG); Associação Do Meio Ambiente (AMA); KULIMA; Environmental Management for Livelihood Improvement (EMLI); Conservation and Development Agency (CODEA); Zambia Climate Change Network (ZCCN). Norwegian Agency for Development Cooperation (NORAD), with support from WWF Norway and WWF Denmark, USD 897,000. 2017-2020 (Phase II).

Photo: WWF - Elephant herd in the Maasai Mara

PROJECT SUMMARY

African ecosystems are of great ecological, social, economic and cultural importance, providing resources that can support communities and enable pathways for adaptation to climate change. They also offer significant economic value. Fisheries, for instance, provide up to US$ 2.5 billion per year in economic benefits for Africa, while recreation, mangrove coastal protection and erosion protection can provide up to US$ 11,000 per km^2 per year, US$ 5,000 per km^2 per year and US$ 11,000 per km^2 per year in benefits, respectively.[42] The increasing change and variability in long-term patterns of temperature and precipitation induced by climate change will have a detrimental impact on the biodiversity and effectiveness of protected and conserved areas across the continent, with significant impacts on food, water, energy and health. These changes will also threaten the foundations of many rural and urban livelihoods. By 2100, climate change could result in the loss of more than 50 percent of African bird and mammal species, a 20-30 percent decline in the productivity of Africa's lakes and significant loss of African plant species.[43] For terrestrial systems, most studies indicate that Africa will be much more significantly affected than other regions.[44] The reality of climate change driven nature loss is critical for both people and biodiversity. In the absence of action, the world stands to see US$ 10 trillion wiped off the global economy over the next 30 years, with developing countries and regions like Eastern and Western Africa being particularly affected.[45]

Recognizing the alarming impacts that climate change poses the long term conservation and development goals in Africa, WWF has been supporting climate change adaptation in Africa since 2011 through its Africa Adaptation Initiative regional programme. The vision of the program is an "Africa where people and nature have enhanced capacity and resources to adapt to climate change."[46] Efforts have been focused on capacity building, vulnerability assessments, policy advocacy, resource mobilization and building resilience at ecosystem and community level across Eastern, Southern and Central Africa.

During its phase II (2017-2020), the WWF AAI has invested in better understanding how climate change is going to impact the future of Africa's protected areas (PAs) and associated species. Several studies were commissioned in collaboration with Anchor Environmental Consultants, to understand the level of vulnerability of 263 protected areas (PAs) across Sub-Saharan Africa to climate change and to develop strategic recommendations aimed at supporting these critical areas to adapt to climate change. This was done by assessing the potential impacts of climate change on these protected areas in terms of habitat change, species loss, increased resource pressure, and the adaptive capacity through their level of financing (in terms of loss of infrastructure and tourism demand) and the extent to which expansion of the protected areas is feasible.[47]

Photo: WWF - Maasai cattle herders

Of the 263 PAs assessed, only four protected areas (1.5 percent) are resilient to climate change (three in Central Africa and one in Southern Africa), 150 (57.0 percent) are highly vulnerable and 109 (41.5 percent) vulnerable. No habitat change is predicted for 109 protected areas while for seven PAs, more than 60 percent change in habitat is predicted by 2050 (one in Central Africa, three in Eastern Africa and three in Southern Africa). More than 50 percent of the 37 PAs' species are predicted to no longer find the PAs climatically suitable by 2050. The assessments have identified key adaptation responses for biodiversity to be implemented across WWF intervention areas. These include (i) creating and rehabilitating climate refugia for biodiversity (areas that remain relatively buffered from contemporary climate change) (ii) preserving the most resilient ecosystems, (iii) restoring, creating and facilitating wildlife dispersal area and movement corridors, within and outside protected, (iv) developing dynamic transboundary strategy and plans to ensure joint management of climate impacts on biodiversity and people, (v) strengthening local and transboundary monitoring of biodiversity responses to climate change and , species and ecosystem interactions and (vi) assisting communities' resilience building through nature-based livelihood activities.

One of the key areas where WWF has conducted this climate change vulnerability assessment is the Greater Mara Ecosystem (GME) within the SOKNOT landscape. The GME covers an area of approximately 4,500–6,650 km^2 within the Mara River Basin, forming the Kenyan section of the Serengeti-Mara Ecosystem. The Masai Mara ecosystem has been regarded as one of the natural wonders of the world, as it supports the most diversity of migratory grazing mammals, including the great migration of more than one million wildebeests annually.[48] About one third of the GME is protected under the Masai Mara National Reserve (MMNR), managed by the government of Narok County and the Kenya Wildlife Service (KWS), while the remainder falls within a number of smaller conservancies under the jurisdiction of members of the Kenyan Maasai community. The GME area, although it comprises only a quarter of the complete ecosystem area, is crucial to the entire system as it provides forage for wildlife during the dry season. Furthermore, GME is estimated to host around 25 percent of the wildlife in Kenya.[49] Tourism is vitally important to the region, but around 55 percent of its annual household income comes from livestock grazing. The conservancy land lease model introduced in 2006 has attempted to integrate these two activities by allowing landowners to partner

with tourism operators, creating privatized Masai rangelands that have supported wildlife and tourism and provided landowners with a steady source of income through lease payments.[50]

Climate change projections for the region point to modest and seasonally variable increases in precipitation (5-10 percent), while temperature increase is likely to be between 2.5^0 and 3.5^{0}C by the end of the century.[51] Changes in precipitation, temperature and land use patterns (such as converting forests to agricultural or pasture lands) are likely to reduce dry season flows and increase peak flows. Studies have highlighted that the basin is highly vulnerable under high (+25 percent) and low (-3 percent) extremes of projected precipitation change.[52] Climate change is also likely to exacerbate many of the current pressures faced by the GME, including changes in wildlife migration patterns, water quality and flow changes, human-wildlife conflict (competition for scarcer resources) and tourist visits. Modelled species distributions indicated that 13 percent of species assessed in the MMNR will no longer find the MMNR climatically suitable by 2050, coupled with an increase in predicted habitat change of 25 percent.[53] Thus the MMNR is considered to be highly vulnerable to climate change with a vulnerability score of 25.5 percent.[54]

To counter these growing threats, conservation measures need to be strengthened and a holistic strategy to increase the resilience and effectiveness of the MMNR and conservancies must be implemented. Ecosystem-based adaptation provides a route through which conservation authorities can tap into international climate financing and implement strategies that provide several co-benefits for rural communities and also address non-climatic stressors. Strategies identified for increasing resilience of the Greater Mara Ecosystem are: extending the conservancy model to incorporate more land, including critical migratory corridors to the east of the MMNR; restoring degraded and more viable areas to climate change; securing environmental flows along the Mara River through better environmental protection of source and catchment areas, sustainable rangeland management and conservation farming methods, protection of buffer areas next to rivers, and adequate sanitation and treatment of waste water; strengthening management of species at high risk. Additional adaptation measures include promoting rainwater harvesting and diversifying the livelihoods of local communities through ecotourism, beekeeping, use of non-wood forest products and programs to improve market access as well as developing an overarching spatial management plan for GME that outlines the monitoring and protection of river systems and catchments and establishes riparian buffer zones to prevent flood damage. In the long term, efforts should be made to establish the Serengeti-Mara Ecosystem as a trans-frontier park.[55]

Going forward, the WWF will support translating the recommendations from the vulnerability assessments done for 263 PAs, into practical ground solutions to safeguard the functions of the most representative biodiversity areas in Africa and community dependent livelihoods and services. The regional programme will invest more in Nature Based Solutions work that leverage measurable and effective adaptation benefits for biodiversity and people in Africa. For the upcoming Africa Protected Area Congress (APAC), taking place in Kigali, Rwanda in March 2022,[56] WWF will push forward the development of a regional strategy on climate change and sustainable management of protected and conserved areas to drive transformational knowledge, solutions, effective policy and sustainable finance for the benefits of biodiversity and people in Africa.

Great Green Wall Initiative

Photo: Horia Cosmicos/Shutterstock

The Sahel forms the vast semi-arid belt that separates the Sahara Desert to the north and the tropical savannas to the south. Spanning an area of more than 3 million km^2, it stretches across 20 African countries, from Senegal in the west to Ethiopia in the east.

The region faces critical challenges: approximately 55 percent of fragile land is highly susceptible to degradation in the Sahel and other African regions; the Sahel has one of the fastest growing populations in the world, with a total population of more than 600 million that is growing at 3 percent per year; it includes countries with some of the lowest rankings on the Human Development Index (Burkina Faso, Chad, Mali and Niger are among the last 10 countries on the index); its subregions are riddled with internal conflict that has internally displaced nearly 1 million people in Burkina Faso, Chad, Mali and Niger[57]; and nearly 15.5 million people were on the brink of severe food insecurity as of 2020, a five-year high.[58] These challenges are further compounded by the growing impacts of climate change.

Studies in the recent years have identified the Sahel as the global hotspot for climate change. Climate models[59] point to a very likely increase in temperature of 3-6^{0}C by the end of the century, from a 1986-2005 baseline.[60,61] The Sahel has been identified as one of the regions where these unprecedented climates are projected to occur the earliest—by the late 2030s to early 2040s—even under a lower-emission scenario.[62] Furthermore, even at 1.5^{0}C warming, precipitation is expected to increase and associated flooding is projected to intensify for most regions in Africa apart from the far west Sahel.[63] Overall, models suggest an increase in precipitation over the central Sahel and a decrease over the western Sahel.[64] The combined effects of temperature and precipitation changes will also have impacts on surface water levels, with a 20-40 percent decline in river flows projected by 2050.[65]

Climate change impacts will also have a detrimental effect on the Sahelian livelihoods, particularly in agriculture, which will face significant reduction in crop yields, leading to further impoverishment in a region that is already grappling with one of the highest levels of multidimensional poverty in the world.[66] Dependence on livestock and agriculture

renders approximately 50 million people in the Sahel highly vulnerable to the impacts of climate change.[67] Climate disasters in recent years have eroded resilience, exacerbating turmoil and conflict and the resulting displacement in the region. Flooding in Lake Chad in 2019, for instance, displaced 100,000 people in an active conflict zone.[68] In 2020, flooding in the Sahel region affected about 760,000 people in Burkina Faso, Cameroon, Chad, Ghana, Mali, Niger, Nigeria and Senegal.[69,70]

The Great Green Wall initiative (GGWI) is a large-scale restoration program to halt environmental degradation and desertification across the African continent. At the time of its conception in 2007, the African Union envisaged the GGW as a "wall of trees" stretching more than 7,000 km long and 15 km wide. However, at about the same time, studies pointed to a steady retreat of the southern border of the Sahara Desert and the greening of several parts of the Sahel.[71] The retreat was probably due to a decadal change to wetter weather patterns in the region and a reduction in aerosol emissions in the Northern Hemisphere that increased aridity during the 60s to 80s.[72] As a result, the efforts surrounding GGWI evolved from simply planting a "wall of trees" to a mosaic approach that builds resilient land use systems with the capacity to adapt to uncertainty and climatic extremes and to enhance the livelihoods of local people and provide long-term solutions for improving environmental and socio-economic conditions in the zone.[73] In its current configuration, the GGWI has become Africa's flagship initiative to combat land degradation, desertification and drought, with a vision of restoring 100 million ha of currently degraded land, sequestering 250 million tons of carbon and creating 10 million green jobs by 2030.[74,75]

In addition to the 21 countries engaged in the initiative, a number of governmental and non-governmental international implementation partners also support the GGWI, including the European Union, Government of France, African Union, FAO, GEF, IUCN, World Bank, United Nations Convention to Combat Desertification (UNCCD), UNEP, Permanent Interstate Committee for Drought Control in the Sahel (CLISS) and Sahara and Sahel Observatory (OSS), among others.

The activities undertaken under the GGWI are broadly clustered under five major strategic axes: sustainable land management and green economy; climate change, socio-economic development and governance in the localities; support for research and development; communication, marketing and advocacy; and information systems, observation, early warning and response. From the program's launch in 2011 through 2019, more than US$870 million had been mobilized in external funding, with GGWI programs covering a total area of 154 Mha, 10 times the size of the originally proposed belt.[76] The largest intervention zones are located in Niger (47.3 Mha), Mali (44.4 Mha), Ethiopia (13.2 Mha) and Eritrea (12.4 Mha).[77]

Figure 1: Funding for multi-country projects reported by international donors (in USD million)[78]

GGWI encompasses a variety of sustainable land management (SLM) activities, including forestry and agriculture initiatives like land restoration, agroforestry and assisted natural regeneration, and soil and water conservation measures like watershed management, construction of boreholes and irrigation systems and building terraces/soil measures. Several transboundary programs (see Figure 1) have been implemented to support the GGWI at the regional level, including the Sahel and West Africa Program (SAWAP) led by the World Bank and GEF, which follows a "mosaic approach" aimed at incremental improvements in oils, nutrient and water management and at reducing the risks of climate change and disasters across 12 African countries.[79] The interventions aim to build community resilience by tackling the root causes of land degradation and to alleviate land tenure insecurity in the region through the issuance of land certificates. Additionally, the program also receives complementary support from the Building Resilience through Information, Communication, and Knowledge Services (BRICKS) project, led by CLISS, OSS and IUCN, which was responsible for facilitating regional learning and monitoring and evaluation to support the SAWAP. These management approaches also address landscape perspectives (including watersheds), community planning, and conservation of biodiversity, including through biological corridors and protected areas Other large-scale interventions supporting GGWI include:

- The Front Local Environnemental pour une Union Verte (FLEUVE) project (2014-2018) developed by the UNCCD's Global Mechanism with funding from the European Union, which aims to improve the livelihoods of drylands populations and strengthen their resilience to land degradation, drought and climate variability through micro-projects and SLM interventions implemented in 23 communities across five countries.
- FAO's Action Against Desertification Program (AAD) (2014-2019), which aimed to build the capacity of rural communities, government and NGO partners to create an enabling environment for large-scale restoration, implement programs for creation of income-generating activities and employment opportunities in rural areas, and establish farmer field schools and knowledge exchanges to combat desertification.
- The Boosting Restoration, Income, Development, Generating Ecosystem Services (BRIDGES) program (2017-2020) led by the FAO-Turkish Forestry Partnership to promote south-south cooperation to combat land degradation and desertification through restoration, which has reinforced the value chains of non-wood forest products, along with building information and monitoring systems and knowledge sharing.
- GEF's Closing the Gaps in Great Green Wall: Linking Sectors and Stakeholders for Increased Synergy and Scaling Up project developed by UNEP and implemented by IUCN (2016-2019), which carried out its aims through enhanced investments, inter-sectoral coordination and engagement of marginalized groups.
- The Large-Scale Assessment of Land Degradation to Guide Future Investment in SLM in the GGWI Countries project (2019-2024) funded by GEF, NASA and USAID, which aims to strengthen science-based evidence. The program brings together several knowledge partners from the region as well as international institutions (e.g. the French National Research Institute for Sustainable Development, University of Lund/Sweden, and European Space Agency).

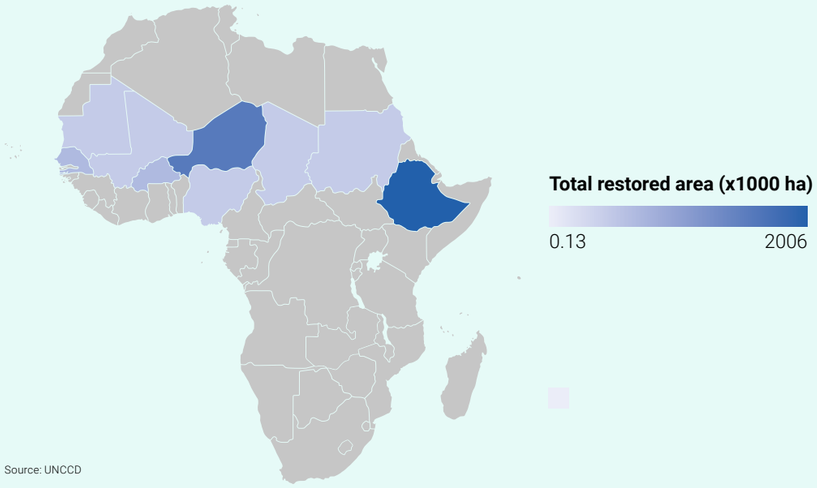

Photo: BOULENGER Xavier/Shutterstock

As of 2021, additional funds of around US$ 16.85 billion have been pledged as part of the GGW Accelerator initiative.[80] The GGW Accelerator aims to transform livelihoods through comprehensive rural development initiatives and by creating a mosaic of green and productive landscapes across 11 countries (Senegal, Mauritania, Mali, Burkina Faso, Niger, Nigeria, Chad, Sudan, Ethiopia, Eritrea and Djibouti).[81] The Accelerator aims to build a GGW Online Platform by 2025 that will monitor, track and connect financing flows with project needs and implementation results; support countries in establishing related monitoring, reporting and verification systems; track implementation in beneficiary countries; and evaluate the impact of accelerator investments and progress made towards the 2030 GGW ambition.[82] The African Development Bank (AfDB) has also pledged to mobilize US$ 6.5 billion towards the GGWI over the next five years. The AfDB has made the Sahel a top priority for investment and for mobilizing new sources of financing to advance climate adaptation opportunities. It will also scale up the Technologies for African Agricultural Transformation (TAAT) program in support of the GGWI, providing access to improved and heat tolerant seeds.[83]

Even before the launch of the GGWI, farmers in the Sahel region were transforming their practices to minimize degradation; for instance, turning to a low-cost method of growing trees and shrubs, using root stock in their cleared fields and using these trees for fuel, fodder for livestock, food and soil improvement. Early evidence showed that nearly 5 Mha of land had already been restored in Niger as of 2011 and 0.5 Mha in Mali.[84] This success was mainly attributed to the adoption of farmer-managed natural regeneration (FMNR), with farmers ''changing the way they manage trees and their perception of the trees'' by going back to the agroforestry practices native to the region. Community ownership and co-creation are, therefore, essential for ensuring that the benefits of the restorative efforts are sustained. A sense of ownership is also key when creating and linking new markets, engaging other assets at scale or enabling diversification into other forms of livelihoods. Interventions need to build on grassroots efforts, while addressing legal issues like tree ownership and creating markets for the products of agroforestry. Projects must also consider local and traditional knowledge, especially when selecting tree species for restoration. Several key species, like Faidherbia albida, a nitrogen-fixing acacia species, have formed an integral part of the FMNR activities implemented by farmers in the Zinder region in Niger. More recently, projects like the Provision of Adequate Tree Seed Portfolio (PATSPO) in Ethiopia have allowed scientists to work with local institutions and communities to identify desirable tree species that are well adapted to local conditions.[85,86]

As of 2020, the GGWI had restored 4 Mha of land within the GGWI intervention zones (see Figure 2) and nearly 17.8 Mha when taking into account all lands restored in the wider GGWI region (between 2007-2019).

Figure 2: Total restored area as reported by 11 GGW member states as of 2019



Source: UNCCD

Current restoration activities have the potential to sequester up to 256 Mt carbon dioxide equivalent in woody biomass and up to 57 Mt of carbon dioxide through the soil by 2030. Agroforestry and SLM activities have also led to the creation of more than 335,000 job opportunities, as well as helping to reduce poverty through income generating activities such as the production and valorization of different fruit and non-timber forest products like honey, Arabic gum, baobab leaves, etc. The revenues from these activities since 2007 have amounted to approximately $90 million across 11 countries, with Niger alone having revenues of $81 million. Overall, nearly 500,000 people have benefited directly from the GGWI activities while another 10.2 million beneficiaries have been reached by the wider regional activities.[87]

To realize its vision of restoring a total area of 100 Mha by 2030, the pace of current restoration activities needs to be sped up to 8.2 Mha/year from the current 1.9 Mha/year. Comparing the average costs for land restoration across Africa ($440/ha) and within the Sahelian region (for instance, the average cost of $530/ha incurred by the SAWAP activities) points to a projected funding gap of approximately $3.6 billion to $4.3 billion per year through 2030.[88] These estimates, however, do not consider the resources needed for capacity building, training farmers or effecting changes in land use policies and governance structures.

To close the funding gap, there is a need to develop mechanisms through which funding and support is also mobilized from the private sector. The Inclusive Green Financing initiative (IGREENFIN) funded by GCF and implemented by IFAD is one such project under the GGWI. It aims to create an enabling environment for investments in adaptation, mitigation and climate technologies by removing the barriers faced by local public development banks, helping them to establish green lines of credit and building the capacity of both banks and smallholder farmers. The aim of the project is to scale its interventions to 12 African countries (Burkina Faso, Côte d'Ivoire, Ghana, Mali and Senegal in Phase 1 and Chad, Djibouti, Eritrea, Ethiopia, Mauritania, Nigeria and Sudan in Phase 2).[89]

Scaling up also requires projects to overcome several governance challenges. Previous experiences with GGWI projects have highlighted key challenges, including: lack of necessary institutional structures (e.g. establishment of national GGW agencies); lack of support from private, non-governmental and research sectors; lack of mainstreaming of environmental management practices into sector strategies, policies and action programmes; lack of coordination, exchange and flow of information and knowledge across the GGWI structures and at the regional and national levels; and the failure of GGWI national agencies to endorse an intersectoral ”landscape approach” that goes beyond jurisdictional borders, mandates and the institutional power of the ministries of environment in each country.

Adopt a tree, record a tree

Tree Adoption Uganda

At Tree Adoption Uganda (TAU), we are powered by the vision of creating communities where both people and nature flourish. We build the resilience of smallholder farmers against climate change by restoring landscapes through tree planting and agroforestry; and train unemployed young people in rural communities to set up and manage indigenous tree nurseries and farms. By planting trees, we restore degraded landscapes and soil, combat desertification, and increase farmer resilience against climate change.

We have worked with TreeCorder in collaboration with our partners at Ecomatcher Ltd – a user-friendly technology platform and mobile phone application that records data on every tree planted, and saves it on the Cloud to be immediately accessible by anyone. With one click, TreeCorder records an image of the tree, its species, GPS position, name of the person who planted it, and the date it was planted. This eliminates any doubts on tree planting data, and promotes accountability for evidence-based adaptation action.

We have worked with over a thousand households to plant more than 300,000 indigenous trees, half of which are mapped on TreeCorder. In addition to training 3,000 young people on activities ranging from grafting, pruning and propagation to managing interactions between humans and nature, we have established 14 environment clubs in schools to stimulate stewardship of the environment through environmental education.

Communities in Uganda are already significantly affected by climate change impacts such as changing weather patterns, water stress, floods, prolonged droughts, landslides, and diseases. At the same time, the forest cover in the country has come down from over 4.5 million hectares in 1990, to less than two million hectares in 2015.[90] The combined impacts of deforestation and climate change has the biggest impact on the rural poor, who rely on subsistence agriculture and the environment for their needs. We believe a concerted and multi-partner approach is needed to adapt to climate change, so we are partnering with the Government of Uganda

Photo: Rachel Landman/Shutterstock

to plant and map 200 million trees over the next five years as part of the Running Out of Trees campaign. As part of the campaign, TAU will plant 200,000 indigenous trees in central and eastern Uganda over the next year, restoring 1000 hectares of land; and extend our environmental education activities.

TAU has also worked to reduce the causes of deforestation by training a thousand households in Bwaise, an urban slum in Kampala, in the conversion of organic waste into briquettes for cooking fuel instead of firewood. The households were taught skills in waste handling, sorting, and drying using low-cost and locally made technology, to provide them with livelihood skills at the same time. This project will be scaled up to the rest of the country starting with the Manafwa watershed. This watershed is part of Mount Elgon National Park, and one of the most highly populated areas in Uganda, with over 90 percent of the population dependent on biomass energy. This results in forest degradation and encroachment into the National Park. Community members will be trained to convert post-harvest agricultural waste and biomass, usually burnt by farmers, into briquettes for domestic use and income generation.

We believe that more corporate organizations and individuals will be willing to invest in the kind of work we do if we are transparent and accountable, and the impact on adaptation will be huge.