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Newsletter of the Grassland Society of Southern Africa

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Crucial to protect mangrove forests

Controlling parthenium on game and livestock farms

Advancing Rangeland Ecology and Pasture Management in Southern Africa

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In this issue

From our editor

Dear reader,

The end of 2022 is drawing near and this is already the last issue of Grassroots for 2022. Here are the highlights and some food for thought to fill your last days at the office before the holidays start:

Parthenium on game and livestock farms is said to "bring famine and desolation to the land". In our feature article, Jeremy Goodall and his team explain how certain management practices can be used to maintain the plant at low densities that are not problematic. An invasion of *Opuntia aurantiaca* (jointed cactus) in South Africa is also reducing valuable grazing land. Learn more about this invasion and how to control it in our feature article by Sive Tokozwayo.

The COP27 summit made news headlines for the past month. Read all about the debate by world leaders on the role of livestock in climate change on page 11. Heidi-Jayne Hawkins, a research director and fellow at Conservation International feels that the science to mitigate climate change is clear, but the progress is slow. She spoke to University World News about her cross-cutting research that focuses on natural climate solutions, which support climate resilience and mitigation.

Barry Meijer is a regenerative farmer in the Klein Karoo and has been incorporating a free satellite-based tool (FruitLook) to efficiently manage the irrigation of his planted pasture. Read all about this educational and inspirational story on page 21.

I am also officially signing off (again!) as editor of Grassroots and handing over to our new editor, Lisa Matthews. Special thanks to my team (Marnus Smit, Francuois Muller, Jamie Paulse, Erica Joubert and J.C. Aucamp) for all your hard work and support. May *Grassroots* grow vigorously!

Enjoy the read!

Merry Christmas & Happy New Year

Malissa

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Despite the care and attention that we devote to the structure of this newsletter and the information it contains, the Grassroots Editorial Team cannot guarantee the completeness and accuracy of the data. The opinion expressed in each article is the opinion of its author and does not necessarily reflect the opinion of the editorial team.

TREE OF THE MONTH

Ficus sur

Broom cluster fig / Besembosvy

RSA Tree No. 50

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Figure 1. Illustration of mature tree. treesa.org

The broom cluster fig is a medium to large tree that can grow 12 – 30 m high. Trees tend to grow much larger in forest habitats. It is one of the more common and widely distributed fig species in South Africa, occurring from Knysna in the Western Cape, along the eastern coast of South Africa, into Limpopo and further north into eastern and northern Africa and the Arabian Peninsula. The species usually grows on riverbanks or in riverine forests but can also be found in drier woodlands and bushveld as well as other frost-free habitats with moderate rainfall. "*Ficus*" is the Latin name for fig while "*sur*" refers to an area in Ethiopia named Sur.

Diagnostic features

- The green to grey-green, simple leaves are oval to ovate shaped. They may have hairy undersides.
- Figs possess a flower head that is called a Syconium, which is the expanded tip of the flower stalk from where the floral parts develop.
- The fruit (figs) are round and green when unripe, turning red when ripe. The figs are carried in massive clusters at the tip of hanging branches.
- The broom cluster figs fruit is the largest of all the indigenous fig species.
- The bark is smooth and white to pale grey in colour, often with a green tinge.

Figure 2. The figs are the most prominent diagnostic feature and often carried in large clusters. zimbabweflora.co.zw

Figure 3. The green leaves are typically oval to ovate shaped. treesa.org

Ecological value and uses

The fig tree is often regarded as a keystone species as it provides food, shade and shelter to a vast number of animals. The leaves are consumed by cattle, goats and sheep and many wild herbivores. Young leaves can also be cooked and eaten by humans. The figs are eaten by all fruit-eating birds and mammals, which are also the disperses of the seed. The fruit of all indigenous fig species is edible. The large, sweet, figs of this species are used to make jam and fig preserve.

The wood can be used to ignite fire through friction as well as for making mortars to grind flour. The soft texture of the wood also makes it ideal for making brake blocks and bed boards for ox wagons. Although the Broom cluster fig tree can be planted as an ornamental in gardens, care should be taken as the surface roots are invasive and can easily lift paving and damage pipes and walls.

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KAROO PLANT OF THE MONTH

Figure 1. A hillside dominated by kraalbos due to historic overgrazing.

Figure 2. Kraalbos in seed.

Galenia africana
Kraalbos

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Kraalbos is a yellow to bright green shrub, growing up to a meter tall under favourable conditions. It is found in disturbed areas from southern Namibia to the western parts of the Eastern Cape.

It is generally replaced by the *Galenia procumbens* to the north and west of its range. Kraalbos is fairly common across its range and is only absent from some fynbos vegetation on higher elevations.

Diagnostic Features

- A large yellow-green shrub with soft leaves of 20 mm long.
- New leaves appear bright green and will turn yellow with age.
- The tiny cream-yellow flowers are borne on spreading inflorescences.
- Kraalbos is almost exclusively found on disturbed areas, such as road edges, old lands, kraals or overgrazed veld.
- Kraalbos will turn progressively more yellow as it is drought-stressed. Plants under severe drought will drop their leaves.

Ecological value

Kraalbos is unpalatable to stock animals and to most game species. It causes ascites (waterpens) in goats and sheep, which can often be fatal. If stock animals are browsing kraalbos it may be an indication that no palatable fodder is available in the given camp.

Due to its ability to colonise bare ground, kraalbos is an excellent indicator of disturbance. Large numbers of kraalbos seedlings are an indicator of deteriorating veld condition. Kraalbos is a valuable pioneer of bare ground and may prevent soil erosion, however, it has no value from a livestock grazing perspective and may cause stock losses due to poisoning.

Figure 3. Kraalbos leaves and seeds.

Figure 4. Kraalbos showing orange-yellow colour due to drought stress.

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How to control *parthenium* on game and livestock farms

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Reprinted from: https://bit.ly/3Y4pnCU

It has been said that *parthenium* (*Parthenium hysterophorus*), a serious weed indigenous to Central and South America, is a scourge that brings famine and desolation to the land. While there may be substance to this illusion, the fact is that parthenium is just a plant that has a few traits enabling it to dominate under certain conditions, particularly if land is not suitably managed.

However, a notable weakness can be exploited to keep the plant in check. It is important for landowners to know the conditions that cause parthenium to thrive, so that suitable management practices can be used to maintain the plant at low densities that is not problematic. This outcome can be accomplished by maintaining moderate levels of animal and veld husbandry.

Characteristics of the plant

Parthenium is an annual weed that grows extremely rapidly – developing from seed to flowering state in under a month – and can reach up to two metres in height. A wide range of temperature conditions are tolerated, enabling it to grow in areas that receive less than 100 mm rainfall per annum. It is a pioneer plant that rapidly dominates disturbed sites and ground denuded of grass, making it highly problematic in overgrazed or highly disturbed land.

A single plant can produce around 15 000 seeds in its short lifespan, which may survive for at least ten years if buried in the soil. The chink in its armour is that *parthenium* is a poor competitor with other vegetation, and if conditions are set that allow for good grass cover, *parthenium* will not be able to dominate, making it considerably less problematic.

Veld assessments, stocking rates

Parthenium has the potential to grow in much of South Africa. However, the

Figure 1. A *parthenium* stand in the Ndumo Game Reserve. The weed is highly problematic in overgrazed or highly disturbed land.

Figure 2. These photographs are of the Makhathini grazing camp in northern KwaZulu-Natal in November 2016 (left) and April 2018 (right). A combination of biological control agents and limited livestock access was used to reduce *parthenium* infestation.

worst infestations are in the northern and eastern subtropical parts of the country, such as the Lowveld. These bushveld areas are also home to most of the country's game farms, because they sustain high levels of biodiversity and the sweetveld can be grazed year-round. Good quality sweetveld has a low grass basal cover of approximately 15% with a high grass canopy cover, which will effectively keep *parthenium* at low densities.

Soil and grass cover are major resources that need to be managed carefully to maintain a viable game enterprise. Game farmers need to conduct regular veld condition assessments and adjust stocking rates and animal ratios accordingly so that the veld does not deteriorate. Failing to do so is an open invitation for *parthenium* to invade.

With *parthenium* in mind, it is equally important to have the correct mix of selective and non-selective grazers. Selective grazers such as wildebeest, impala and blesbok are able to modify grass composition and cover because they use their lips to select the plants they wish to eat. Animals such as cattle, zebra, buffalo and elephants are non-selective in their grazing habits, because they generally use their tongues for grazing or because they consume large amounts of material while grazing.

To ensure good veld cover and composition, the general principle is to keep stocking rates at roughly 50% of the farm's carrying capacity for venison production and trophy hunting, or over 50% for ecotourism and sport hunting. It is also important to maintain the metabolic mass of selective and non-selective grazers at a 1:1 ratio – for example, one cow or buffalo to six impala or two blue wildebeest.

Rehabilitation of veld

The first step in rehabilitating areas that are invaded by *parthenium* is to restrict animal access – for example, cutting down thorn trees and spreading the bush over the infected site will help reduce disturbance by grazers. Promoting the growth of unpalatable grasses in the brush will improve ground cover and increase competition against *parthenium*. Application of broadleaf herbicide may be necessary in dense *parthenium* stands to aid the establishment of grass in the first year.

Resting of veld enables grass recovery and is recommended on cattle farms. However, this may not be possible on game farms that do not have camps, and stocking at half the carrying capacity is therefore vital for good veld cover.

Mlawula Nature Reserve in Eswatini successfully managed *parthenium* at one stage by reducing the number of grazers in a bid to reduce grazing pressure. This enabled the recovery of good veld cover, which suppressed *parthenium*. Another example comes from the Makhathini Flats in northern KwaZulu-Natal.

In this instance an infestation of *parthenium* in a livestock grazing camp was rapidly overwhelmed by grass and broadleaf herbs, once livestock access was limited to restricted periods only. This was done in combination with the introduction of biological control agents.

Employing biological methods

Biological control using natural enemies that can only survive on *parthenium*, have been used to successfully manage the weed in Queensland, Australia, for several decades, and more recently in South Africa. Two rust fungal pathogens and three insect agents are utilised in South Africa – the research on this type of biological control is ongoing.

Biological control is a long-term strategy as the agents can take time to become widespread and fully effective. Biological control does not aim to eradicate *parthenium*, but by combining it with other management options it can reduce the weed to more manageable levels over time.

However, it is critical that game and livestock farmers must first and foremost be custodians of good veld management. Grazing pressure must also be kept at levels where it is not injurious to the soil or grass.

Good veld management and biological control will assist to keep the weed at low densities. *Parthenium* is an aggressive opportunist; the resource base is a landowner's shield, and conservation of soil and grass cover is the best form of defence.

Good veld management practices and the use of biological control is the best arsenal, for against these weapons *parthenium* has limited defences.

For more information, send an email to Jeremy Goodall at GoodallJ@arc.agric.za.

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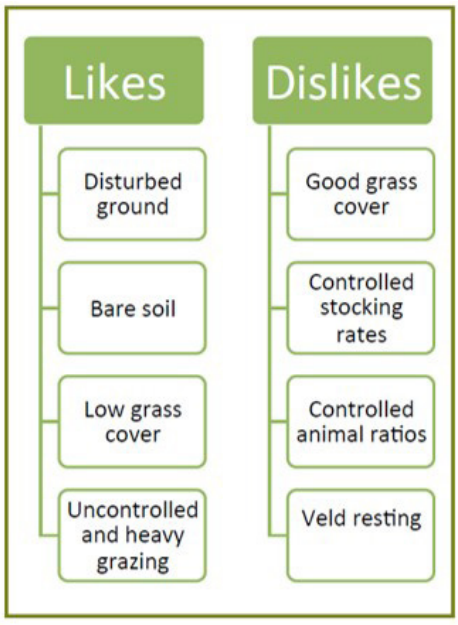

Figure 3. Likes and dislikes of the *parthenium* weed.

Invasion of *Opuntia aurantiaca* (jointed cactus)

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Jointed cactus came from South America (eastern Argentina and southern Uruguay). In South Africa, the plant can be found in the Eastern Cape, Northern Cape, KwaZulu-Natal, Free State, Gauteng, Limpopo and Mpumalanga. Jointed cactus is characterised by spiny, many-branched, spreading succulent up to 1,5 m high with underground tubers. The plant has no leaves, but have flattened leaf-like stem which is bright green, sometimes tinged with reddish-purple and covered in sharp, needle-like thorns.

The flowering occurred from November to January and produces sterile reddish succulent fruit. Uncontrolled infestations of jointed may reduce the grazing capacity of grazing lands. Jointed cactus may disperse through floods, vehicles, animals and wind. According to National Environmental Management: Biodiversity Act (Act No 10 of 2004)- jointed cactus falls under Category 1b which necessities its eradication. Cactus can be controlled by biological (cochineal) and chemical (monosodium methanearsonate) (MSMA). Burning is recommended for not heavily infested areas.

Introduction

Scientific name: *Opuntia aurantiaca*
Common name: Jointed cactus, jointed prickly pear, tiger pear, tiger-pear
Family name: *Cactaceae*
Origin of Jointed cactus
Opuntia aurantiaca commonly known as jointed cactus, jointed prickly pear, tiger pear and tiger-pear), belonging to the family name of *Cactaceae*. Jointed cactus originated from Argentina, Paraguay and Uruguay. Jointed cactus came to South Africa (Cape town) in 1843 as an ornamental plant. It was taken to the Eastern Cape by settlers and planted as an ornamental in gardens and graveyards.

The plant escaped into the veld and was first reported as weed in the Bedford district in 1892. Today, the jointed cactus is well adapted to grow in a different climatic weather conditions or habitats.

Jointed cactus transmitters

Animals, vehicles, floods and wind.

Plant morphology

Cactus is an inconspicuous (unnoticeable) perennial succulent which grow up 2 m or less with in with underground tubers. Jointed cactus is characterised clustered spines (200 mm long), fleshy segments or joints (50-200 mm long) with the width ranged from 10-30 mm. Young joints are slightly flattened and have a bright green colour while older joints become cylindrical in shape. Jointed cactus becomes slim with long joints in high rainfall areas whereas spines develops shorter and thinner. In bush environment joined cactus may grow up to 2 m height. During the drought joints becomes red to purplish colour. The spines grow in groups from greyish colour areas on the joints called areoles. The joints detached itself during drought times. Spines are grouped and positioned in such way that it may hook anything passes the plant.

Stem and leaves

Stems are dark green to purplish in colour, much-branched, and consist of a series of rounded, almost cylindrical segments. The spines are very sharp, rigid, and minutely barbed near their tips. The leaves are reduced to small cone-shaped structures and shed when the stems are still young.

Flowers and fruit

The flowers are bright yellow, 30 to 40 mm long. Small green to reddish club-like fruits are formed which readily become detached from the plant. The immature fruit are green in colour, but turn red to purplish as they mature. Jointed cactus flowering occurred in summer season (November and January). Jointed cactus fruits (20-35 mm long) are fleshy, spiny, and egg-shaped to somewhat pear-shaped. The seed produced

Figure 1. Vehicle as one the seed dispersal.

Figure 2. The entire plant of jointed cactus (stem, leaves and fruits).

Figure 3. Stem, leaves and cluttered spines of jointed cactus.

Figure 4. Jointed cactus during its flowering stage (November to January).

Figure 5. Segments of jointed cactus.

Figure 6. Large jointed cacti in the veld

by joined cactus is always not viable (sterile).

Habitat of jointed cactus

In South Africa, jointed cactus can found in the Eastern Cape, Northern Cape, KwaZulu-Natal, Free State, Gauteng, Limpopo and Mpumalanga. In Eastern Cape, the plant has been reported in Bisho Thornveld, Queenstown Thornveld, Great Fish Noorsveld (i.e open woodlands, fence-lines, roadsides and stream-banks).

Growth and reproduction

The matured joints may detach from the main plant, reaches the ground and develop into a tuber, and functions as a storage organ. Formulation of new joints commences in early spring and continues until March or April.

These joints normal drop-off in winter, but joints may anytime if the plant is under water stressed due to prolonged drought. Jointed cactus propagates itself by vegetative means, all the seeds produced by this plant are sterile. Detached joints and fruits from the main plant to the ground develops roots and new joints whenever conditions are favourable.

Jointed cactus uses a specialised type of metabolism which is unique to many succulents, detached joints and fruits can survive for a very long time. Cactus species have a remarkable drought resistance characteristic. Joints are disseminated by water or floods; new infestations often appear long river banks.

Negative impact of jointed cactus

Jointed cactus is most noxious plant to both wild and livestock (causes injuries to grazing or browsing animals). The sharp spines penetrate the skin causing sores, abscesses and often lameness in small stock. Spiny joints also become lodged in the hair and wool of animals resulting inconvenience to handlers and reducing the wool quality. Cactus infestation reduces the grazing capacity of the veld. Jointed cactus has a potential of replacing acceptable grasses. In the past, dense and uncontrolled infestations have made farming altogether impossible.

Figure 7. Jointed cactus has sharp thorns that easily attach to passing animals and people.

Control measures

In South Africa jointed cactus can be controlled by cochineal and Monosodium methanearsonate (MSMA). MSMA is an organic arsenical pesticide currently registered for use in the United States. MSMA is a broad spectrum herbicide used to control grasses and broadleaf weeds. Burning is recommended in low density areas, harvested and allow the plant to dry and burn it later.

Conclusion and recommendation

In terms of the Alien and Invasive Species Regulations (AIS), National Environmental Management: Biodiversity Act (Act No 10 of 2004), jointed cactus has been declared a category 1b species, which necessitates its removal and destruction. Trading or planting of jointed cactus is illegal in South Africa.

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Climate and Livestock: COP27 round-up

PASTRES

Reprinted from: https://bit.ly/3HgalEq

At COP27 world leaders have failed to address the climate and livestock debate thus failing to diffuse the misleading and dangerous narratives villainising livestock for climate change. Instead, livestock and livestock keepers are key to ensuring food, income and social security in the Global South. Recognising these roles is crucial to just climate actions.

Livestock has increasingly been pitched as the villain in discourses of climate change, favouring a techno-utopian shift to plant-based and synthetic diets instead. Many poor and marginal people around the world cannot afford to eliminate nutrient-dense animal-source foods from their diets. Anti-meat proclamations are elitist and ignore the many benefits that grazing animals offer within sustainable systems.

While world leaders skirted the issue, experts and advocates at the sidelines of COP27 provided evidence that sustainable livestock can play a critical role in climate adaptation, mitigation and justice. "At the COP27 summit, climate negotiators and governments alike should recognise that sustainable livestock can now play a vital role in delivering climate justice" wrote Semplice Nouala, head of the agriculture and food security division at the African Union Commission, in a poignant Al Jazeera article titled "Livestock is a form of climate justice in the Global South."

The advocacy around livestock at COP centred around three main points which are elaborated in the PASTRES report

PASTRES
Pastoralism, Uncertainty, Resilience

Figure 1. Livestock is the livelihood of many people in Africa.

"Are livestock always bad for the planet?"

Rethinking climate assessments

Firstly, many of the popularly used figures to make a case against livestock are misinterpreted or misrepresented. For example, a FAO assessment shows that data comparing emissions from livestock and transportation tends to be exaggerated. While greenhouse gas emissions from livestock, in the form of methane and nitrous monoxide, are assessed at 14.5% of the total emissions over the lifecycle of the animal – including through feeding, processing and supply – the complementary figure for transport is unavailable. The livestock figure is often equated with the direct emissions from transport valued at 14%, while direct emissions from livestock is only estimated to be around 5%.

At the same time, carbon dioxide emissions from transport have a longer lasting impact on the environment than methane from livestock which decomposes in a few years.

Secondly, livestock systems across the world are different with different implications for climate.

At the COP27 side-event "The cow in the room: can sustainable livestock production deliver climate adaptation, mitigation, and food security?" Simeon Ehui, regional director for sustainable for Africa said, "The cow in Kansas is different from the cow in Kenya."

Recognising these differences can channel appropriate climate action. For example, Africa should strive towards adaptation not mitigation pointed Bernard Kimoro from the Ministry of Agriculture, Livestock, Fisheries and Cooperatives in Kenya, during the same event.

A nuanced approach to livestock that differentiates between diverse production systems was also endorsed by the latest mitigation report by the UN's Intergovernmental Panel on Climate Change in April, 2023.

Adopting a systems approach

Unlike lifecycle assessments, a systems approach sees livestock in context and recognises the many benefits offered by extensive and pastoral systems to the environment, such as improving soil carbon sequestration, protecting against wildfires, and enhancing biodiversity.

Many scientists have identified ways of maximising the benefits from livestock in such systems, such as through improving ways of feeding and managing manure. Investment through appropriate climate finance can help in reducing greenhouse gasses, and improving

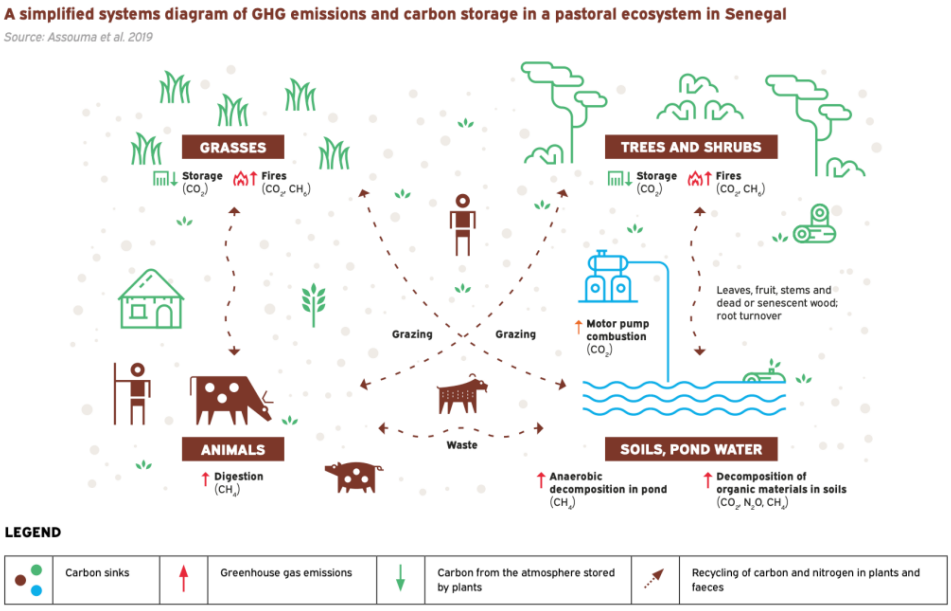


Figure 2. A simplified systems diagram of GHG emissions and carbon storage in a pastoral ecosystem in Senegal (Source: Assouma et. Al. 2019).

grazing and rangeland management.

Centering livestock keepers

Central to visions of farm-free futures is concerns of lands and livelihoods for smallholder farmers and pastoralists from the Global South. The livestock sector accounts for 30-50% of agricultural GDP in Africa, and supports the livelihood and food security for about 350 million people. Livestock serves as a reliable source of income and a valuable safety net for those poor farmers who contribute the least, and yet remain the worst affected by the climate crisis. Therefore, the 'Africa COP' seemed like an apt forum to call for centring livestock keepers for climate justice and environmental sustainability in the future.

The side-event "Livestock transitions: Global options and local realities for adaptation and mitigation" spoke about tapping into the knowledge and innovations of livestock keepers, who are in many ways already overcoming climate change, and making these practices more efficient and widespread.

Follow the campaign

Through the COP27 period, PASTRES promoted the report "Are livestock always bad for the planet?" and its briefing and infosheets. Blogs on these knowledge products can be found here:

- Are livestock always bad for the planet?
- The truth about livestock
- Placing livestock in context through a systems approach
- Centering livestock-keepers

Updates are also available through the PASTRES Twitter handle @PASTRES_erc.

AngloAmerican

Climate action: The science is clear, but the progress slow

Eve Ruwoko

Current Address: University World News, Africa Edition
Reprinted from: https://bit.ly/3iD9SBQ

Much of the science that is needed for climate action is in place and the onus is on governments, corporates and civil society to make the mitigation of climate change an immediate priority.

But, in a dangerous post-truth age, where evidence is increasingly ignored, climate change scepticism is a real concern. This makes innovative science communication a priority.

This is according to Heidi-Jayne Hawkins, a research director and fellow at Conservation International (CI), an environmental non-profit organisation. Hawkins is also an honorary research associate at the University of Cape Town, South Africa.

In an interview with *University World News*, Hawkins spoke about how her cross-cutting research focuses on natural climate solutions, which supports climate resilience and mitigation.

UWN: *What is your main field of expertise and how did you start to work as a climate scientist?*

HH: My expertise is in plants, specifically the ecological process of nutrient cycling between plants, soil and the atmosphere. Plants were and are, of course, pivotal in creating the relatively low carbon dioxide atmosphere on which current life on Earth depends, but my path to climate science was a circuitous one.

My interest in plants was sparked by the miracle of photosynthesis and I was also motivated to contribute to sustainable agriculture, so my PhD explored how underground networks of fungi, called mycorrhiza, contribute to plant nutrition (and save on fertilizers) in exchange for carbohydrates. This led to my postdoctoral work, and I later joined CI.

It was in seeing how resource-poor communities are the most vulnerable to climate change that I become involved in climate science.

UWN: *What is the focus of your work at CI and how is it relevant to the climate action within the region?*

HH: My main focus is on natural climate solutions. Nature can provide one-third of the cost-effective climate mitigation needed to maintain warming below 1.5°C between now and 2030, as explained in papers by Bronson Griscom and colleagues.

Natural climate solutions may also provide Africa's nations with ways to deliver on the Paris Climate Agreement, while also improving soil carbon, productivity, biodiversity and cleaning air and water.

My research team and I have been quantifying the potential of African savannas and grasslands (rangelands) to sequester carbon while maintaining biodiversity with improved practices of grazing and fire management.

This is built on prior fieldwork and modelling, including work exploring Africa-appropriate grazing approaches and the explicit inclusion of resource-poor rural communities in research.

The outcome has been that we can improve practices and climate resilience, often enabling indigenous people to regain traditional knowledge, while challenging misinformation.

Recently, we produced a very high-resolution map of soil organic carbon and its drivers, and this, together with the modelling, helped to establish the first carbon credit project for South African savannas and its communities in 2022.

Figure 1. Dr Heidi-Jayne Hawkins. Image provided.

The map also informs climate-resilient land use across South African biomes. Working with other experts in CI, we are now pooling our knowledge to develop a strategy for climate resilience in African rangelands.

Using new paradigms in soil science, we are testing the relative contribution of wild and domestic animals to climate cooling.

UWN: *Based on your fieldwork, what are some of the pressing climate change issues facing African communities in your region, in particular women and youths?*

HH: Based on our fieldwork and surveys, the most commonly heard of issues for communities living on rangelands is degradation of land (increased bare ground, soil erosion, less forage for animals, and less or poor quality water) exacerbated by climate change. Underlying these problems are socioeconomic issues such as overuse of rangelands because of a lack of economic alternatives.

Poor education, especially for women, is also a barrier to land restoration. For

this reason, we acknowledge and specifically target women and youths to increase their agency and inclusion in decision-making about land use.

Recent work with Coventry University has revealed that trade-offs on rangelands occur at three key levels: between people at national and local levels, between ecosystem services, and trade-offs between people at local level (eg, a village).

Generally, we find that more participatory approaches are needed (such as between national and local levels) but, as part of this, it is often vital to separate men, women and youths into focus groups to ensure that everyone's voice is heard.

UWN: *What has been the impact of climate change on biodiversity in Africa? How can African universities and researchers contribute toward more sustainable ecosystems?*

HH: Africa is estimated to contain one-fifth of all known species of plants, mammals and birds in diverse and biologically important ecosystems such as forests, savanna, grassland, wetlands and marine as well as freshwater habitats. This biodiversity is linked to ecosystem services as diverse as soil carbon, food, flood prevention and ecotourism.

However, as climate change accelerates over the next century, it is expected to be one of the major drivers of the loss of African biodiversity.

Warming in Africa is expected to accelerate to anything between 0.2°C to 0.5°C per decade. Precipitation has been unaffected in some areas (the arid areas of South Africa) but has increased in East and Central Africa.

Encouragingly, biodiversity could also mitigate climate change. For example, research by colleagues suggests that wilder rangelands and-or greater diversity in livestock types may be essential for carbon sequestration and reduced greenhouse emissions and this is a key topic we are exploring further.

Another research area important to biodiversity is to test land use practices that may protect, maintain or restore existing ecosystems, for example, what specific practices of animal management and fire frequency will reduce or remove greenhouse gases in socially and ecologically appropriate ways, and how do we differ in various contexts?

Scientists across disciplines can also assess what barriers (political, land tenure) must be overcome to create landscape connectivity needed for various ecological and social processes to occur (animal movement and migration, pastoralism, water and carbon flow).

UWN: *Only 3.8% of global climate change research funding has been allocated to Africa and only 1% to educational institutions. What could be some of the implications of this on climate change research output in the region?*

HH: Insufficient funding to the Global South restricts researchers in creating locally appropriate solutions, as much data is based on the Global North. The lack of data means that various research products (global climate models, global maps of reforestation potential, global carbon maps) are highly inaccurate, and potentially damaging if used to advise [on] land use.

Data gaps in the Global South can be addressed through North-South research consortia where diverse expertise and local knowledge are combined to create research products that are relevant to Africa and other under-researched areas. Funders are increasingly aware of this and encourage this type of collaboration.

UWN: *What can be done to bridge the gap between researchers, policymakers, and communities?*

HH: The Sustainable Development Goal 17 (global partnerships for the goals) emphasises, not only that North-South scientists should collaborate, but also that all stakeholders should collaborate in solving global challenges, that is, in other words, communities, researchers and policymakers.

It is important that research design is explicitly informed by these stakeholders from the onset, that they are involved throughout via, for instance, data collection, discussion of results, and how results can be used on the ground, or to inform policy.

UWN: *As Africa prepares to host the Conference of the Parties (COP27) in Egypt at the end of 2022, what are some of the pressing climate (mitigation and adaptation) issues that, as a researcher, you expect to be addressed?*

HH: The science is clear, but progress on climate action is too slow. The evidence is that human activity is causing climate change due to rising atmospheric carbon dioxide relative to pre-industrial levels, and if we do not take action to create a net zero carbon world, rising temperature and erratic weather will continue to worsen.

Much of the science that is needed for action is in place and the onus is on governments, corporates and civil society to make mitigation of climate change an immediate priority.

In a dangerous post-truth age, where evidence is increasingly ignored, climate change scepticism is a real concern. This makes innovative science communication a priority.

Most governments are already aware that nature can be 30% of the solution to climate change, but it is essential that scientists make their voices heard and motivate for additional financing towards protection, management and restoration of natural ecosystems.

Unlocking funds for climate science, especially in Africa, is also essential so that we can create context-specific and ecologically appropriate solutions.

Globally, researchers can look for innovative ways to turn the climate challenge into opportunity, such as economic development built on zero-carbon businesses.

An example is sustainable land and livestock use to provide carbon credits and supplementary income for resource-poor people.

Another is green buildings that not only reduce emissions but have multiple benefits like green jobs and improved human health.

Besides climate mitigation, adaptation to climate change is a key theme for Africa. Fortunately, many actions that will help people adapt to climate change can also contribute to climate mitigation.

For example, in the Northern Cape of South Africa, CI is assisting livestock owners to procure climate-resilient sheep breeds that need less water, utilise forage efficiently and tolerate high temperatures.

This adaptation action likely also means that plant cover is maintained, soil erosion is minimised and soil carbon is retained.

Phantom Forests: Why Ambitious Tree Planting Projects Are Failing

High-profile initiatives to plant millions of trees are being touted by governments around the world as major contributions to fighting climate change. But scientists say many of these projects are ill-conceived and poorly managed and often fail to grow any forests at all.

Fred Pearce

Current Address: Yale Environment 360
Reprinted from: https://bit.ly/3iF22aP

It was perhaps the most spectacular failed tree planting project ever. Certainly the fastest. On March 8, 2012, teams of village volunteers in Camarines Sur province on the Filipino island of Luzon sunk over a million mangrove seedlings into coastal mud in just an hour of frenzied activity. The governor declared it a resounding success for his continuing efforts to green the province. At a hasty ceremony on dry land, an official adjudicator from Guinness World Records declared that nobody had ever planted so many trees in such a short time and handed the governor a certificate proclaiming the world record. Plenty of headlines followed.

But look today at the coastline where most of the trees were planted. There is no sign of the mangroves that, after a decade of growth, should be close to maturity. An on-the-ground study published in 2020 by British mangrove restoration researcher Dominic Wodehouse, then of Bangor University in Wales, found that fewer than 2 percent of them had survived. The other 98 percent had died or were washed away.

"I walked, boated, and swam through this entire site. The survivors only managed to cling on because they were sheltered behind a sandbank at the mouth of a river. Everything else disappeared," one mangrove rehabilitation expert wrote in a letter to the Guinness inspectors this year, which he shared with *Yale Environment 360* on the condition of anonymity. The outcome was "entirely predictable," he wrote. The muddy planting sites were washed by storms and waves and were otherwise "ecologically unsuited to mangrove establishment, because they are too waterlogged and there is no oxygen for them to breathe."

Researchers found little evidence that government-led planting in India resulted in more tree cover, carbon uptake, or community benefits.

"It was a complete disaster," agrees Jim Enright, former Asia coordinator of the U.S.-based nonprofit Mangrove Action Project. "But no one that we know of from Guinness or the record-planting proponents have carried out follow-up monitoring." Guinness has not responded to requests for comment.

Such debacles are not unusual. Forest scientists say they are surprisingly frequent, and they warn that failed afforestation projects around the world threaten to undermine efforts to make planting a credible means of countering climate change by reducing carbon dioxide in the atmosphere or generating

Figure 1. More than 9,000 people in Leh, India planted more than 50,000 tree saplings in under an hour on October 10, 2010. Drukpa Publications via Wikipedia.

Figure 2. A villager in Peukan Bada, Indonesia plants mangrove trees. Chaideer Mahyuddin / AFP via Getty Images.

Figure 3. Volunteers plant trees at the edge of China's Badain Jaran Desert last year. Wang Jiang / VCG via Getty Images.

carbon credits for sale to companies to offset their emissions.

In another high-profile case, in November 2019, the Turkish government claimed to have planted more trees on dry land than anyone else in a single hour — 300,000, in the central province of Çorum. It beat a record, also confirmed by Guinness inspectors, set four years before in the Himalayan state of Bhutan. The Çorum planting was part of a National Afforestation Day, when volunteers planted 11 million trees at 2,000 sites across Turkey. President Recep Tayyip Erdogan was among those wielding a spade.

But two months later, the head of the country's union of forestry workers reported that a survey by its members had found that as many as 90 percent of the national plantings had died. The government denies this, but experts said its counter-claim that 95 percent of the trees had survived and continued to grow was improbably high. No independent audit has yet been carried out.

In an investigation published last year into extensive government-organized tree planting over several decades in the northern Indian state of Himachal Pradesh, Eric Coleman of Florida State University and colleagues found little evidence that it had resulted in more tree cover, carbon uptake, or community benefits. Typically, tree species growing on common land that were useful to local people for animal fodder and firewood had been replaced by plantations of fast-growing but less useful trees, often fenced off from local communities.

Another study, published last year by the nonprofit World Resources Institute (WRI) in Mexico, called into question the benefits from a billion-dollar government-funded environmental recovery program. Sembrando Vida pays farmers to plant trees across the country to help Mexico meet its climate targets under the Paris Agreement. But WRI found the program has no effective audit of outcomes, and that rates of forest loss were currently greater in states implementing the plan than in others. It concluded that the program "could have had a negative impact on forest cover and compliance with the country's carbon mitigation goals."

Tree planting in the Philippines under its National Greening Program has also been a widespread failure, according to a 2019 study by the government's own Commission on Audit. Ministers imposed unachievable planting targets, it said, resulting in planting "without … survey, mapping and planning." The actual increase in forest cover achieved was little more than a tenth of that planned.

Unanimity of support for tree planting may reduce the impetus for critical analysis of what is achieved at each project.

The causes of failure vary but include planting single species of trees that become vulnerable to disease; competing demands for the land; changing climate; planting in areas not previously forested; and a lack of aftercare such as watering saplings.

Everybody likes trees. There is no anti-tree lobby. A global push to go beyond conservation of existing forests and start creating new ones goes back to 2011, when many of the world's governments, including the United States, signed up

Figure 4. Trees blackened by the 2021 Bootleg Fire in Oregon, which burned through woodlands providing Microsoft with carbon offsets. Nathan Howard / AP.

to the Bonn Challenge, which set a goal of restoring some 860 million acres of forest globally by 2030. That is an area bigger than India, and enough to soak up 1.7 billion tons of carbon dioxide annually, adding almost a quarter to the current estimated forest carbon sink.

In 2020, at its annual meeting in Davos, Switzerland, the World Economic Forum launched One Trillion Trees, an initiative aimed at adding a third to the world's current estimated inventory of around 3 trillion trees. Even Donald Trump got behind the push, promising to plant a billion trees across the U.S.

But the very unanimity of support for tree planting may reduce the impetus for detailed audits or critical analysis of what is actually achieved at each project. The paucity of follow-up thus far has resulted in a great deal of wasted effort – and money.

Every year, "millions of dollars" are spent on reforesting landscapes, according to Lalisa Duguma of World Agroforestry, an international research agency in Nairobi, Kenya. Yet "there are few success stories." Typically only a minority of seedlings survive, he says, because the wrong trees are planted in the wrong places, and many are left untended, in part because ownership and management of trees is not handed over to local communities.

Such failures often go unnoticed, believes Duguma, because performance indicators measure planting rates not survival rates, and long-term oversight is minimal because projects typically last three years or less. The result is "phantom forests."

The record for restoring mangroves along coastlines, often in an effort to hold back coastal erosion from storms and rising tides, is especially bad. An analysis last year by the Netherlands-based NGO Wetlands International, which had previously sponsored mangrove planting, concluded that "while many tens of millions of euros have been spent on mangrove restoration in recent years, the majority of these restoration projects has failed. With success rates ranging between 15-20%, a lot of conservation funding has gone to waste." It blamed poor planting methods and the wrong species planted in the wrong places.

Most planting across Southeast Asia has been of *Rhizophora* red mangroves. Their cuttings are easy to harvest from existing trees and to plant. Typically, they are planted in tidal mudflats, which ensures no competing land uses, but most are starved of oxygen or washed away by constant inundation at high tide, according to an analysis by Shing Yip Lee of the Chinese University of Hong Kong.

Even the best-planned planting projects can come undone, leaving behind non-existent forests and uncaptured carbon.

The government of Sri Lanka launched a mass mangrove planting program around its shores to help prevent a repeat of the disastrous loss of life there during the 2004 Indian Ocean tsunami. But the program has turned out to be an abysmal failure. "Nine out of 23 project sites … showed no surviving plants," according to a 2017 study by Sunanda Kodikara of the University of Ruhuna. "Only three sites showed a level of survival higher than 50 percent."

Too often, argues Duguma, tree planting is "greenwashing" aimed at grabbing headlines and promoting an image of governments or corporations as environmentally friendly. Tiina Vahanen, deputy director of forestry at the UN's Food and Agriculture Organization, noted recently that many projects end up being little more than "promotional events, with no follow-up action."

Cynical PR is one thing, but phantom forests are also increasingly sabotaging efforts to rein in climate change. This happens when planters claim the presumed take-up of carbon by growing forests as carbon credits. If certified by reputable bodies, these credits can count toward governments meeting their national emissions targets or be sold to industrial polluters to offset their emissions. Many corporations plan to use their purchase of carbon credits as a means of fulfilling promises to attain "net-zero" emissions. So the stakes are rising.

But even the best-planned and best-audited planting projects can come undone, leaving behind non-existent forests and uncaptured carbon. The California Air Resources Board (CARB) is a major certifier of carbon-offset forests across the American West. It approves the carbon credits generated by the forests, which are then sold to industrial polluters in California who want to offset their emissions in line with state regulations.

But climate change is leaving the western U.S. increasingly vulnerable to wildfires — raising serious questions about the viability of the forests and the credibility of their carbon credits.
To meet this challenge, CARB requires offset developers to hold back from sale a proportion of the credits, which they put into a central buffer fund as insurance against a variety of potential mishaps during the 100-year planned lifetime of the offsets. Up to 4 percent of credits insure against wildfires. That buffer fund picked up the tab, for instance, when 99 percent of the carbon

in a forest offset project on Eddie Ranch in Northern California burned in a fire in 2018.

But the CARB certification system is running out of buffer carbon, according to an analysis published in August by ecologist Grayson Badgley at CarbonPlan, a nonprofit climate solutions database. He found that just seven years into its supposed century-long insurance, 95 percent of the wildfire buffer has been consumed by just six fires across the West. CARB says that certifying more forests will grow the buffer account and prevent a default. But Danny Cullenward, an environmental lawyer at American University in Washington, D.C. and co-author of the CarbonPlan analysis, calls this "a giant Ponzi scheme."

He says the problem of undercapitalized buffer accounts for carbon is widespread among the hundreds of markets set up internationally to certify and trade carbon offsets for corporate clients. They have "essentially no regulatory requirements and operate instead on loose private standards," he says.

Forest ecologists say creating space to allow nature to do its thing is usually a better approach to restoring forests than planting.

Those private standards are likely to be increasingly inadequate, says forest ecologist William Anderegg of the University of Utah, who estimated recently that climate change will make wildfires four times more likely across the American West by the end of the century, raising "serious questions about the integrity of [offset] programs."

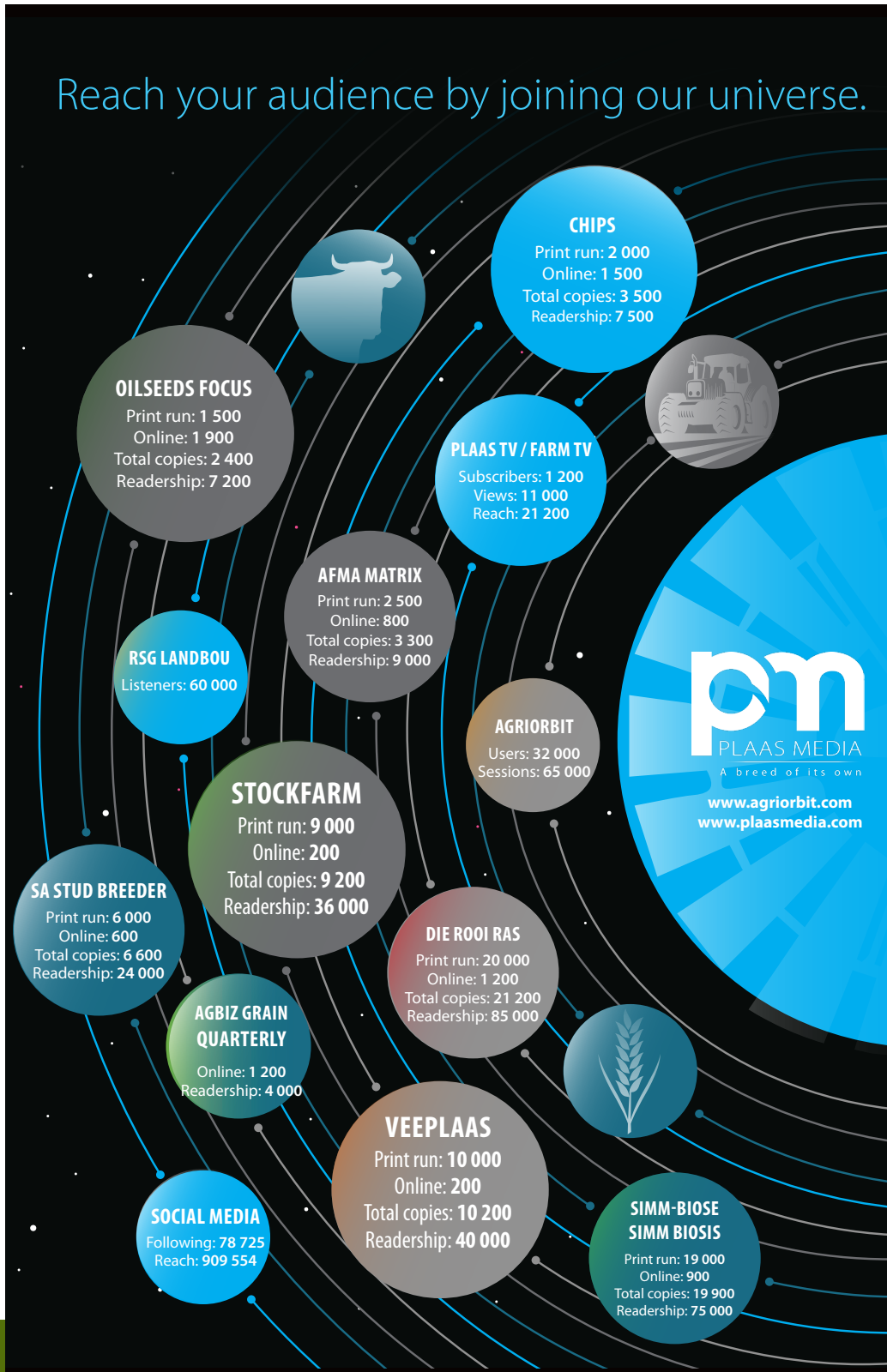
Besides climate change and wildfires, another major problem for forest planters is bad relations with locals. In a global survey of organizations involved in forest restoration, Markus Höhl of the University of Gottingen found widespread concern about a lack of buy-in from forest communities. Project promoters did not ask the local people what trees they wanted, or where they should be planted.

Not surprisingly, those locals often reacted badly. For example, in northern Malawi, they broke fences and burned a growing forest to get back the common grazing land on which the trees had been planted. In two Nigerian projects, villagers cut all the planted non-fruit trees for firewood, while protecting those that bore fruit.

Forest planting can work if the social and environmental conditions are right, and if planting is followed by long-term monitoring and aftercare of the trees. There has been substantial regrowth of the Brazil's Atlantic Forest following a joint initiative of the government and private sector. But even here progress has been haphazard and much of the increase has been a result of natural regeneration rather than planting.

In fact, many forest ecologists say creating space to allow nature to do its thing is usually a better approach to restoring forests than planting. "Allowing nature to choose which species predominate … allows for local adaptation and higher functional diversity," argues one advocate, Robin Chazdon of the University of Connecticut, in her book *Second Growth*. For mangroves, Wetlands International now recommends abandoning widespread planting and instead creating areas of slack water along coastlines, where mangroves can naturally reseed and grow.

Ashwini Chhatre, an expert in forest governance at the Indian School of Business in Hyderabad, is not alone in saying that "after three decades of walking through planted forests … it is surprising any are successful at all."



Mangrove forests won't be able to spread further in South Africa, so protecting them is crucial

Jacqueline L Raw

Current Address: Research Chair in Shallow Water Ecosystems Ocean Sciences Campus, Nelson Mandela University

Reprinted from: https://bit.ly/3VA8HS5

Mangrove forests are a common sight in some tropical and subtropical areas of the world like Indonesia, Florida in the US, parts of Brazil and Australia. They can also be found on African coasts, including South Africa's KwaZulu-Natal and Eastern Cape provinces.

These tidal forests of trees and shrubs are often talked about in the context of climate change. Along with other coastal wetlands like salt marshes and seagrasses, they are able to store more carbon than terrestrial ecosystems. Waterlogged soils preserve the organic carbon and prevent decomposition – and if they're left undisturbed, this "blue carbon" is locked up over thousands of years. This means they can play a key role in the oceans's carbon cycle.

Mangroves are also valuable assets as ecosystems because they support a significant amount of biodiversity.

Mangroves won't grow in cool climates. In the northern hemisphere, their range ends at areas where it snows in winter. But, even though the coasts of places like Brazil, Australia and South Africa don't get freeze events, mangroves still stop occurring at a certain latitude in the southern hemisphere.

We wanted to know why this is the case and to determine whether there are other areas along South Africa's coast that are climatically suitable for mangroves but where the forests don't grow.

We also wondered, since climate change will make some parts of the

Figure 1. A mangrove seed at Nxaxo estuary on South Africa's Wild Coast. J. Raw

world warmer in the coming years and decades, whether mangroves might in future be able to grow in parts of South Africa where they're not found now. Finally, we wanted to understand whether climate change will make areas in South Africa where mangroves currently exist unsuitable for the forests in future.

Our new study reveals the answers. Through a combination of species modelling and ocean modelling, we discovered it is South Africa's high wave-energy that keeps mangroves from spreading: their seeds are pushed around the ocean without being easily able to get washed into the estuaries where they can take root and grow.

And existing mangrove forests are at risk from changes in rainfall, which are predicted in climate change scenarios for the region. Increased rainfall can lead to more flooding. Less rainfall can result in estuary mouths closing off from the sea. Extreme or repeated occurrences of either change can make it difficult for mangroves to survive and thrive.

It's therefore essential to safeguard existing mangrove forests. Different approaches will be needed for mangrove forests in rural and urban areas, but whatever is done must be done soon to preserve these important wetlands.

Modelling

Mangrove forests don't cover a lot of ground in South Africa. Their total range in the country is only about 2,000 hectares across 32 of the 214 estuaries along about 1,000km of the country's east coast. Mangroves are classified as an indigenous forest type and are therefore included in the country's National Forests Act. This requires that all natural forests on private, communal or state-owned land are protected. Most mangrove forests in South Africa, however, are not in formally protected areas.

As the first step in our research, we created a species distribution model. We collated everything we knew about where mangroves grow in South Africa. We ran the model to see where else in South Africa those conditions were met and whether mangroves grew there.

The model identified good candidate areas. But mangroves did not occur in those places. This meant there must be another process creating this limitation.

Then we ran the same model but took climate change into account by feeding in data about areas that are predicted to become warmer (and so may be more hospitable for mangrove forests in future). This also showed that estuaries further south would be suitable for mangroves, but that conditions in some estuaries that currently support mangroves could become unfavourable – and this could lead to mangrove loss.

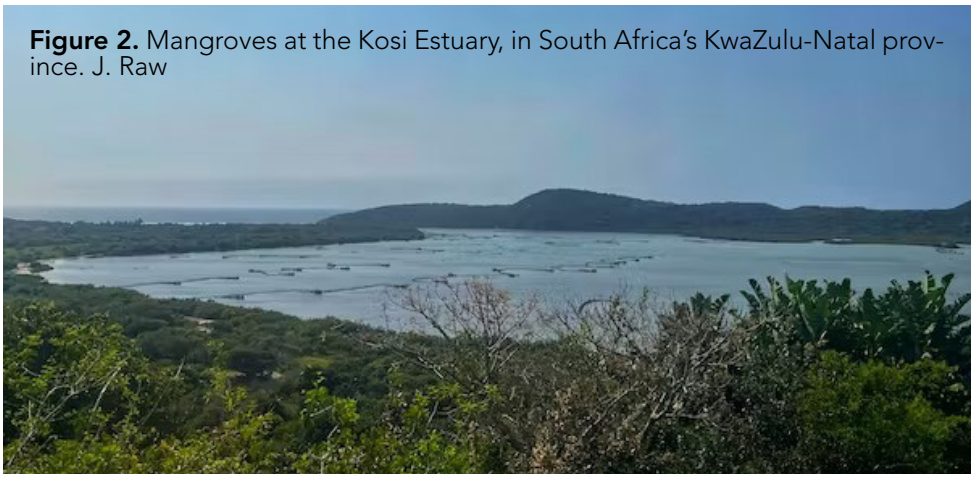


Figure 2. Mangroves at the Kosi Estuary, in South Africa's KwaZulu-Natal province. J. Raw

Ocean activity

Mangroves spread to new locations through floating seeds (known as propagules), which fall from the trees and are carried out to sea. Recent research has shown how important ocean currents are for transporting mangrove propagules in different part of the world. We wondered whether this could be the process limiting mangroves from occurring in those other suitable estuaries.

Through a collaboration with colleagues at the University of Brussels and the San José State University in California in the US, we were able to include some of this ocean modelling in our study. This was a way to simulate how mangrove propagules would float offshore in the southern African region.

The ocean model showed that although the Agulhas Current transports mangrove propagules rapidly south (about 600 km in three weeks) to those suitable estuaries, the coast is very exposed, with lots of waves and sandy beaches. These conditions make it difficult and increasingly unlikely for mangrove propagules to reach and enter relatively small estuary mouths.

Many seeds wash up on beaches or rocky shores where they cannot establish new mangrove forests or become part of existing forests. The ocean modelling confirmed that propagules can float for weeks or months without reaching an estuary.

These findings suggest that mangroves are not going to become more widespread in South Africa as temperatures rise with climate change. This is contrary to what has been predicted at the global scale for mangrove forests, and what is already occurring in other regions.

We are however not advocating for mangroves to be manually planted further south because the places where this would happen are already occupied by salt marsh vegetation. Salt marshes support different species to mangroves; for example they provide habitat for certain birds to nest that don't use mangroves. Replacing one natural ecosystem with another is not recommended.

Value what we have

We recommend that estuaries currently supporting mangroves be safeguarded through appropriate conservation, restoration, and management measures. This would give mangroves the best possible chance of naturally responding to climate change (as they have done through millennia).

The protection and management of mangroves in South Africa needs to be integrated into coastal management practices and biodiversity conservation, as well as national and provincial climate adaptation strategies.

For example, stewardship programmes are likely to help reduce human impacts on these ecosystems. In rural areas where mangrove wood is sometimes used as building material and for building fish traps, approaches such as community-based monitoring, or payment for ecosystem services programmes, are viable options. In contrast, in urban areas mangroves can be afforded protection by reducing pollution and limiting activities through zoning in estuary management plans.

FruitLook – a powerful tool for monitoring irrigation, growth and nutrients

Natalie Nolte

Current Address: Mycelium Media Colab
Reprinted from: https://bit.ly/3ivyBrB

A trip to Barry Meijer's regenerative farm is always educational and inspirational. On my latest visit he introduced me to FruitLook, an incredible free tool for farmers!

The rains have barely come this year, and so water is a worry but Barry has found by using this app, he is managing his irrigation more effectively, and getting better results. He's able to sketch out his fields on the satellite map, which he saves on his profile. For each area, the app then tells him how much water has transpired each day, as well as the biomass production and the nitrogen present. Graphs show how this changes over time, and a heat map shows the exact areas of the field that are higher or lower in these levels. So he can work out how much each area of his fields need to be irrigated. He can also see which areas are struggling and which are abundant.

This is an amazing, free service offered by Western Cape Government, you can sign up to it here: https://fruitlook.co.za

Barry primarily uses Fruitlook for monitoring growth. "The resolution allows me an in depth look at my fields. I plan all my irrigation based off FruitLook." Barry mentioned that the University of Davis in California has done significant studies on how much water you need to replenish from your evaporation. "If you give me an evaporation number, I know based on my crops that I have to replace about 80% of what evaporated. That is called the crop coefficient."

Barry says he gets his evaporation numbers every morning at 8 am, which allows him to schedule today's sprinkler on yesterday's evaporation. "If you grow lucerne, after you have mowed it, for the first couple of days you actually give it 105% of what evaporated. But as soon as the lucerne starts to grow and covers the soil, the evaporation rate drops off significantly to 70%. Most of my fields are under permanent irrigation, so I can very easily make that adjustment. That is a major use of the Fruitlook program."."

Figure 1. Lush green pasture on Barry Meijer's regenerative farm.

Figure 2. A 40-day grazing cycle is followed on the farm.

"Because of the resolution you can go to the exact point in the field and go and see what the issue is, for example I can see if there is a frog in my sprinkler. You can fix the problem and within a few weeks you see that you have caught up again."

Barry says that the biggest benefit he gets from Fruitlook is information. "It is a tool that helps you successfully manage your farms production. I can look at Fruitlook on a weekly basis and see how much growth has happened in the past week. That is based on dry material. So, I can quickly just do a calculation and see this was my biomass growth over the last couple of months or weeks."

Barry works on a 40-day grazing cycle. "I can basically take the number from FruitLook and do a quick calculation and extrapolation to figure out how much food is on that field and how many square meters I have to give every cow. It is amazing that FruitLook is so accurate that I can just use that, and even if it is out by 10 %, it does not matter. It needs to be somewhat fluid to make it work."

Visit Barry Meijer's website at: www.meijersrust.co.za and follow him on Facebook: www.facebook.com/Meijersrust

Common weed discovered to be a "Super Plant"

Yale University

Reprinted from: https://bit.ly/3P33MH6

Scientists may come up with new strategies to engineer crops like corn to help endure prolonged drought by better understanding the novel plant metabolic pathway in the plant.

The weed could also hold the key to drought-resistant crops.

In a world troubled by climate change, a common weed provides crucial hints about how to develop drought-resistant crops.

Purslane, also known as *Portulaca oleracea*, combines two different metabolic pathways to produce a unique sort of photosynthesis that allows the plant to withstand drought while remaining extremely productive, according to Yale University scientists. The researchers recently published their findings in the journal *Science Advances*.

"This is a very rare combination of traits and has created a kind of 'super plant' — one that could be potentially useful in endeavors such as crop engineering," said Yale's Erika Edwards, professor of ecology and evolutionary biology and senior author of the paper.

Plants have developed a diverse set of processes to enhance photosynthesis, the process by which green plants utilize sunlight to synthesize nutrients from carbon dioxide and water. Corn and sugarcane, for example, evolved C4 photosynthesis, which allows the plant to stay productive at high temperatures. Succulents, such as cacti and agaves, have another kind of photosynthesis known as CAM photosynthesis, which allows them to live in deserts and other dry regions. C4 and CAM have different functions, yet they both use the same biochemical pathway to act as "add-ons" to conventional photosynthesis.

Purslane is unique in that it exhibits both of these evolutionary adaptations, allowing it to be both highly productive and drought tolerant, an unusual combination for a plant. Most scientists assumed that C4 and CAM operated independently inside purslane leaves.

Figure 1. Purslane has the ability to withstand drought while remaining extremely productive.

But the Yale team, led by co-corresponding authors and postdoctoral scholars Jose Moreno-Villena and Haoran Zhou, conducted a spatial analysis of gene expression within the leaves of purslane and found that C4 and CAM activity is totally integrated. They operate in the same cells, with products of CAM reactions being processed by the C4 pathway. This system provides unusual levels of protection for a C4 plant in times of drought.

The researchers also built metabolic flux models that predicted the emergence of an integrated C4+CAM system that mirrors their experimental results.

Understanding this novel metabolic pathway could help scientists devise new ways to engineer crops such as corn to help withstand prolonged drought, the authors say.

"In terms of engineering a CAM cycle into a C4 crop, such as maize, there is still a lot of work to do before that could become a reality," said Edwards. "But what we've shown is that the two pathways can be efficiently integrated and share products. C4 and CAM are more compatible than we had thought, which leads us to suspect that there are many more C4+CAM species out there, waiting to be discovered."

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1. "Spatial resolution of an integrated C4+CAM photosynthetic metabolism" by Jose J. Moreno-Villena, Haoran Zhou, Ian S. Gilman, S. Lori Tausta, C. Y. Maurice Cheung and Erika J. Edwards, 5 August 2022, Science Advances. DOI: 10.1126/sciadv.abn2349

Could AI help you to write your next paper?

Large language models can draft abstracts or suggest research directions, but these artificial-intelligence tools are a work in progress.

Matthew Hutson

Current Address: The New Yorker
Reprinted from: https://bit.ly/3PadEis

You know that text autocomplete function that makes your smartphone so convenient — and occasionally frustrating — to use? Well, now tools based on the same idea have progressed to the point that they are helping researchers to analyse and write scientific papers, generate code and brainstorm ideas.

The tools come from natural language processing (NLP), an area of artificial intelligence aimed at helping computers to 'understand' and even produce human-readable text. Called large language models (LLMs), these tools have evolved to become not only objects of study but also assistants in research.

LLMs are neural networks that have been trained on massive bodies of text to process and, in particular, generate language. OpenAI, a research laboratory in San Francisco, California, created the most well-known LLM, GPT-3, in 2020, by training a network to predict the next piece of text based on what came before.

On Twitter and elsewhere, researchers have expressed amazement at its spookily human-like writing. And anyone can now use it, through the OpenAI programming interface, to generate text based on a prompt. (Prices start at about US$0.0004 per 750 words processed — a measure that combines reading the prompt and writing the response.)

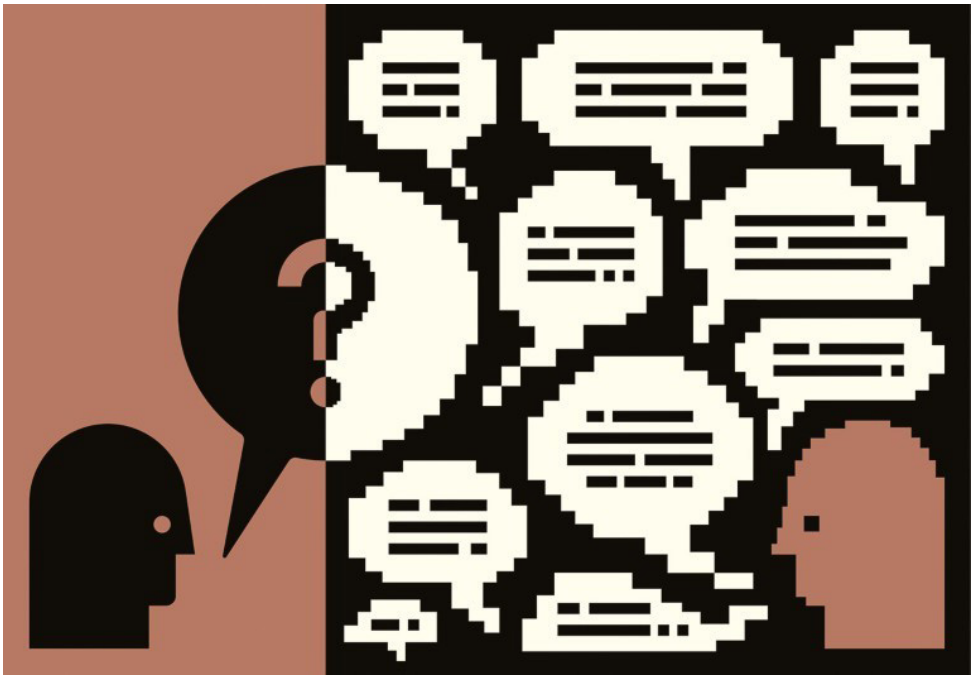
"I think I use GPT-3 almost every day," says computer scientist Hafsteinn Einarsson at the University of Iceland, Reykjavik. He uses it to generate feedback on the abstracts of his papers. In one example that Einarsson shared at a conference in June, some of the algorithm's suggestions were useless, advising him to add information that was already included in his text. But others were more helpful, such as "make the research question more explicit at the beginning of the abstract". It can be hard to see the flaws in your own manuscript, Einarsson says. "Either you have to sleep on it for two weeks, or you can have somebody else look at it. And that 'somebody else' can be GPT-3."

Organized thinking

Some researchers use LLMs to generate paper titles or to make text more readable. Mina Lee, a doctoral student in computer science at Stanford University, California, gives GPT-3 prompts such as "using these keywords, generate the title of a paper". To rewrite troublesome sections, she uses an AI-powered writing assistant called Wordtune by AI21 Labs in Tel Aviv, Israel. "I write a paragraph, and it's basically like a doing brain dump," she says. "I just click 'Rewrite' until I find a cleaner version I like."

Computer scientist Domenic Rosati at the technology start-up Scite in Brooklyn, New York, uses an LLM called Generate to organize his thinking. Developed by Cohere, an NLP firm in Toronto, Canada, Generate behaves much like GPT-3. "I put in notes, or just scribbles and thoughts, and I say 'summarize this', or 'turn this into an abstract'," Rosati says. "It's really helpful for me as a synthesis tool."

Language models can even help with experimental design. For one project, Einarsson was using the game Pictionary as a way to collect language data from participants. Given a description of the game, GPT-3 suggested game variations he could try. Theoretically, researchers could also ask for fresh takes



on experimental protocols. As for Lee, she asked GPT-3 to brainstorm things to do when introducing her boyfriend to her parents. It suggested going to a restaurant by the beach.

Encoding coding

OpenAI researchers trained GPT-3 on a vast assortment of text, including books, news stories, Wikipedia entries and software code. Later, the team noticed that GPT-3 could complete pieces of code, just like it can with other text. The researchers created a fine-tuned version of the algorithm called Codex, training it on more than 150 gigabytes of text from the code-sharing platform GitHub[1]. GitHub has now integrated Codex into a service called Copilot that suggests code as people type.

Computer scientist Luca Soldaini at the Allen Institute for AI (also called AI2) in Seattle, Washington, says at least half their office uses Copilot. It works best for repetitive programming, Soldaini says, citing a project that involves writing boilerplate code to process PDFs. "It just blurts out something, and it's like, 'I hope this is what you want'." Sometimes it's not. As a result, Soldaini says they are careful to use Copilot only for languages and libraries with which they are familiar, so they can spot problems.

Literature searches

Perhaps the most established application of language models involves searching and summarizing literature. AI2's Semantic Scholar search engine — which covers around 200 million papers, mostly from biomedicine and computer science — provides tweet-length descriptions of papers using a language model called TLDR (short for too long; didn't read). TLDR is derived from an earlier model called BART, by researchers at the social media platform Facebook, that's been fine-tuned on human-written summaries. (By today's standards, TLDR is not a large language model, because it contains only about 400 million parameters. The largest version of GPT-3 contains 175 billion.)

TLDR also appears in AI2's Semantic Reader, an application that augments scientific papers. When a user clicks on an in-text citation in Semantic Reader, a box pops up with information that includes a TLDR summary. "The idea is to take artificial intelligence and put it right into the reading experience," says Dan Weld, Semantic Scholar's chief scientist.

When language models generate text summaries, often "there's a problem with what people charitably call hallucination", Weld says, "but is really the language model just completely making stuff up or lying." TLDR does relatively well on tests of truthfulness[2] — authors of papers TLDR was asked to describe rated its accuracy as 2.5 out of 3. Weld says this is partly because the summaries are only about 20 words long, and partly because the algorithm rejects summaries that introduce uncommon words that don't appear in the full text.

In terms of search tools, Elicit debuted in 2021 from the machine-learning non-profit organization Ought in San Francisco, California. Ask Elicit a question, such as, "What are the effects of mindfulness on decision making?" and it outputs a table of ten papers. Users can ask the software to fill columns with content such as abstract summaries and metadata, as well as information about study participants, methodology and results. Elicit uses tools including GPT-3 to extract or generate this information from papers.

Joel Chan at the University of Maryland in College Park, who studies human–computer interactions, uses Elicit whenever he starts a project. "It works really well when I don't know the right language to use to search," he says. Neuroscientist Gustav Nilsonne at the Karolinska Institute, Stockholm, uses Elicit to find papers with data he can add to pooled analyses. The tool has suggested papers he hadn't found in other searches, he says.

Evolving models

Prototypes at AI2 give a sense of the future for LLMs. Sometimes researchers have questions after reading a scientific abstract but don't have the time to read the full paper. A team at AI2 developed a tool that can answer such questions, at least in the domain of NLP. It began by asking researchers to read the abstracts of NLP papers and then ask questions about them (such as "what five dialogue attributes were analysed?"). The team then asked other researchers to answer those questions after they had read the full papers[3]. AI2 trained a version of its Longformer language model — which can ingest a complete paper, not just the few hundred words that other models take in — on the resulting data set to generate answers to different questions about other papers[4].

A model called ACCoRD can generate definitions and analogies for 150 scientific concepts related to NLP, whereas MS^2, a data set of 470,000 medical documents and 20,000 multi-document summaries, was used to fine-tune BART to allow researchers to take a question and a set of documents and generate a brief meta-analytical summary.

And then there are applications beyond text generation. In 2019, AI2 fine-tuned BERT, a language model created by Google in 2018, on Semantic Scholar papers to create SciBERT, which has 110 million parameters. Scite, which has used AI to create a scientific search engine, further fine-tuned SciBERT so that when its search engine lists papers citing a target paper, it categorizes them as supporting, contrasting or otherwise mentioning that paper. Rosati says that that nuance helps people to identify limitations or gaps in the literature.

AI2's SPECTER model, also based on SciBERT, reduces papers to compact mathematical representations. Conference organizers use SPECTER to match submitted papers to peer reviewers, Weld says, and Semantic Scholar uses it to recommend papers based on a user's library.

Computer scientist Tom Hope, at the Hebrew University of Jerusalem and AI2, says that other research projects at AI2 have fine-tuned language models to identify effective drug combinations, connections between genes and disease, and scientific challenges and directions in COVID-19 research.

But can language models allow deeper insight or even discovery? In May, Hope and Weld co-authored a review[5] with Eric Horvitz, chief scientific officer at Microsoft, and others that lists challenges to achieving this, including teaching models to "[infer] the result of recombining two concepts". "It's one thing to generate a picture of a cat flying into space," Hope says, referring to OpenAI's DALL·E 2 image-generation model. But "how will we go from that to combining abstract, highly complicated scientific concepts?"

That's an open question. But LLMs are already making a tangible impact on research. "At some point," Einarsson says, "people will be missing out if they're not using these large language models."

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Why you shouldn't pave over your garden

Future Water Institute

Current Address: University of Cape Town

Reprinted from: https://bit.ly/3F8G07V

As attractive as paving and artificial lawn may be for Cape Town home owners whose gardens have succumbed to the drought, they are counterproductive when it comes to building a climate-resilient city, says Dr Kevin Winter of UCT's Future Water Institute and Water Task Team.

Recent winter rainfall over Cape Town has brought some relief after another long, dry summer. Stringent water restrictions remain in place in an effort to contain demand and allow storage dams to fill in the face of persistent uncertain weather.

"For many home owners, however, the rainfall has come too late in that prohibitions on using water to irrigate gardens have left lawns and plants wilting and dying. Many are thus tempted to abandon their lawns – as a recent message that slipped into the City of Cape Town's news suggested," says Winter.

"It stated that a 'top way' to help save water this winter is to let go of your natural grass lawn by installing artificial lawn or paving. This apparent advice might be appealing to weary gardeners, but it is counterproductive."

Here are three reasons why.

Hardened surfaces increase storm-water runoff

Paved and artificial surfaces – known to landscaping professionals as "hardscaping" – reduce the possibility of water infiltrating the soil and recharging groundwater. Water falling on roofs and hardened surfaces builds up above ground and must consequently be removed from the urban space in order to avoid flooding.

"This is well known," says Winter.

Figure 1. Paved and artificial surfaces – known to landscaping professionals as "hardscaping" – reduce the possibility of water infiltrating the soil and recharging groundwater. Photo Wikimedia.

Figure 2. Growing woody indigenous plants and ground cover helps to cool surface temperatures and encourage water infiltration. Photo Kevin Winter.

Figure 3. Replacing lawns with climate-resilient, drought-tolerant, local indigenous vegetation can help to manage one's garden and encourage water infiltration into the ground. Photo Kevin Winter.

"What is less obvious is the challenges of managing storm water once it enters canals and rivers via a network of storm-water channels and pipes. Once surface runoff reaches urban canals and rivers there is limited opportunity within the city of Cape Town to store this (frequently polluted) storm water and then use it to recharge groundwater and the aquifers."

Peak flow rates to the canals often occur within minutes of a rain shower and, within a short space of time, large volumes of water are lost into the sea.

"Another result of 'flashy' discharges to canals and rivers through an often-blocked storm-water system is localised flooding in low-lying areas. Increasing areas of hardscapes (including artificial grass) on properties will simply exacerbate the chance of flash discharges and rapid losses of water to the sea," explains Winter.

Given the extent of urban development, it is impossible now to reconstitute Cape Town's riverine landscape to a pristine state. All that is possible is to direct storm water into constructed wetlands that can help recharge groundwater, rather than directly into canals.

Water-sensitive gardening can also help. When lawns are difficult to manage with limited alternative water sources, replacing them with climate-resilient, drought-tolerant, local indigenous vegetation can help to manage one's garden and encourage infiltration into the ground with the additional benefit of reducing runoff and protecting against flash-flooding in the neighbourhood.

Good domestic garden practice means keeping rainwater on one's property for as long as possible without creating risk to immediate or adjacent properties. Some ideas worth considering include:

- Capturing a portion of rainwater for later use for flushing toilets, the washing machine, cleaning or sharing with others
- Directing harvested water to infiltration zones, including low-lying lawns, flower beds or rain gardens, tree or mulch pits to replenish groundwater
- As far as is reasonably possible, planting only locally indigenous vegetation that is adapted to the climate and soil and needs no artificial irrigation
- Where paving is necessary, using it to direct water to drain into the soil and ultimately to replenish the groundwater.

"Now is not the time to pave over domestic gardens or allow the deterioration of parks. It is time to 'grow green' in water-sensitive ways."

Hardened surfaces heat the city

A well-known phenomenon associated with above-normal temperatures in city centres, as compared with adjacent suburban and rural areas, is the 'urban heat-island effect'. Like a hot stone in the sun, concrete, brickwork and tarmac roads absorb and store heat. This raises the ambient temperatures in built-up urban areas.

Various studies have shown how urban gardens and parks help to reduce surface temperature extremes – not only do plants simply not get as hot as concrete, paving and tarmac, they also limit how much the surface heats up by shading it.

One United Kingdom study shows how trees and shrubs in parkland areas kept mean maximum daily soil surface temperatures in the summer lower by 5.7°C than in areas without woody plants, grasses and lawns.

It showed too that trees in domestic gardens kept summer soil surface temperatures lower by 2.2°C, and grass in an experimental plot kept maximum

Figure 4. Gardens have potential to attract indigenous wildlife species – particularly wild birds, like this Cape White-eye. Photo Wikimedia.

surface temperatures lower by up to 24°C when compared to adjacent areas with concrete surfaces.

"Cape Town needs to become increasingly prepared to deal with urban heat-island effects and warmer temperatures that could have an impact on health and ecological systems, and increase energy demand for cooling indoor conditions," says Winter.

"The lesson: Now is not the time to pave over domestic gardens or allow the deterioration of parks. It is time to 'grow green' in water-sensitive ways."

Hardened surfaces chase nature away

He continues: "We may not always welcome every creature into our gardens, but most will stay far away from a garden that offers no food or suitable breeding sites. A diversity of landscaping cover (for example groundcovers, shrubs, rockeries, trees and structures providing hideaways) creates niche habitat opportunities for native species with varying needs. Artificial, hardened surfaces don't."

Four desirable reasons for creating a biodiverse, water-sensitive garden include:

- Gardens have potential to attract indigenous wildlife species – particularly wild birds – and to offer protection for threatened species, eg Leopard Toads and Cape Dwarf Chameleons.
- A diversity of trees, shrubs and plants in a garden can mitigate light pollution sources from neighbouring properties and nearby roads.
- Green spaces on and around a property can help to establish and maintain localised habitat islands for native species.
- A biodiverse urban garden creates a powerful opportunity for residents, especially children, to connect with nature; and it heightens interest in attracting and caring for nature right where one lives. Studies have shown that humans with access to nature report better psychological well-being, lower hypertension and obesity, faster recovery times from illness and improved cognitive functioning.

Ensuring a climate-resilient city starts with your garden

The challenge of water restrictions and mixed messages about what is or isn't the right thing to be doing in a water crisis make it easy to lose focus on the long-term project of ensuring urban biodiversity, says Winter.

"We all have the means to contribute towards building a climate-resilient city. For those with a domestic garden, you can start by using the kinds of nature-based solutions outlined above to slow the flows of rainwater from your house, roof and paved areas; to use that water to recharge the groundwater through infiltration zones; to reduce the effect of 'the urban heat island' and help to keep urban spaces cool; and finally to attract native species to stay in the city."

Author contributions by

Dr Kevin Winter, Peta Brom, Professor Neil Armitage, Professor Andrew Spiegel, Emeritus Professor Les Underhill and Dr Kirsty Carden.

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Let's go back to basics: Knowledge as the foundation of farming

Khululiwe Ntombela

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Agriculture is a big contributor to the economy, livelihooks and culture in the African continent. In particular, livestock farming is an agricultural practice that is regarded as an ancient farming system that is still being practiced globally. Since it is an ancient practice, we then need to ask ourselves, how did the ancient farmers practice livestock farming?

With the absence of modern technology and access to information, what did ancient livestock farmers rely on in order to farm? It is fairly simple, ancient farmers observed, collected and analysed 'data' from the environment; and they tested different strategies and management systems to adapt to environmental changes.

This 'data collection' was from reading the signs shown by plants and animals when the environment changes, to using indigenous astronomy and making use of indigenous seasonal calendars, for example as with the Nama people in South Africa. In this way, they gathered knowledge which aided in their resilience to environmental hazards and disasters.

In the 21st century, many livestock farmers are struggling to farm profitably and sustainably while experiencing various environmental changes. Where could we have gone astray? The answer lies in knowledge; from production, access, modification, sharing to application.

Knowledge is an important part of farming that is often overlooked. Just as much as the right soil, climate, livestock breed, vegetation are all important for a farmer, so is knowledge, which is an intangible intellectual asset that forms part of the human assets.

Have we forgotten to develop and apply basic knowledge when it comes to livestock farming? Are we so focused on complicated solutions that we have forgotten that some solutions require local knowledge that is simple and uncomplicated to it's producers and holders? Most of the knowledge that current farmers have, is local ecological knowledge that has been tested and was passed down from generation to generation. Local Ecological Knowledge (LEK) is also used synonymously with Indigenous knowledge (IK) and Traditional Ecological Knowledge (TEK). LEK is generally defined as:

"a cumulative body of knowledge, practice, and belief evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, 1999: 8).

From this definition, LEK is differentiated from all other knowledge systems obtained through formal institutions, such as universities. From the definition, it depicts that LEK is not stagnant, but is a flexible and versatile knowledge that is to be amended to suite current situations, the biophysical and socioeconomic circumstances.

Farmers continuously test new methods based on what they learnt from their forefathers. They are an everyday "living experience" of farming, and therefore they can be seen as knowledge producers. This knowledge from their forefathers is generally undocumented and is passed down orally from generation to generation.

There is a need for local ecological knowledge to be recorded, and farmers need to be recognized as knowledge producers. A knowledge system is known to be a network that links actors, organisations and involved stakeholders to perform different functions that link the knowledge of how-to with actions. Farmers possess local ecological knowledge, and should be considered to be part of an agricultural production system, that might shape the future of sustainable agriculture on the African continent. In this way, farmers can have a sense of importance and belonging.

Africa is faced with a problem where, in most cases of agricultural based programmes, farmers are often expected to use new technologies that they most of the time do not have the background knowledge of, or they had no inputs in developing those technologies.

When funding for such programmes collapse, so does the use of this "new technical knowledge" as many technologies are outside the budgets of farmers. Then, farmers revert to using their local ecological knowledge to farm.

Championing local ecological knowledge holders can also be beneficial in knowledge exchange and assimilation by fellow farmers. In this way, other farmers will trust this knowledge, since it has been shaped by people who use this knowledge every day in their own farming enterprise.

This could be a step in the right direction to restore and preserve our "Natural Intelligence", as proposed by Laura Lynes in her recent article published in The Resilience Institute, Spring 2022 Update Newsletter.

An Ecological Guide to the Bush

Bruce McKenzie

Reprinted from: https://bit.ly/3Y6kwBp

Bruce McKenzie's *An Ecological Guide to the Bush* captures the essence of what makes the bushveld tick. Here you'll find the basic principles of how ecosystems work, with the emphasis on energy flow through the bushveld and the adaptations that the plants and animals make in facilitating this energy flow.

This book will answer the questions you always wanted to know about:

- Why can zebra and wildebeest, both grass eaters, live happily together? Why does the giraffe only feed on tree leaves?
- Why do large predators have to rest for up to 20 hours a day?
- How much energy does a bird expend flying?
- Why are reptiles mainly carnivores and why do lizards have to rest regularly?
- How important are grasshoppers, dung beetles and other insects to ecosystem functioning?
- Why do small predators need to eat proportionately more than larger predators?
- Why are termites so important for understanding energy flow in the bushveld?
- Why are small leaves necessary in the more arid bushveld areas? What are the nutritional differences between grass and tree leaves?
- How have snakes adapted to an unfavourable body shape?
- Why do very small herbivorous mammals need to consume high quality foods? Why do very large herbivores produce so much poorly digested dung?

The book is based on Bruce's approach to interacting with students and citizen scientists over the past 40 years and will enrich the understanding of bushveld management and conservation.

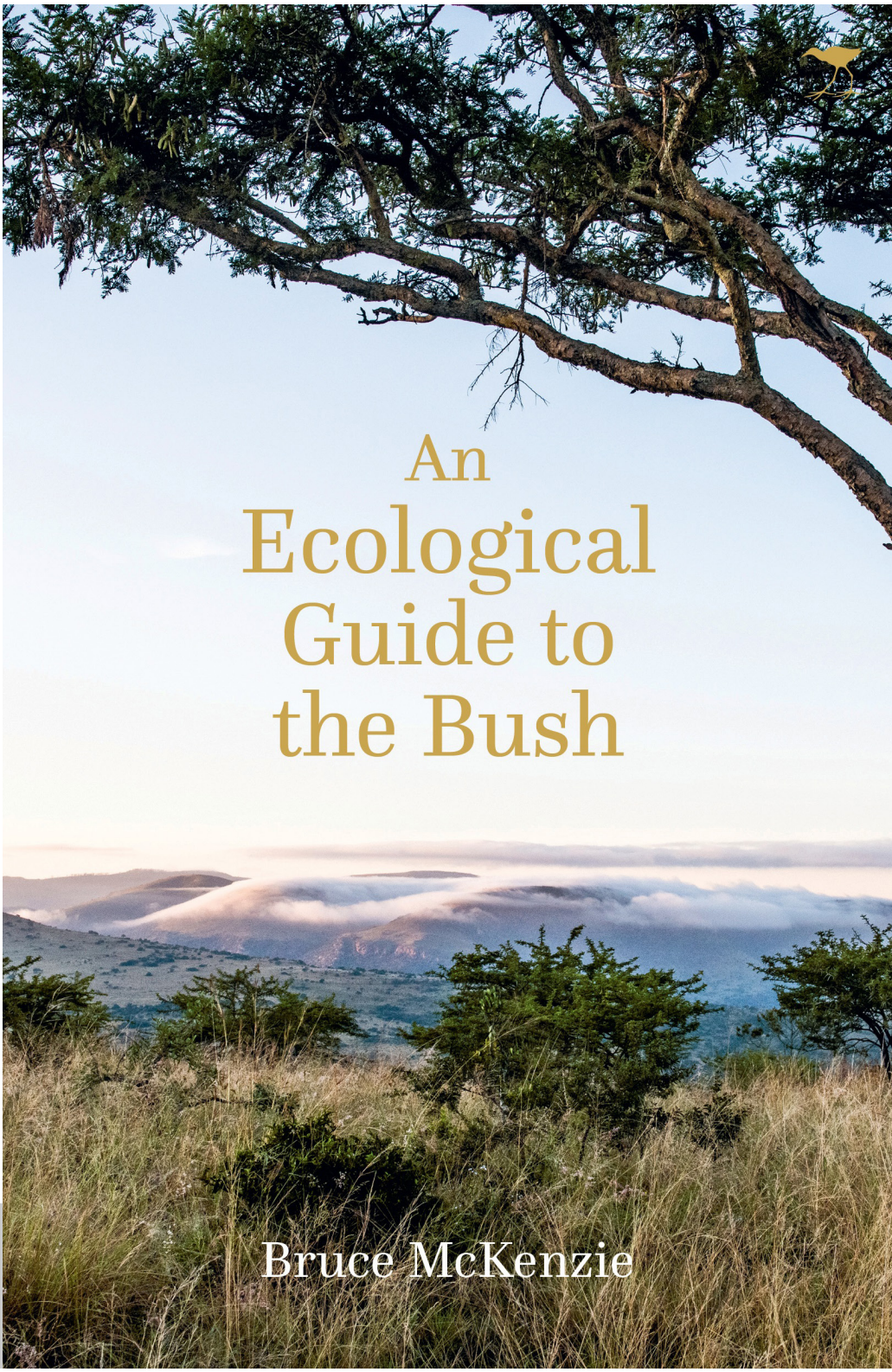
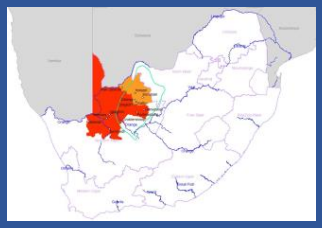


Figure 1. Bruce McKenzie's *An Ecological Guide to the Bush*



17 March 23 |
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RESTORE KALAHARI

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- Showcase regional case studies

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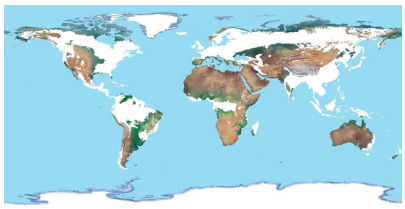
Websites, Webinars & Podcasts

Absa AgriTrends 2022

The Absa AgriTrends 2022 report provides insight from industry experts on the factors affecting agriculture in South Africa, and what this might mean for the future. Get the full report here.

Rangeland Atlas

A Rangelands Atlas has been developed to raise awareness of the importance of rangelands and highlight the changes taking place which are having significant impacts on rangelands, demanding their protection and restoration. View it here.



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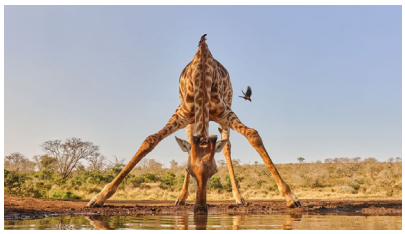
View 16 Breathtaking images from the Nature Conservancy's annual photo contest here. The winning shots feature everything from glowing mushrooms to sauntering lions.



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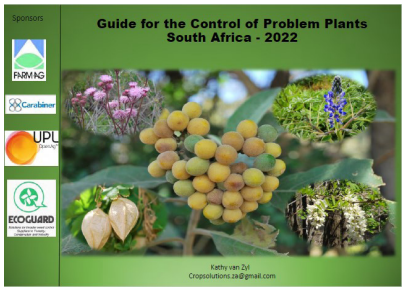
Guide for the Control of Problem Plants South Africa 2022

The new Guide for the Control of Problem Plants, South Africa 2022 (chemical control) is now available. The guide comes in a pdf format and can be purchased at a rate of:

- R100.00 for an individual user (no printing option), or
- R200.00 for a printable option.
- Organisations wishing to purchase the guide may do so in a pdf format that allows multiple shares and prints. A donation is requested in this instance.

Kindly contact Kathy van Zyl at cropsolutions.za@gmail.com or 072 599 2883 if you would like to support this initiative by purchasing a copy.



Go check out the following

Websites, Webinars & Podcasts

Common names of South African Grasses

Frits van Oudtshoorn has compiled a list of common names of grasses in South Africa in one document. Visit the Grassland Society of South Africa at: https://grassland.org.za/ to view this list.

Plant Conservation Webinar: What lies beneath

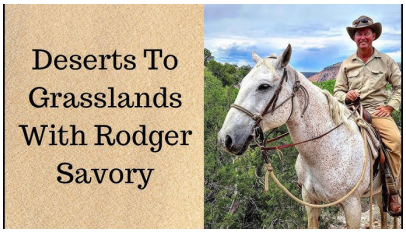
On 24 November 2022, Rupert Koopman, Prof Jaco le Roux, Dr Dunja Macalister, Prof Muthama Muasya and Lucan Page presented a webinar about underground microbiomes; to see how they support and arrange our biodiversity in South Africa. You can watch it here if you have missed it or would like to watch it again.

Grasslands are a very important biome in South Africa – Mansfield2day

Melanie Walker chats to Andrew Hanke from SANBI about the importance of grasslands in South Africa and how to create artificial grassland in your garden. Watch it here.

"Turning Deserts into Grasslands," with Rodger Savory

Rodger Savory is an ecologist who is focused on turning deserts into grasslands. Rodger is the director of Savory Holistic, which utilizes livestock to turn deserts into grasslands that have a positive impact on the climate, water quality and wildlife. He is now proposing to restore a desert in southern California and talks about his hopes for this project. Watch it here.



Upcoming events

23 – 26 January 2023

Combined Congress

The Combined Congress is an annual congress of three scientific societies, including Soil Science Society of South Africa (SSSSA), Southern African Society for Horticultural Sciences (SASHS) and the South African Society of Crop Production (SASCP). The Southern African Weed Science Society (SAWSS) who was also part of this collaboration, is now represented by SASCP. Weed science topics are thus still included in the congress. These societies join forces to optimise resources and promote collaboration between members.

The congress usually takes place the third week of January every year, and the location is rotated across the country. These three societies are further represented and scientifically supported by the local journal, South African Journal of Plant and Soil (SAJPS), that publishes original articles and commentaries on research in the fields of fundamental and applied soil and plant science.

Visit https://combinedcongress.org.za/ for more information.

30 January – 2 February 2023

5th National Global Change Conference 2023

The Global Change Conference is a national conference that is organised biennially by the Department of Science and Innovation (DSI) and the National Research Foundation (NRF) under the auspices of the Global Change Grand Challenge (GCGC). The next conference (GCC5) will be hosted in partnership with the University of the Free State and will be held at the Bloemfontein Campus of the University of the Free State.

For more information go to https://gcc5.org.za or contact the Conference Secretariat at secretariat@gcc5.org.za.

If you would like to advertise your upcoming event, please contact us and we will include it in our next edition.

Upcoming events

14 – 16 March 2023

Africa Agri Tech 2023

Africa Agri Tech Conference and Exhibition is dedicated to connecting the Southern African agricultural, scientific, and technology communities at one event, staged over three days. The event aims to deliver premium insights coupled with best-in-class presenters and suppliers; exploring global trends and advances in agricultural science, technology, and innovation; and the benefits that these will bring to the agricultural ecosystem in the future.

The event comprises a three-day main conference, exhibition showfloor, and co-located events including: Women in Agriculture, Innovation Challenge, Start-up pitches to venture capitalists, foreign trade lounge, hybrid event offering, Agriculture Industry Achievement Awards, and South Africa's inaugural Agriculture Hall of Fame. Visit https://africa-agri.co.za/ for more information.

2 – 6 June 2025, Adelaide, Australia

XII International Rangeland Congress

The Australian Organising Committee of the XII International Rangeland Congress, on behalf of the Australian Rangeland Society and the International Rangeland Congress Continuing Committee, invites you to participate in the International Rangeland Congress to be held June 2-6, 2025 at the Adelaide Convention Centre, Adelaide, Australia.

It is our goal to provide a vibrant platform for scientific exchange and education on the contemporary challenges and opportunities facing the rangelands and its communities. We will ensure there are many opportunities to network and connect with fellow delegates and celebrate achievements in our fields.

We recognise not everyone will be able to attend in person so we will design an exciting program that promotes exchanges via social media, live streaming, interactive Q&A sessions, and recording of select content. We look forward to seeing you in Adelaide in 2025!

Visit us and express your interest in attending the Congress:
www.irc2025.rangelandcongress.org or conference@aomevents.com.

If you would like to advertise your upcoming event, please contact us and we will include it in our next edition.

Deadlines for

Newsletter of the Grassland Society of Southern Africa

Grassroots

submissions

Issue 1: 1 February 2023

Issue 2: 1 May 2023

Issue 3: 1 August 2023

Issue 4: 1 November 2023

Please visit
www.grassland.org.za/publications/grassroots/submit-to-grassroots-now
for submission guidelines.

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