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Grassroots

Newsletter of the Grassland Society of Southern Africa

Perspective on
ENVIRONMENTAL ISSUES AND LIFESTYLE PRODUCTION

Rhino Coin
CAN A CRYPTOCURRENCY HELP SAVE AFRICA'S RHINOS?

New tool to predict invasive plants

Advancing Rangeland Ecology and Pasture Management in Southern Africa

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In this issue

From our editor

Welcome to the first issue of Grassroots for the New Year. We trust you all had a happy festive season and that 2019 is a good one!

We start this year with good news and sad news. We are very proud of one of our founder members, Dr Winston Trollope, who has been awarded the 2018 Henry Wright Lifetime Achievement Award for his significant contribution to fire ecology and management in grasslands and shrublands, through the Association for Fire Ecology.

He is the first international recipient of a lifetime achievement award and will be presented with it at the International Fire Ecology and Management Congress later this year. Congratulations Winston!

Sadly, one of our Namibian members, Dr Dave Joubert passed away in December 2018. Dave had made a great contribution to savanna research and had been a lecturer at the Namibia University of Science and Technology. He will be greatly missed within our GSSA community.

The African Journal of Range and Forage Science has recently published a special issue focusing on research in the Karoo.

This is a much-needed special issue as it has been over a decade since a research journal has dedicated one of its issues to the Karoo. For more information, have a look at the advert in this Grassroots issue.

This issue contains a variety of recent news articles, hopefully there's something in here for everyone!

These articles range from invasive species, soil fertility management and *Lablab purpureus* – a species used as a dry-season feed in Kenya to sustainable livestock production and key performance indicators for dairy farmers.

We also would like to see what interesting fieldwork our readers are up to and so we have started off the new year with a photographic competition.

Here we invite you to submit any photos related to rangeland ecology and pasture management into our competition and your photo may be on the next cover of Grassroots.

Any interesting photos taken while doing fieldwork are also encouraged – and will be put into our next issue! We would also like to hear of any achievements among our members – please let us know if you have recently completed your Masters or Doctorate or received any special awards.

Finally, a reminder of the 54th GSSA Congress coming up later this year in Upington. Registration is now open, and abstracts can be submitted. It will be great to see you all there!

Happy reading!

Contact us

If you have any feedback, comments, or suggestions, feel free to contact us at: info@grassland.org.za

Read more on

Abstracts for the 54th GSSA Annual Congress on page 5;
All upcoming events on page 34;
Exciting, new photo competition on page 36.

@GrasslandSociety-ofSouthernAfrica

2019 RESEARCH SKILLS WORKSHOP

* R FOR BIOLOGISTS *

1 JULY 2019 @ DESERT PALACE HOTEL, UPINGTON

FACILITATOR: DR VICTORIA GOODALL

WWW.VLGSTATS.CO.ZA

Course description: R statistical software (https://www.r-project.org/) has become a popular tool for data storage, manipulation and particularly data analysis. R is used in many disciplines and has become one of the most common statistics platform in ecology. The program is free and open-source, runs on all major operating systems and has many graphical and statistical operations built-in. However, one of the challenges to using this software initially is the computer programming required to run the analyses. This course will focus on the use of R, via a user interface R-Commander. It will cover the analysis of biological data using common statistical techniques and interpretation of the results.

Course content: Basic descriptive statistics, hypothesis testing, linear regression, generalized linear models and principal component analysis.

Requirements: A basic knowledge of the statistics is required for this course. A brief overview of the theory will be given. The practical component will be run using R and R-Commander. Delegates must have R and R-Commander loaded on their computers. An internet connection will be provided.

*** For more information, please email info@grassland.org.za or visit https://2019gssa.dryfta.com/en/ ***

Grassroots

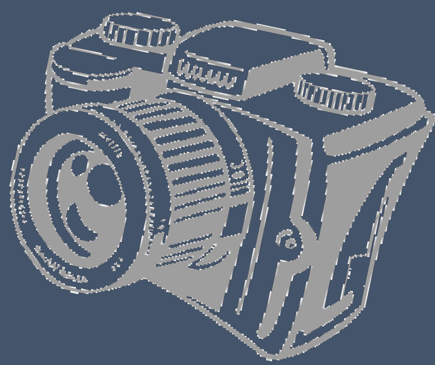
Newsletter of the Grassland Society of Southern Africa

Photo competition

Are you a keen photographer? Have you recently taken unique photos while doing field work?
Enter them into any of the following two categories and your photo can be our next ***Grassroots* cover**!

"Cover" photos
Any high quality photos that are related to rangeland ecology and pasture management in southern Africa

"Research in Action" photos
Any interesting photos taken while collecting data or doing field work that are related to rangeland ecology and pasture management in southern Africa



Winning photos will feature in the next *Grassroots* and the overall winning photo will be on the cover!

Competition runs for the next 3 Grassroots editions of 2019!

How to enter:.

- Choose one of the above categories.
- Photos must be in jpg format and not exceed 10 MB.
- Email your entries with your name and contact details to **photos.grassroots@gmail.com.**
- Include a title and information on where and when the image was taken.
- Email your photos before 17h00 on the following dates:
    - 10 April 2019 (*May edition*)
    - 1 July 2019 (*August edition*)
    - 1 October 2019 (*November edition)*
- You will receive a confirmation email upon entrance.

For additional information, send an email to **info@grassland.org.za**

***Terms & Conditions:**

- Anyone is welcome to enter, except the *Grassroots'* publication team and their immediate family. Photos will be judged by the publications team.
- More than one entry is allowed.
- A participant who is announced as a winner may not enter the competition for the following editions.
- *Grassroots* holds the right to use entered photos elsewhere in *Grassroots*, the GSSA website, or for future marketing purposes without compensation to the photographer.
- A photographer will receive the necessary recognition if any of his/her photos are published by *Grassroots.*
- Winners will be notified a week before publication.

Winston Trollope Wins the Henry Wright Lifetime Achievement Award

"Pioneers in fire ecology like Winston, has left us with a legacy of applied science that has laid the foundation for sound fire management practices in Southern Africa. These practices are what science should be about - not merely a scientific result of research on paper, but a result in the field where it makes a difference."
~ Tiaan Pool, Nelson Mandala University

Reprinted From: http://bit.ly/2BUcSRY

The Association for Fire Ecology (AFE) is pleased to announce Dr. Winston Trollope has been awarded the 2018 Henry Wright Lifetime Achievement Award for his significant contribution to fire ecology and management in grasslands and shrublands.

Dr. Trollope is from South Africa and obtained B.S. (1962) and M.S. (1971) degrees in Agriculture and a Ph.D. (1984) in Rangeland Science at the University of Natal in Pietermaritzburg. Winston held faculty and administrative positions at the University of Fort Hare in South Africa for 35 years, where he pioneered scientific work in fire ecology and fire management in savannah ecosystems of Africa and globally.

He has presented at more than 70 conferences worldwide, often as an invited speaker, and has published 150 publications, chapters, or reports. His masters research resulted in burning programs that are still in use to control macchia vegetation in the mountainous areas of the Eastern Cape Province. His doctoral research had similar long-lasting effects and have improved the use of fire as a range management practice for both domestic livestock systems and wildlife management.

AFE honors career achievements in fire ecology and management by recognizing the pioneers and early advocates in our field. Each year, lifetime achievement awards are presented to individuals who have made significant contributions to fire ecology and management and who have inspired and mentored a generation of fire ecologists.

The award for individuals who primarily work in grassland and shrubland ecosystems is named after Henry Wright of Texas Tech University. Henry's extensive research in prescribed fire, along with his extension programs and university courses, helped fire become an accepted management practice for controlling brush and weeds and for restoring grasslands. Winston is particularly honored to receive this award, as he visited Henry Wright in 1971 and received invaluable advice on the characterization of fire intensity, which he applied extensively in African grasslands and savannas and which formed the basis of his research program.

Dr. Trollope is AFE's first international recipient of a lifetime achievement award. He will be presented with the Wright Award at the 8th International Fire Ecology and Management Congress, November 18-22, 2019, in Tucson, Arizona.

A list of all Lifetime Achievement Award winners is available at http://bit.ly/2T70WqX.

About AFE

The Association for Fire Ecology (AFE) is a nonprofit organization dedicated to improving the knowledge and use of fire in land management. Our members include scientists, educators, students, managers, practitioners, policymakers, and interested citizens. To learn more about AFE, visit www.fireecology.org.

For more information, contact Annie Oxarart, 541-852-7903, office@fireecology.net.

Figure 1: Winston Trollope is acknowledged for his significant contribution to fire ecology and management in grasslands and shrublands.

Karoo Special Issue - African Journal of Range and Forage Science

Reprinted From: http://bit.ly/2SsQmVG

It has been nearly 20 years since Dr W Richard J Dean and Dr Suzanne J Milton published an edited volume concerning southern Africa's drylands and over a decade since a research journal has dedicated one of its issues to the Karoo.

The Karoo Special Issue (KSI), published in *African Journal of Range and Forage Science*, Volume 35, Issue 3 & 4 is thus a truly influential issue.

The Karoo is an arid to semi-arid area across the western third of South Africa, comprising the Succulent Karoo and Nama-Karoo biomes. Its environment and people have experienced considerable changes, and now face new challenges as the Anthropocene unfolds.

The Anthropocene relates to the current geological age during which human activity has been the dominant influence on climate and the environment.

The special issue brings together new information in 20 papers, a mixture of reviews, research articles and commentaries, significantly adding to the previous syntheses of Karoo knowledge.

While previous ecological research on land-use practices in the Karoo has emphasised the impact of grazing by domestic livestock on vegetation, the KSI brings an historical depth to this use that has rarely been highlighted before, together with an analysis of several new data sets that have hitherto not been explored extensively.

The issue is also a multi-disciplinary issue.

Dedicated to Dr Suzanne J Milton and Dr W Richard J Dean the KSI papers, many of which were written by their colleagues, friends or former students, represents a Festschrift that celebrates and honours their research as well as the inspiration and leadership they have to a generation of scientists.

The special issue can be accessed here: http://bit.ly/2SYclJv.

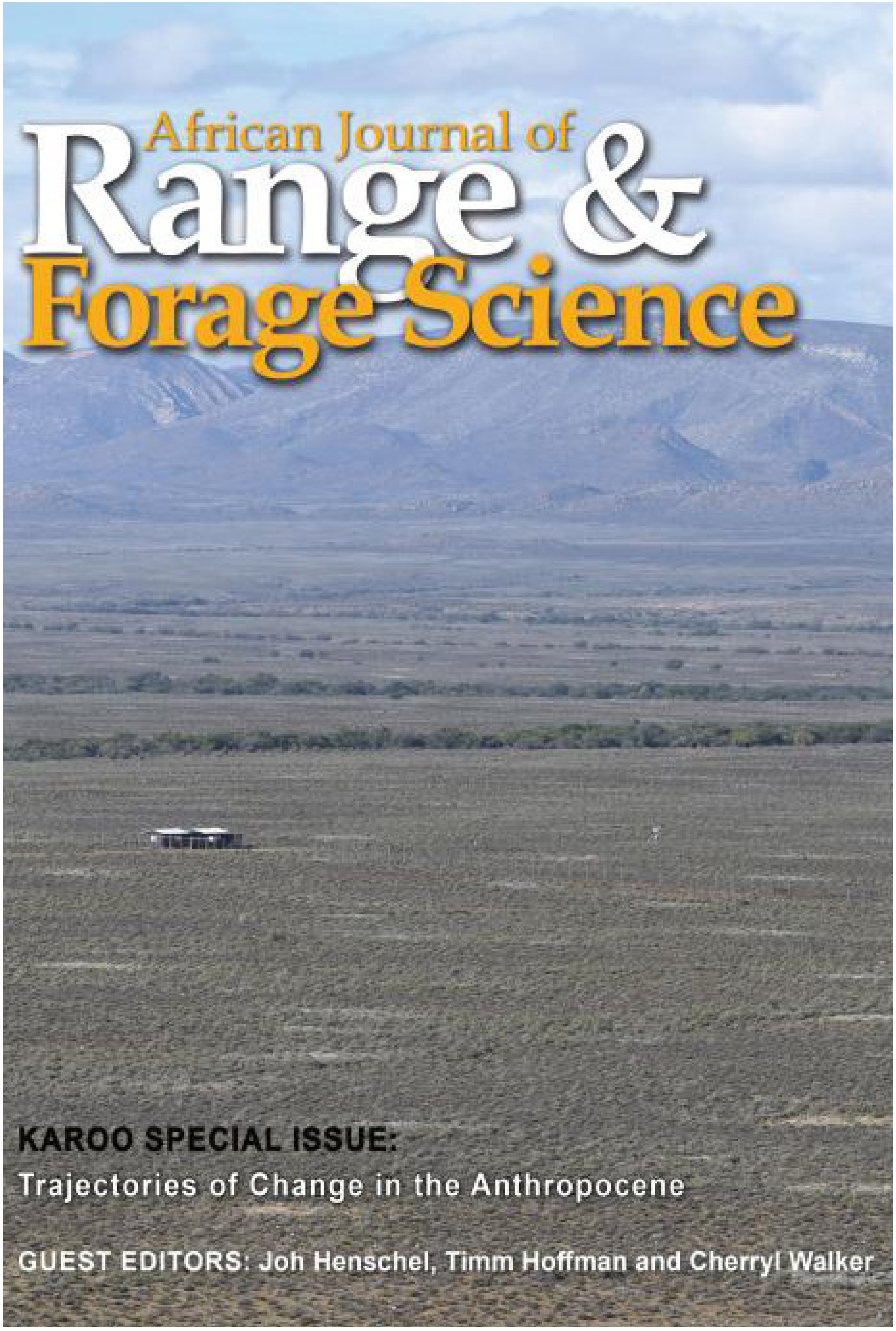


Figure 1: The special issue of the African Journal of Range and Forage Science was published in November 2018.

Status of the African Journal of Range & Forage Science with the Department of Higher Education and Training

Dr Pieter Swanepoel

The African Journal of Range & Forage Science is subsidised by the Department of Higher Education and Training (DHET), which has several lists of journals that qualify for subsidy purposes. Accredited journals are those appearing in the following indices:

- ISI (social science citation index, science citation index, and arts and humanities citation index),
- IBSS,
- Scopus,
- Norwegian journal list,
- DHET local journal list (these are "transitional" titles that have been identified by DHET as meeting the criteria but expected to get accepted onto the international indexes within two years).

The African Journal of Range & Forage Science is listed on several of these abovementioned lists, including the ISI and Scopus.

Recently, the DHET has cleaned up the local journal list, removing titles that already appear on the international lists.

The African Journal of Range & Forage Science was removed from the DHET local journal list, because it already appears on the international lists. The African Journal of Range & Forage Science will therefore continue to qualify for publication subsidy on the basis of its ISI listing.

For any uncertainty, contact Freyni du Toit (journal@grassland.org.za) or Dr Pieter Swanepoel (pieterswanepoel@sun.ac.za).

New tool to predict which plants will become invasive

Research predicts which species are more likely to become invasive based on biological traits

University of Vermont

Reprinted From: http://bit.ly/2IRh8YH

Around the world, over 13,000 plant species have embedded themselves in new environments -- some of them integrate with the native plants, but others spread aggressively. Understanding why some plants become invasive, while others do not is critical to preserving the world's biodiversity.

New research from the University of Vermont provides insight to help predict which plants are likely to become invasive in a particular community. The results showed that non-native plants are more likely to become invasive when they possess biological traits that are different from the native community and that plant height can be a competitive advantage.

"Invasive species can have a devastating effect on our natural ecosystems and cause long-term environmental and economic problems," said Jane Molofsky, a professor in UVM's Department of Plant Biology and senior author of the study published November 6, 2018 in *Nature Communications*. "Our aim was to leverage big data and statistical techniques to evaluate this problem in a novel way by comparing traits of native and non-native plants across a range of plant communities."

Working with a team of international collaborators, Molofsky and colleagues at UVM explored differences in biological traits of 1,855 native and non-native plant species across six different habitat types in temperate Central Europe.

In each habitat type, the authors compared the traits of native and non-native plants. Of the non-native plants, they looked at differences in those that "naturalized," meaning they reproduce in nature without direct intervention by humans but did not aggressively spread, and invasive species, those that spread over long distances and often cause serious ecosystem damage.

Being taller promotes success

In almost all of the studied habitats, the findings showed non-invasive plants shared similar traits with the native plant community, such as plant height, leaf characteristics and average seed weight. In contrast, invasive species appeared to have similar but slightly different biological characteristics -- they were similar enough to be present in the same habitats but just different enough to have unique characteristics that allowed them to flourish.

Figure 1: While native to Europe and Asia, Queen Anne's lace (Daucus carota) is an invasive plant in many parts of North America. New research from UVM finds a single biological trait - plant height - may help predict which plant species are likely to become invasive in a given environment. (Photo: Milan Chytry)

For instance, some invasive plants were taller on average compared with the native species. This phenomenon suggests the additional height of some invasive plants gives them better access to light and enables them to outcompete native plants and spread more aggressively.

The findings support a novel theory of invasion called the edge of trait space model that suggests non-native plants can co-exist with a native plant community when they share a set of specific biological traits but can invade when they have slightly different adaptations to local environmental conditions. Therefore, newly introduced species must be similar enough to thrive in a community of native species, but their differences may enhance their invasion success.

The results indicate that a single, easily measurable trait -- plant height -- can be a highly predictive factor in determining which plants may become invasive in a given environment. While the predictive traits may differ among different flora, the research suggests eradication efforts should focus on non-native plant species that differ from their native communities.

"We need new predictive tools to help inform policy and management decisions around conservation and biodiversity," said co-author Brian Beckage, a professor in the Department of Plant Biology and Department of Computer Science, and affiliate of the UVM Gund Institute for the Environment. "Our hope is that this model can be used as a screening tool to determine which plants have the highest probability of becoming invasive in the future."

Story Source

Materials provided by University of Vermont.

Journal Reference

1. Jan Divíšek, Milan Chytrý, Brian Beckage, Nicholas J. Gotelli, Zdeňka Lososová, Petr Pyšek, David M. Richardson, Jane Molofsky. Similarity of introduced plant species to native ones facilitates naturalization, but differences enhance invasion success. *Nature Communications*, 2018; 9 (1) DOI: 10.1038/s41467-018-06995-4

South Africa's invasive species guzzle precious water and cost US$450 million a year

The country's pioneering first report on its biological invaders paints a dire picture for resources and biodiversity.

Sarah Wild

Reprinted From: https://go.nature.com/2BYanym

South Africa is losing its battle against biological invaders, according to the first attempt by the government to comprehensively assess the status of the country's alien species.

The invaders, including forest-munching wasps, hardy North American bass and trees attractive to mosquitoes, cost the country approximately 6.5 billion rand (US$450 million) a year and are responsible for about a quarter of its biodiversity loss. That's the conclusion of a pioneering report that the South African National Biodiversity Institute in Pretoria released on 2 November.

Invasive species also guzzle a substantial amount of South Africa's water, a serious problem in a country suffering from a prolonged and catastrophic drought that is expected to worsen as the climate changes.

The report, which the institute compiled in response to 2014 regulations that mandate a review of invasive species every three years, examines the pathways by which these species enter the country and the effectiveness of interventions. It also weighs the toll they take on the nation's finances and biodiversity.

This achievement constitutes a "significant advance" compared with efforts by most other countries, says Piero Genovesi, who chairs the invasive species specialist group of the International Union for Conservation of Nature in Rome. He says that other reports have looked at the impact of biological invasions, or at measures to address the problem, but they have not considered all aspects of invasions.

Helen Roy, an ecologist at the Centre for Ecology and Hydrology near Oxford, UK, says that, to her knowledge, this is the first comprehensive synthesis of the state of invasive species by any country. The report provides "an incredible basis" on which to build predictive approaches to invasive species that could be used to inform prevention strategies in South Africa, she says.

Figure 1: The invasive ant *Linepithema humile* disrupts seed dispersal in indigenous South African plants. Credit: Mark Moffett/Minden Pictures/Alamy

Climate change

Across the world, invasive alien species — organisms that have been introduced into ecosystems beyond their natural habitats, and that spread over large distances on their own — are considered a major threat to biodiversity, human health and economies. Climate change is expected to further their spread around the world, in part by reducing the resilience of native ecosystems. In 2015, 37 researchers from 14 national organizations, led by the National Biodiversity Institute and the Centre of Excellence for Invasion Biology at Stellenbosch University, began compiling the South African report. The researchers collated data from agencies and institutions around the country to measure the different aspects of biological invasion.

They report that 7 new species are introduced into South Africa each year, and that about 775 invasive species have been identified so far. This contrasts with the 556 invasive taxa listed in the government's 2014 regulations on invasive species. Most of the species identified by the latest report are plants, with insects the next most common. (For comparison, the United Kingdom reports that it has 184 non-native invasive species). The report's authors consider 107 of these invaders to have major impacts on the country's biodiversity or on human well-being.

Invaders of note include trees in the *Prosopis genus*, such as honey mesquite (*P. glandulosa*), which was introduced throughout Africa for animal fodder. The shrub damages animal grazing areas, outcompetes local plants and, according to a 2017 study in Mali, seems to encourage the growth of populations of the malaria-carrying *Anopheles* mosquito[1], among other things.

Other invasive species include the Sirex wasp (*Sirex noctilio*), first detected in the country in 1962, which seriously threatens South Africa's 16-billion-rand forestry industry; the ant *Linepithema humile*, which comes from Argentina and disrupts seed dispersal in indigenous plants; the North American smallmouth bass (*Micropterus dolomieu*), which has outcompeted indigenous fish species; and the water hyacinth (*Eichhornia crassipes*), originally from South America, which chokes the country's dams and waterways.

Figure 2: The water hyacinth *Eichhornia crassipes*, originally from South America, can choke South Africa's waterways. Credit: John Robinson/Africa Media Online/ Alamy

Thirsty invaders

As well as their significant financial toll, the report holds invasive species responsible for a quarter of the country's biodiversity losses. The researchers also find that invasive species in South Africa take a shocking toll on the water supply.

This year, Cape Town almost became the first major city in the world to run out of water. (It was saved at the last minute by stringent water restrictions). In May, researchers argued that alien plants, which often use more water than do indigenous ones, consumed more than 100 million litres of water a day — about a fifth of the city's daily usage. They warned that water losses due to invasive species could triple by 2050 because trees including black wattle and cluster pines are spreading. The latest report estimates that invasive trees and shrubs, if left unchecked, could threaten up to a third of the water supply to cities such as Cape Town, and consume up to 5% of the country's mean annual rainfall runoff.

Despite enacting the 2014 regulations and spending at least 1.5 billion rand a year to curb invasive species, the country is not keeping up, says the report. "The most concerning finding was how ineffective we have been," says report co-author Brian van Wilgen, an applied ecologist at Stellenbosch University.

But the authors also note that their confidence in almost all their estimates is low, because of poor monitoring and evaluation data — a problem that can be mitigated in future reports through increased research into impacts and monitoring techniques.

Jasper Slingsby, an ecologist with the South African Environmental Observation Network in Cape Town, agrees that researchers in South Africa right now are limited by the available data. "We need better funding and concerted research effort in this space as a national priority," he says.

References

1. Muller, G. C. et al. Malar. J. 16, 237 (2017).

To keep the planet flourishing, 30% of Earth needs protection by 2030

The move would safeguard biodiversity, slow extinctions, and help maintain a steady climate, a leading group of conservationists say.

Emma Marris

Reprinted From: https://on.natgeo.com/2IJ6YZP

This week (31 January 2019), a United Nations working group responded to a joint statement posted online in December by some of the world's largest conservation organizations calling for 30 percent of the planet to be managed for nature by 2030—and for half the planet to be protected by 2050. But exactly what counts as "protected"—and how countries can reach those goals—is still up for debate.

Conservationists say these high levels of protection are necessary to safeguard benefits that humans derive from nature—such as the filtration of drinking water and storage of carbon that would otherwise increase global warming. The areas are also needed to prevent massive loss of species.

Humans and their domestic animals are squeezing the rest of life on Earth to the margins. Today, only four percent of the world's mammals, by weight, are wild. The other 96 percent are our livestock and ourselves. Since 1970, populations of wild mammals, birds, fish, and amphibians have, on average, declined by 60 percent.

Habitat loss is widely regarded as the top cause of species extinction around the world and these dramatic population declines are a red flag that many species are on thin ice—but the good news is that there is still time to save most species. The International Union for Conservation of Nature's Red List of Threatened Species lists 872 species as extinct, but a whopping 26,500 species as threatened with extinction. To save those species, their homes and the other species with which they depend must be protected—and quickly.

"We've got a really tight clock," says Brian O'Donnell, director of the Wyss Campaign for Nature, based in Durango, CO, who advocates globally for more conservation areas. "Every year we wait, we put more species in peril."

The call is part of a process of setting global environmental targets organized by the Conference of the Parties to the Convention on Biological Diversity. Negotiations on the specifics of the target will continue until a meeting in Beijing in October 2020.

The targets will replace and go beyond the "Aichi Biodiversity Targets," which were set in 2011 and are supposed to be reached by 2020. Among them is a goal of protecting 17 percent of terrestrial and inland water, and 10 percent of coastal and marine areas.

Those goals are still within reach. As of 2018, 14.9 percent of the Earth's land surface and 7.3 percent of the world's oceans are formally protected.

Signatories of the 30 percent by 2030 call posted this week include BirdLife International, Conservation International, the National Geographic Society, the Natural Resources Defense Council, the Nature Conservancy, and nine other non-governmental organizations. Most see the 2030 target as a stepping stone on the way to an even more ambitious goal: conserving half of the planet by 2050.

Calls to protect half the Earth date back to the 1970's, but the concept has gained momentum in recent years thanks to the 2009 founding of the Nature Needs Half movement and the 2016 publication of eminent naturalist E.O. Wilson's book Half Earth.

"There has been a great convergence of thought in terms of people thinking on a bigger scale," says Jonathan Baillie, executive vice president and chief scientist at the National Geographic Society, based in Washington D.C. "It is very rare to get all the major conservation organizations to agree to one thing."

Supporters say that having an ambitious and clear target may help the crisis of biodiversity loss get the attention it deserves from governments and private institutions. In recent years, concern over climate change has captured more attention.

O'Donnell says that at the latest meeting on the Convention on Biodiversity country's environment ministers were the highest ranking officials attending, and many of those only stayed for part of the meeting. In contrast, meetings of the Paris Climate Accord are attended by presidents and prime ministers. At the same time, the climate talks receive far more media and public attention. But the issue of saving biodiversity "needs to be elevated among global leaders," O'Donnell says.

Including indigenous people

Some observers are waiting to hear more details before they support the idea.

The call to protect 30 percent of the Earth "alarmed" Victoria Tauli-Corpuz, the United Nations Special Rapporteur on the rights of indigenous peoples, based in Baguio City, Philippines. Tauli-Corpuz was one of the authors of a 2018 report criticizing conservation organizations for kicking indigenous people off their traditional lands to create protected areas, preventing those previously displaced by parks from reclaiming their lands, or aggressively policing their behavior and harming their livelihoods by prohibiting farming or hunting.

Conservationists increasingly acknowledge the rights of indigenous people to their lands, and even point to the fact that land controlled by indigenous people is often much better cared for, from a biodiversity perspective, than land controlled by settlers. Although indigenous people make up less than five percent of the global population, they own or manage about 25 percent of the Earth's land—much of it far more diverse and sustainably managed than the remaining three quarters. And despite the challenges of poverty and insecure land rights, indigenous people and local communities spend around four billion dollars a year on conservation—a significant chunk of the total global spend of about 21 billion.

But Tauli-Corpuz, who is indigenous herself, says ideologies change slowly, and for many the full-time presence of people making a living seems incompatible with conservation. "I think they are still trapped in the idea that people should not be intervening in nature," she says. "I came from a meeting in Nairobi a few days ago, and almost all the speakers were still speaking about this issue."

She has called for a grievance mechanism to be set up, so that indigenous people can formally complain to the United Nations if they are harmed by conservation projects, but this has not yet been done. Restitution of land and resources taken by earlier conservation projects has by and large not happened yet either, she adds. "Calling for an increase without dealing with the issues raised by indigenous people is going to be problematic," she says.

Those behind the 2030 call say that land managed and inhabited by indigenous people and other local communities will count toward the target. "Protecting biodiversity means protecting indigenous rights," says O'Donnell. "That is going to be at the center of 30 percent for the planet, rather than in conflict with it."

Innovative new approaches

Some areas are managed by local people for both conservation and sustainable use. O'Donnell and Baillie both gave the example of the Northern Rangelands Trust, a consortium of conservancies in Kenya in which local pastoralists from 18 different ethnic groups manage their land for both livestock grazing and wild animal conservation, with the financial and logistical support of NGOs and governmental institutions.

The project makes clear that not all of the "protected areas" in the 30 percent target will look like the kind of parks and reserves many Americans are familiar with. The International Union for the Conservation of Nature has created a typology of categories of protected areas, ranging from Type Ia, "Strict Nature Reserves," with limited access for people, to Type IV, "Protected area with sustainable use of natural resources"—which more or less describes many places where indigenous people live today.

This, coupled with the superior track record of indigenous people in protecting biodiversity, is why Erle Ellis, an environmental scientist at the University of Maryland, Baltimore County says that as far as he is concerned, "enforcement of indigenous sovereignty should be automatically part of that 30 percent."

Beyond the many flavors of "protected area," the call includes room for "Other Effective Area Based Conservation Measures." As the capitalization hints, this is not just a vague phrase, but an increasingly codified category of land management, first sketched out in the 2011 Aichi targets. One report defines it as "a geographically defined space, not recognized as a protected area, which is governed and managed over the long-term in ways that deliver the effective in-situ conservation of biodiversity, with associated ecosystem services and cultural and spiritual values."

Potential examples include traditional hunting and gathering grounds; natural areas on military bases; areas set aside for scientific research; sacred sites and cemeteries; pastures of native grasslands; or even diverse city parks.

Avoiding "paper parks"

According to the groups' vision statement, the 30 percent that is protected won't just be the part that is cheapest and easiest to protect but should be fully representative of the diversity of the planet's ecosystems. Yet that may be difficult to achieve by 2030, says Ellis.

"The big question about getting to 30 percent in a little over ten years is whether the speed is going to sacrifice quality," he says. "It would be a shame if people tried to get there fast by conserving the land that isn't really under pressure."

Likewise, he says, conserving land without making sure there is long-term funding to manage it and plans to ensure the stability and prosperity of surrounding communities risks creating "paper parks" that are routinely plundered of resources by those who don't have a stake in the area or are driven by necessity. "By trying to move too past it is possible that they will create a huge realm of failed conservation," he warns.

So the emerging vision is more complex than the "30 percent by 2030" slogan may suggest. By 2030, leading conservationists say, Earth should dedicate 30 percent of its land and sea to a robustly financed, locally supported, ecologically representative mix of areas managed for the benefit of nature.

This story was produced in partnership with the National Geographic Society.

Coming up with new solutions for yellow thatch grass

René de Klerk (for Safari News)

Reprinted From: http://bit.ly/2NDiuEX

Yellow thatch grass (*Hyperthelia dissoluta*) has been a problem in the Waterberg region of Limpopo for years. This fire-dominant perennial species grows up to 3m tall and occurs naturally in the Highveld region of South Africa. New growth is extremely nutritious and palatable during its early growth stages, but once mature, wildlife no longer shows interest.

While much debate has been ongoing over the best solution for the grass that is taking over the reserve's open plains, management at Mabula Game Reserve is now experimenting with different methods. It is still early days, but they are hoping to find the best solution for their grassy problem.

"There is a lot we can do about the grass, but not much to stop it from growing back," says Mabula reserve manager Kobus Havemann. The grass occurs in high densities on most of the open plains in the reserve. These plains are great areas for game viewing, but the thatch grass that dominates is not palatable once mature, and it reaches this about two months after new growth starts. It also competes with other grass species as nothing else is as aggressive and quick to grow. "Plenty of animals will use the thatch grass on the plains, but to be a food source we have to keep it short," says Havemann.

Keeping it short is where the challenge lies. Thatch grass has numerous uses, including roofing, but continuously harvesting in an area with dangerous game is not viable. Burning the grass is a short-term solution, but it returns even thicker. Even slashing the grass does not solve the problem.

Management has chopped and burned for the last 20 years, but they are hoping research will provide better solutions. Research ecologist Preller Human is now searching for possible answers and has set up experimental sites of 50m x 50m next to one another in an area that was previously burnt. One site will be left untouched. Another plot is seeded with beneficial grass, while microbes were introduced at a third site. Microbes and seeds were combined in another plot. The last two plots were aggravated (the top soil disturbed) with one seeded, and another microbes and seeds added.

Figure 1: Invasive grassland species: Yellow thatch grass

After three years of surveys, which will be towards the end of 2019, Human will be able to reveal what the effects of fire, slashing and microbes are on the thatch grass.

"Only then will we find the best management practises," says Human. Part of it also includes watching ungulates to see whether they actively seek the microbe sites – the reason why they are next to each other.

A local farmer has recently been contracted to rake and bale thatch grass in a n attempt to take away the seed bed that naturally forms when you cut grass but leave the stalks on the ground. This provides the ideal medium for new seeds to germinate and flourish and it is felt that this may aggravate the thatch grass problem on Mabula.

This is a very exiting experiment and we may just have stumbled across a solution to control thatch grass effectively in the long term. Havemann says Mabula's open plains are extremely important for tourism as sightings are guaranteed with the shorter grass. The vital information gained from the research will assist the reserve in adapting its management plan and inform important decisions.

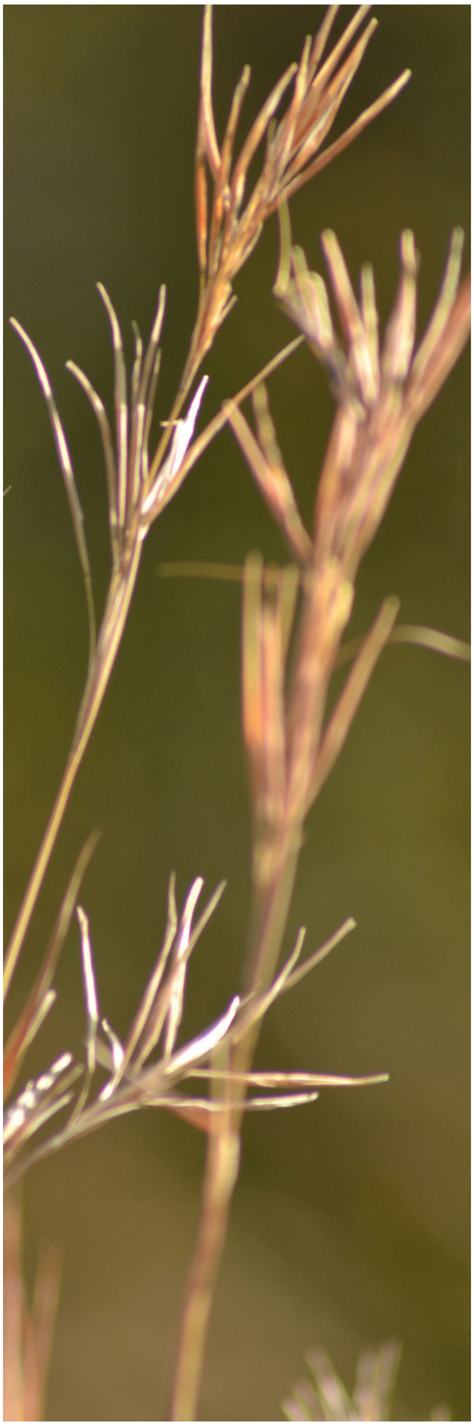


Figure 2: Yellow thatch grass in Mabula Private Game Reserve

Conservation Agriculture and soil fertility management: Part 1

Theoretical principles and practices

Hendrik Smith[1] and Gerrie Trytsman[2]

Current Address: [1]Conservation Agriculture Facilitator and [2]Independent Scientist, Grain SA
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In South Africa, crop production systems based on intensive and continuous soil tillage have led to excessively high soil degradation rates with a reduction in natural soil fertility in areas under grain production. It also results in the consistent recommendation of the use of huge quantities of chemical fertilizers that are biologically unnecessary, economically extravagant and ecologically damaging. Tillage results in the oxidation and destruction of carbon in the soil by increasing the soil oxygen levels, thereby promoting bacteria populations to expand and consume active carbon in the soil. Soil organic carbon (SOC), or soil organic matter (SOM), is the key element that drives soil health, which in turn is the primary factor having an impact on sustainable crop production. If sound farming practices are sustained over time, soil health improvement could significantly escalate, influenced by positive changes in a wide spectrum of soil parameters, including soil fertility, which then result in improved productivity and profitability of farming systems.

There is general agreement among key stakeholders in South Africa, that soil health and sustainable crop-livestock production will only be achieved through the adoption and implementation of Conservation Agriculture (CA) principles and practices. CA is seen as an ideal system for sustainable and climate-smart agricultural intensification and regeneration, through which farmers can attain higher levels of productivity and profitability, while improving soil health and the environment.

One of the good agricultural practices (GAPs) associated with CA is integrated soil fertility management (ISFM), which essentially depends on locally adapted CA principles and practices to build-up soil health, allowing producers to reduce the use of fertilisers, while sustaining good and stable yields and increasing profitability. This understanding is

Figure 1: Crops can be planted into crop residues without physically disturbing the soil.

important if we wish to sustain productivity at the lowest possible costs, both economic and ecological. Without being able to go into details, this paper aims to provide a few principles, advantages and examples of ISFM.

Integrated soil fertility management

This concept of ISFM emphasizes the maximization of nutrient use efficiency, the enhanced access of soil nutrients to plant roots, the response of soil as a living ecosystem and the role of sound locally adapted soil management practices enhancing ecosystem functions and services leading to improved soil fertility. The concept acknowledges that neither practices based solely on mineral fertilizers nor solely on soil ecosystems services are enough for sustainable crop production, especially during the transition years after starting with CA on degraded soils. It also requires well-adapted, disease- and pest-resistant germplasm, as well as other GAPs. The critical soil ecosystem processes involved are transformations of carbon, cycling of nutrients, maintenance of the structure and fabric of the soil, and biological regulation of soil populations.

Ways to increase nutrient use efficiency (NUE)

Nutrient use efficiency, which may be defined as the yield obtained per unit of available nutrients in the soil (supplied by the soil + fertilisers), could be improved as follows:

- Adjustment of fertiliser application rates based on (natural) soil fertility levels taking account of SOC level, organically bonded nutrients, nutrient cycling and/or previous cropping practices, especially legumes, and their residue biomass.

- Apply fertiliser at the right time and place and using the right source.

- Plant crops at the right planting density having enough plants to ensure optimal and efficient nutrient access and yield. In CA higher planting densities (around 30% higher than the norm) or at least above 22 000 p/ha ensures effective use of soil nutrients and water in the whole soil profile and surface area, while reducing temperature at soil surface level.

CA Principles and practices enhancing ISFM

Many producers world-wide have achieved large improvements in soil health in a relatively short time. What are these farmers doing differently?

Minimum soil disturbance

Physical soil disturbance, such as tillage with a plough, disk, or chisel plough, that results in bare or compacted soil is destructive and disruptive to soil microbes and creates a hostile, instead of hospitable, place for them to live and work (See Photo 1). The soil may also be disturbed chemically or biologically through the misuse of inputs, such as fertilizers and pesticides. This disrupts the symbiotic relationship between microorganisms and crop roots. By strategically reducing chemical inputs, we can take advantage of these soil ecosystem services to allow plants to freely access essential nutrients.

Diversify with crops and animals

Sugars made by plants, through the miracle of photosynthesis, are released from their roots into the soil as liquid carbon and traded to soil microbes for nutrients to support plant growth. This soil ecosystem service is a vital element of healthy soils and can be enhanced through the inclusion of as many different plants and animals as practical. Livestock utilizing cover crop mixtures, for example, contribute to this diversity. With ultra-high density grazing utilizing 30-50% of available material, livestock can stimulate root development and recycle 80% nutrients in the form of dung (See Photo 2). Biodiversity directly leads towards a diverse array of soil microbes from a range of functional groups, which again improves the soil's ability to support nutrient dense, high vitality crops, pastures, fruit and vegetables.

Biodiversity is ultimately the key to success of any agricultural system. Lack of biodiversity severely limits the potential of any cropping system and disease and pest problems are increased. A diverse and fully functioning soil food web provides for nutrient, energy, and water cycling that allows a soil to express its full potential.

Grow living roots throughout the year

There are many sources of food in the soil that feed the soil food web, but there is no better food than the liquid carbon exuded by living roots (See Photo 3).

Soil organisms feed on liquid carbon from living plant roots first. Next, they feed on dead plant roots, followed by above-ground crop residues, such as straw, chaff, husks, stalks, flowers, and leaves. Lastly, they feed on other organisms lower in the soil food web.

Healthy soil is dependent upon how well the soil food web is fed. The provision of plenty of easily accessible food (liquid carbon) helps soil microbial communities to colonise and recycle nutrients for plants to grow. The functioning of the soil ecosystem is therefore determined by the presence, diversity and photosynthetic rate of actively growing green plants and roots. Cover crop mixtures produce root exudates with varying composition and effects, and have different zones of nutrient uptake, because they differ in amount, depth, and patterns of root branching.

Figure 2: Livestock utilising mult-specie cover crops through ultra-high density grazing drastically enhances the impact of diversity.

Permanent organic soil cover

Soil should always be covered by growing plants and/or their residues, and soil should rarely be visible from above. A mulch keeps the soil cool and moist which provides favourable habitat for many organisms that begin residue decomposition by shredding residues into smaller pieces (See Photo 4).

Important soil ecosystem services and functions underlying ISFM

Carbon transformations:

The decomposition of organic materials into simpler molecules is one of the most important ecosystem services performed by soil organisms. Decomposition is also defined as the mineralization of carbon; 90% is carried out by microorganisms such as bacteria and fungi greatly facilitated by soil meso and macrofauna that fragment residues and disperse microbial propagules.

Nutrient cycling:

The cycling of nutrients is a critical ecosystem function that has positive direct impacts (through plant-microbial symbiotic relationships) on crop yield due to increases in plant available nutrients, especially nitrogen (N) through biological nitrogen fixation (BNF) by soil bacteria (e.g. Rhizobium) and phosphorus (P) through arbuscular mycorrhizal fungi (AMF). As said above, it literally means that these microorganisms release nutri-

Figure 3: There is no better food for the soil food web than the liquid carbon exuded by living roots.

ents to the roots in exchange for carbon to feed on, either from root exudates, or from plant/root organic material. Increasing populations of bacteria and fungi provides more food for protozoa (feeding on bacteria) and nematodes (feeding on bacteria, fungi, protozoa, other nematodes and roots) and their waste (manure) is directly available to plants as nutrients.

On a global scale, BNF accounts for around 65% of the nitrogen used by crops and pastures. There is scope for considerable increase. The supply of nitrogen is inexhaustible, as nitrogen comprises almost 80% of the earth's atmosphere. While estimates of symbiotic BNF can be as high as 400 kg N ha−1yr−1, average BNF is about 10-fold lower. Growing legume rotational and cover crops adds biologically fixed N.

Most soils in South Africa contain low amounts of soluble phosphorus due to the parent material and/or P being fixed in acid soils. However, if levels of AMF colonisation are high, there will be no need to add large quantities of inorganic P, or in some cases, none.

The additional plant diversity and growth period obtained with cover crops promotes root proliferation and activity, stimulates a greater variety of soil microorganisms and enhances carbon and nutrient cycling. The soil surface is covered for a longer period during the year, so nutrient losses from runoff and erosion are reduced. This longer period of plant growth substantially increases the amount of plant biomass produced, which in turn increases organic matter additions to the soil. It also traps excess soluble nutrients not used by the previous crop, prevents them from leaching, and stores (recycles) them for release during the next growing season.

Nutrients provided by CA and enhancedecosystem services

Table 1 illustrates the amount of nutrients potentially available to the next crop through CA and various soil ecosystem processes – only N, P and K are included. As an example, an average Dry Matter (crop residue) quantity of 12 t/ha (typically produced by a mixed summer cover crop) was used, a soil depth of 10cm, a SOM of 2.5% and soil bulk density of 1.3 g/cm^3. The nutrients available to the next crop in the example illustrated in Table 1 are freely supplied by the soil ecosystem functions and services that have been influenced by the CA system; these nutrients are valued at R 8315. This value will increase as CA practices are optimized, SOM have increased, and other soil ecosystem services have improved (such as soil microbial recycling of nutrients). To shorten the transformation period of restoring these functions (e.g. in a degraded soil), quality CA practices are needed that will speed-up the biological process and time. In wetter areas with clay soils this could take 3 to 5 years, but in warmer areas with sandy soils, it could take longer. In Part II of this article a case study from Ottosdal, North West Province will be described.

Table 1: Nutrients potentially available through CA and various soil ecosystem processes.

CA component and ecosystems services	N (kg/ha)	P (kg/ha)	K (kg/ha)
Above-ground biomass / crop residues (through microbial C transformation)[1]	168 (40% available for next crop	24 (20% available for next crop in 1st year = 5)	249 (SA soils have sufficient K)
Below-ground biomass of roots[2]	50 (20)	11 (2.2)	72
SOM (2.5%; 20 kg N released per 1% SOM)[3]	50	0	0
Nutrient cycling through microbes (e.g. with high colonisation of AMF)[4]	0	21	0
Nutrients available to next crop (kg/ha)	140	28	321
Nutrients Costs (R/kg)	17	40	15
Nutrient value (R/ha)	2380	1120	4815

[1]N fixed by legumes and available for next crop (10% legumes in mix) forms part of aboveground biomass

[2]Nutrient cycling by cover crop roots forms part of root biomass value

[3]P and K could also be added; values will increase with higher SOM levels

[4]This value has ga great potential to increase in future as microbial diversity and activity rise

Figure 4: Permanent organic soil cover provides a favourable habitat for many organisms.

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Conservation Agriculture and soil fertility management: Part 2

Case study on a degraded soil in the North West Province

Hendrik Smith[1] and Gerrie Trytsman[2]

Current Address: [1]Conservation Agriculture Facilitator and [2]Independent Scientist, Grain SA
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Following an introduction to some theoretical principles and practices of CA and integrated soil fertility management (ISFM) in Part 1 (November 2018 edition), this article presents a case study of a one-season soil rehabilitation process of a degraded soil on the farm Humanskraal of George Steyn in the Ottosdal area.

The soil was degraded due to continuous tillage and excess water run-off, leading to severe sheet, rill and gully erosion. The soil type is an Oakleaf soil form, a fairly common soil for crop production in the region with a depth of about 500-600mm and underlain by weathered rock material. To prepare the soil for crop production, the gullies were closed with a disk during winter.

The Grain SA CA research project team, which included George Steyn, decided to initiate a biological soil rehabilitation process on these degraded fields through the establishment of a ten species cover crop (CC) mix, planted with an Amazon spreader (for the small seeds) and a John Deere no-till planter (for the big seeds). As described in Part 1, the use of crop diversity, in this case a summer CC mixture, enhances and speed-up the biological (ecosystem) processes in the soil. No fertilisers were used because the previous crop was not harvested due to a poor stand and performance.

The summer annual CC mixture included functional groups such as legumes, cash crops, grasses, as well as a brassica in the form of radish. The winter mixture included the same functional groups. The summer mix had mainly annual grasses that are not easily decomposed (such as Babala and fodder sorghum), while the winter CC mix had temperate crops that decomposed fairly quickly. The impact of the different CC mixtures on maize grain yield will be determined after harvest in June 2017. The DM determined from the summer CC mix during the growing season was between 11 and 14 t/ha with an average of 12 t/ha.

This gives us a good indication of the potential amount of nutrients locked-up in an organic form within the biomass. This plant biomass contains on average 1.4% N, 0,3% P and 2% K considering previous sample analyses. This amount to an estimated total amount of nutrients of 168 kg nitrogen (N), 24 kg of phosphorous (P) and 249 kg of potassium (K), of which around 40% of N could potentially be made available for the next crop through decomposition by microbes.

The CC was left to be killed by frost; a decision was made not to roll it flat in order to enhance the mulch durability and to escape possible decomposition by microbes before planting. Assessment of soil health Soil samples were taken on 19 April 2016 during the fully developed growth stage of the summer CC stand, where after a Haney soil health analyses were done. Most nutrients that were available in the soil were effectively taken up by the cover crops.

The Haney soil health analyses (Table 1) show the available N, P, and K in kg/ha in the field established by the warm season CCs; the nutrient levels can be regarded as below average due to the degraded state of the soil.

Table 3 shows that phosphorous saturation is below 5% which indicate that additional inorganic phosphorous fertiliser is needed. With less than 1% SOM the soil can be seen as highly degraded due to a long period of continuous tillage practices.

The establishment of a multi-specie CC system are seen and applied as the start of a process to build-up the degraded soil, which could take up to 7 years or more, depending on the situation and the quality of CA application, the soil type and the climate. However, it is anticipated that this type of CC system, rotated every second year by a cash crop producing high amounts of residues (such as maize), could quickly restore

Table 1: Available organic and inorganic nutrients (kg/ha) and value (R/ha) in a soil under warm season cover crops.

Cost R / Kg	Nutrient	Nutrient value (kg/ha)	Total	Organic	Inorganic
17	Nitrogen	23.3	R 396	R 133	R 263
40	Phosphorus	42.5	R 1 700	R 72	R 1 628
15	Potassium	209.7	R 3 146	R 0	R 3 146
		R 5 242	R 205	R 5 037	
Saving					

Table 2: Available organic and inorganic nutrients (kg/ha) and value (R/ha) in soils under cool season crops.

Price R / Kg	Nutrient	Nutrient value (kg/ha)	Total	Organic	Inorganic
17	Nitrogen	19.9	R 339	R 156	R 183
40	Phosphorus	54.6	R 2 185	R 84	R 2 101
15	Potassium	285.6	R 4 284	R 0	R 4 284
		R 6 808	R 240	R 6 568	
Saving					

Table 3: Salient analytical data for the degraded soil taken during the growing season of a summer cover crop mix.

Soil pH (H_2O)		7,3
Soluble Salts	mmho / cm	0,3
Excess lime rating		1
Soil Organic Matter (SOM), LOI %		0,8
Calcium	ppm	187
Aluminium extractable	ppm	651.6
Phosphorous Saturation	%	4,6
Iron extractable	ppm	378

Table 4: Critical plant nutrient levels in maize leaves.

Critical plant nutrients levels in leaf opposite and below the ear at tasseling									
% of DM	Ppm of DM								
N	P	K	Mg	Ca	S	Zn	Fe	Mn	B
2.9	0.25	1.9	0.15	0.4	0.15	15	25	15	10
Source: Hoeft & Peck, 1991									

Figure 1: Soil with surface crusts and signs of severe erosion. At the stage when the cover crop was fully developed, photo 2 was taken on the 14 April 2016; the crop yielded an average biomass production of 12t DM/ha.

soil ecosystem functions and decrease the rehabilitation or transformation period to 3 or 4 years.

In a high temperature, low rainfall environment such as Ottosdal, the high amounts of CC residue would almost immediately have had a positive effect on the soil water content with much higher infiltration rates and much less water loss through evaporation. During the following few years, the presence of a diversity of plant roots in the soil will most probably have a positive impact on soil microbial diversity and activity, including mycorrhizas, which are highly dependent on a host and living roots.

These effects are currently being measured in on-going research in Grain SA's on-farm CA trials across the country. The establishment of perennial pastures is another possible solution, as part of the crop diversity within integrated crop-livestock systems, to facilitate the

Figure 2: Fully developed mixed summer cover crop system.

restoration process. From a degraded soil to commercial maize production

In order to put this field back into maize production (as was aimed for), the following fertilizer application rates (side dress) were used to establish the maize crop aiming for a 5 t/ha yield in the 2016/2017 season: 33 kg of N/ha – this amount of N will cover a yield target of only 2 ton/ha; the remaining N required will be provided through nutrient cycling and C decomposition of the CC mix's DM and roots. Depending on the production of the CC, a saving of 70-80 kg/ha of N can quite easily be attained during the first year (see Table 1, Part 1).

Eighteen kg of P/ha – this amount of P will cover a yield target of 5 ton/ha; from the Haney soil analysis it is clear that C content and microbial biomass activity is not yet sufficiently restored to recycle and/or release sufficient soil P to support plant P requirements for a yield target of 5 ton/ha. It is expected that more P will be released from the soil in the next couple of years through biological processes and colonization of mycorrhizal fungi. It has been shown in the past that only 20% P fertiliser is taken up during the first year after application, while soil microbes provide plants with the amounts of nutrients required. 12 kg of K/ha - since there is sufficient amounts of K in the soil, this application was just to establish strong vigorous seedlings; additional Sulphur and Zinc were also applied. No further inputs as far as soil fertility management were deemed necessary. This was due to a great supply of nutrients in the cover crop residues that will be made available as the CC biomass decomposes through microbial activity.

Figure 3: A 100% cover by the mixed summer cover crop residues.

Photo 1 shows the soil surface before cover crops was planted. Low levels of cover with a soil surface crust and erosion can be seen. The photo was taken on 27 January 2016, just before the cover crops were planted.

Photo 3 shows the CC residues (left standing) killed by the winter frost, taken on 2 September 2016. A decision was made not to flatten it because of the positive effect the standing residues would have had on wind and water erosion. The cooler soil under the residue cover will also benefit the water cycle due to the lower evaporation from the soil surface.

Photo 4 was taken just before the maize was planted on 12 December 2016; note

Figure 4: Field with summer cover crop residues just before planting the maize crop.

that the easy decomposable leaves containing the most nutrients were already decomposed by the microorganism. Only the woody plant material containing the less digestible tannins and lignin fragments in the residues were left. It is in decay or decomposition that this organic matter becomes useful as it becomes the fuel for 'bacterial fires' in the soil, which operates as a factory producing plant nutrients.

Photo 5 shows the maize crop at tasseling and silking stage with no signs of any nutrient deficiencies. The lower older leaves remain green. By April 2017 the predicted maize yield on this field was 7.5 ton/ha, indicating by all standards to a successful regeneration (restoration) of a degraded soil into full maize production using the principles of CA and ISFM. A good tool to monitor soil fertility or the uptake of plant nutrients is leave analysis (at this growth stage); plant nutrient levels should match the values shown in Table 4.

Conclusion

This case study has demonstrated that CA facilitates the successful application of ISFM, the recovery of critical soil ecosystem functions and the restoration of degraded soils. This process requires from producers a quality implementation and adaptation of CA practices such as crop diversity and more specifically, multi-species cover crop systems. It also requires an understanding of soil health and a long-term vision on soil restoration or regeneration, especially under dry and sandy soil conditions.

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Figure 5: Maize established after the summer cover crop showing no signs of nutrient deficiencies.

Congress 54 Organising Committee are waiting for student sponsorship applications. Any student wanting to be sponsored for the Congress registration fees must email Erica Joubert at info@grassland.org.za for the criteria and application form.

UN Biodiversity Conference Agrees New Conservation Designation

A new designation, 'other effective area-based conservation measures', has been agreed at the UN Biodiversity Conference in Egypt that will further advance progress towards the global biodiversity goals.

Harry Jonas, Kathy MacKinnon and Trevor Sandwith

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The likelihood that the global community will meet its area-based conservation targets by 2020 took a major step forward at the UN Biodiversity Conference in Egypt. To inform the global gathering, UNEP-WCMC and IUCN published the Protected Planet Report 2018 which states that almost 15% of the world's terrestrial areas and 7% of marine areas are currently protected. This is commendable progress but still falls short of the requirements in Aichi Target 11, which calls on Parties to conserve 17% and 10% respectively. Now a new designation - 'other effective area-based conservation measures' - has been agreed that will further advance progress towards these goals.

While protected areas are the main conservation measure currently contributing to the global targets, Aichi Target 11 includes reference to 'other effective area-based conservation measures' (also referred to as 'OECMs' or 'conserved areas'). IUCN's World Commission on Protected Areas subsequently facilitated a process to generate technical advice on the definition and criteria on OECMs for the Convention on Biological Diversity (CBD). The process culminated at the 14th UN Biodiversity Conference at which Parties agreed a definition, namely:

A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio-economic, and other locally relevant values.

This is a major step towards achieving Target 11 and will be an important legacy from the meeting. Recognition of 'conserved areas' will contribute not only to coverage targets but also to ecological representation, important areas for biodiversity and connectivity. Government agencies, private entities and Indigenous peoples and local communities all govern and manage a diversity of areas that may not be designated protected areas but nevertheless support effective biodiversity conservation. Examples of conserved areas include no-go areas such as sacred natural sites and war graves, as well as areas managed for their ecosystem services such as watershed protection areas. These areas can now be recognized as conserved areas and reported to the World Database on Protected Areas.

The magnitude of the contribution that might be made by the new designation is highlighted by a recent study. BirdLife International analysed over 750 key biodiversity areas (KBAs) across ten countries and found that around 80 per cent of the KBAs were partly covered by one or more potential OECMs and over half were wholly covered.

This underscores the exciting opportunity to recognize and engage an increasingly broad range of stakeholders in conservation, progress Target 11 and lay a good foundation for setting post-2020 targets where networks of protected and conserved areas are recognized and supported to achieve effective conservation across landscapes and seascapes.

Figure 1: A new conservation designation will further advance the progress towards the global biodiversity goals.

New global study positioned to dominate thinking about herbivores and plant biodiversity and savannas

Dr Dave Thompson

Current Address: Biodiversity Scientist, SAEON Ndlovu Node
E-mail Address: dave@saeon.ac.za

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Herbivores impact on plant biodiversity in many of the world's ecosystems, but the magnitude and direction of these herbivore effects (positive, negative or no effect) vary widely within and among ecosystems.

Understanding such impacts is vital for conserving plant diversity and ecosystem functioning in a human-altered world, especially in disturbance-dependent grasslands and savannas where herbivore communities are typically species-poor, and often numerically reduced versions, of their former selves.

Prevailing theory predicts that the activity of herbivores – primarily being feeding by grazers, should increase plant biodiversity in environments where rainfall is high (high productivity), and have the opposite effect in dry environments (low productivity). However, isolated studies reveal that not all grassy systems conform to this theory, with deviations from the pattern being seen.

This calls into question the generality of the role of system productivity in governing herbivore effects on diversity and suggests that alternative mechanisms may be driving how animals impact on their environments.

New global study

Now, a study recently published in Nature Ecology & Evolution is providing just that alternative mechanism, and is offering rather compelling evidence which explains how and why herbivores impact plant biodiversity.

In grappling to explain different patterns in how herbivore-exclusion plots at the Konza Prairie LTER (Long Term Ecological Research) station (USA) and in the Kruger National Park (South Africa) affected plant biodiversity immediately after and in the years following herbivore removal, a group of researchers hit on an intriguing idea.

Could the ability of herbivores to change the abundance of the dominant plant species – which is linked to those species being palatable or not to the herbivores, affect resource availability and so either encourage or prohibit additional species?

To test this hypothesis, the researchers – led by Dr Sally Koerner of the University of North Carolina Greensborough and including Dr Dave Thompson from SAEON's Ndlovu Node, established the 'Grazing Exclosure Consortium' to conduct a meta-level analysis comparing findings from large herbivore exclosure experiments from around the world. Ultimately plant species composition data from 252 sites spanning six continents and a large rainfall gradient (mean annual precipitation 45-1511 mm) were 'donated' for inclusion in the analyses.

To be included in the Grazing Exclosure Database, sites had to meet five criteria: (1) exclosures had to be located in herbaceous dominated communities – sites ranged from tallgrass prairie to alpine meadows to desert; (2) herbivores with adult body mass > 45 kg were excluded from plots using fencing, with adjacent plots exposed to herbivores; (3) data had to be collected after at least three years of herbivore exclusion; 60% of sites provided data reflecting 10 or more years of grazing manipulation and 18% of sites provided herbaceous data following 50 years of exclusion; (4) plots inside and outside the exclosure had to be sampled at the same time and sampling intensity; and (5) data had to be available at the species level.

And the result?

A positive, but weak relationship between grazing-induced change in species richness and annual rainfall (as a proxy for productivity) was found. But the pattern emerging from the data showed a much stronger relationship

Figure 1 (a + b): Herbivore exclusion plots erected at Konza Prairie LTER station (left) and in the Kruger National Park in 2006 showed differing effects of grazing (or rather, the lack of grazing) on plant diversity. In attempting to explain this, researchers were forced to challenge conventional thinking.

between grazing-induced changes in dominance and changes in species richness.

Where herbivores decreased the relative abundance (biomass, cover) of dominant species, plant species richness increased, while increased dominance caused a decline in species richness. This relationship holds true across all continents and their assortment of wild and domestic herbivores, and across the rainfall gradient.

Change in dominance explains positive and negative herbivore impacts on plant biodiversity across vastly different grassy systems globally by considering the traits of the dominant plants – those characteristics of a species that impart competitive advantage, that result in resource limitation for others, and which allow grazing tolerance or avoidance. Strong dominance by just a few species is a nearly universal feature of herbaceous ecosystems.

As a consequence, this new thinking points to 'dominance management' – essentially altering competition for resources using herbivores as an effective conservation strategy.

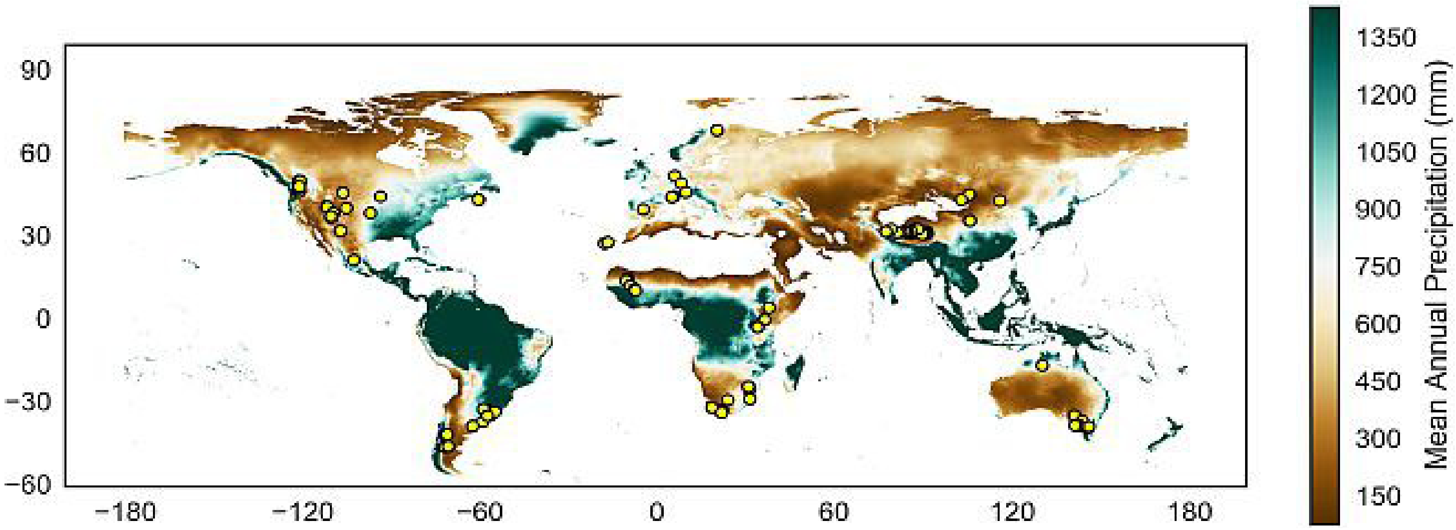

Figure 2: Map of the 252 site localities included in the meta-analysis, with mean annual rainfall shown. Many sites overlap, so not all are visible.

Figure 3 (a - d): Herbivore type and number varied among exclusion sites, and included domesticated cattle, sheep, goats, burros and horses, as well as native wildlife such as bison, caribou, kangaroo and the full complement of large African herbivores.

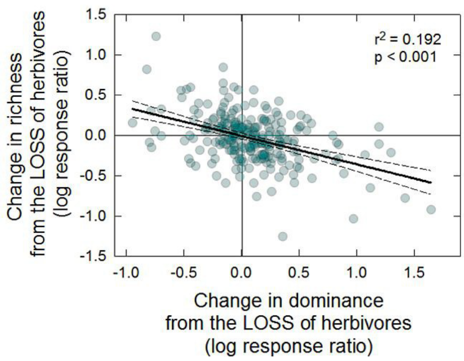

Figure 4: The change in species richness (as a measure of diversity) between grazed and ungrazed treatments at each of the 252 sites correlated more strongly with change in the biomass or cover of dominant species than with precipitation (as a proxy for system productivity).

Each dot represents a single site.

Sustainable livestock production is possible

New research advocates use of pastures with shrubs and trees as it is more sustainable, improving animal welfare and increasing biodiversity.

Professor Donald Broom

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Consumers are increasingly demanding higher standards for how their meat is sourced, with animal welfare and the impact on the environment factoring in many purchases. Unfortunately, many widely-used livestock production methods are currently unsustainable. However, new research out today from the University of Cambridge has identified what may be the future of sustainable livestock production: silvopastoral systems which include shrubs and trees with edible leaves or fruits as well as herbage.

Professor Donald Broom, from the University of Cambridge, who led the research said: "Consumers are now demanding more sustainable and ethically sourced food, including production without negative impacts on animal welfare, the environment and the livelihood of poor producers. Silvopastoral systems address all of these concerns with the added benefit of increased production in the long term."

Current cattle production mostly occurs on cleared pastures with only herbaceous plants, such as grasses, grown as food for the cows. The effects on the local environment include the removal of trees and shrubs as well as the increased use of herbicides, all of which result in a dramatic decrease in biodiversity. Additionally, there is also contamination of soil and waterways by agricultural chemicals as well as carbon costs because of vehicles and artificial fertiliser necessary to maintain the pasture.

The researchers advocate that using a diverse group of edible plants such as that in a silvopastoral landscape promotes healthy soil with better water retention (and less runoff), encourages predators of harmful animals, minimizes greenhouse gas emissions, improves job satisfaction for farm workers, reduces injury and stress in animals, improves welfare and encourages biodiversity using native shrubs and trees. Additionally, shrubs and trees with edible leaves and shoots, along with pasture plants, produce more food for animals per unit area of land than pasture plants alone. Trees and shrubs have the added benefit of providing shade from hot sun and shelter from rain. It also reduces stress by enabling the animals to hide from perceived danger. "The planting as forage plants of both shrubs and trees whose leaves and small branches can be consumed by farmed animals can transform the prospects of obtaining sustainable animal production," said Professor Broom. "Such planting of 'fodder trees' has already been successful in several countries, including the plant *Chamaecytisus palmensis* which is now widely used for cattle feed in Australia." Another success has been in Colombia where a mixed planting of the shrub Leucaena with a common pasture grass resulted in a 27% increase in dry matter for food and 64% increase of protein production. When ruminants, such as cows, goats and silvopastoral system, researchers have seen an increase in growth and milk production. Milk production in the tropical silvopastoral system mentioned above was 4.13 kg per cow when compared with 3.5 kg per day on pasture only systems. As the numbers of animals per hectare was much greater, production of good quality milk per hectare was four to five times greater on the silvopastoral system.

Figure 1: It is clear that silvopastoral systems increase biodiversity, improve animal welfare and provide good working conditions while enabling a profitable farming business.

One of the additional benefits of using the silvopastoral system is that it increases biodiversity. Biodiversity is declining across the globe, and the main culprit is farming – 33% of the total land surface of the world is used for livestock production. If farmers were to switch to sustainable livestock production methods, such as the silvopastoral system, the result would be much greater biodiversity with no increase in land use.

Professor Broom added: "It is clear that silvopastoral systems increase biodiversity, improve animal welfare and provide good working conditions while enabling a profitable farming business. The next step is to get farmers to adopt this proven, sustainable model."

Source

Prof Donald Broom https://www.cam.ac.uk/research/news/sustainable-livestockproduction-is-possible, Sept 12, 2013: Republished, slightly condensed for lay-out purposes under https://creativecommons.org/licenses/by-nc-sa/3.0/.

Key performance indicators for dairy farmers

Dr Carel Muller

Current Address: Research Associate, Faculty of Animal Sciences, University of Stellenbosch

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Milk prices for dairy farmers are affected by supply and demand. Farmers have, for except, the volume and quality of milk being produced, generally little effect on milk prices. The profitability of a dairy herd is affected mostly by the milk yield income (+90% of farm income) and the production cost of milk. The feeding cost of all the animals in a dairy herd constitutes the largest part of the production cost. By feeding more concentrates to cows, milk yield increases although feed cost also increases. This increase in milk yield may result in a lower income because of the law of diminishing returns. The profitability of a dairy herd can also be improved by reducing the production cost of milk.

This can be done in several ways. This requires applying specific management actions as suggested by key performance indicators. Some of these indicators are discussed in this paper.

Number of cows in milk

The number of cows in milk determines the total milk yield of a dairy herd. A dairy herd consists of first lactation cows and older cows. The milk yield of cows increases from first to fifth lactation, therefore most cows in the herd should be older cows (in second plus lactation). The genetic merit of first lactation cows affects the herd's future genetic merit. At least 82% of all the cows in the herd should be in milk. This percentage increases when cows are longer (more days) in milk, i.e. when herd average days-in-milk (DIM) increases. The growth of a dairy herd can be observed by comparing the current number of cows in milk to the number the previous year(s). A trendline can be fitted using records of at least three (or more) previous years. A dairy herd should increase in numbers from year to year. When this is not the case, two major problems may be the cause, i.e. the culling rate among cows is high or the survival rate of heifers from birth to first calving is low. From a dairy herd of 100 cows, at least 85% should calve down every year when reproduction management is good. The bull: heifer ratio is usually 50:50 unless sexed semen is being used. Based on this ratio, 42 heifers are available for rearing to replace cows. If 85% of heifers survive to first calving, it means that 36 first lactation cows should enter the dairy herd. At a culling rate of 25% among cows, there are 11 surplus first lactation cows; however, when the culling rate is higher, the number of surplus cows is less. At a lower heifer survival rate to first calving, fewer heifers are available to rear to first lactation. The survival rate of heifers from birth to first calving is determined by the comparing the number of heifers born in a specific year to the number of these heifers calving down for the first time. When 100 heifers are born in a specific year and 80 heifers eventually calve down for the

Figure 1: Jersey cows utilizing a pasture

first time, the heifer survival rate to first calving is 80%. It is also important to know at which age heifers are lost from the herd as this affects the mortality cost of heifers. A higher age at culling increases the mortality cost of heifers, mostly due to feeding cost which increases daily. The mortality cost of lost heifers should be included as part of the rearing cost of the surviving heifers.

Milk yield per cow

The average milk yield of a dairy herd is a common point of discussion among dairy farmers. It is often regarded as an indication of the standard of a dairy herd, i.e. high milk yields being a "top" herd while low milk yields are regarded as a poor performing herd. However, the emphasis should rather be the amount of milk collected by the processor rather than the farmer's herd estimations. The reason for this is that not all milk produced is sold. Some milk is used in calf rearing and for household purposes. Milk is also discarded being contaminated when cows are treated for mastitis and other infections. Each treatment has a specific milk withdrawal period. This is required to prevent milk becoming contaminated by antibiotics. The amount of milk cows produce is also reduced by the level of subclinical mastitis as indicated by herd (or bulk tank) somatic cell counts. This also has a negative effect on the milk price because of poor milk quality.

Milk income – feed cost

This indicator is based on the difference between the milk income and feed cost and is estimated as the gross margin per cow per day. This figure changes every time milk or feed prices change. Similarly, the breakeven point of production is also affected by feed and milk prices. This refers to the minimum milk yield per cow per day to cover the dairy herd's production cost of milk. Milk yield must be higher when the feed price is high or when the milk price is low. The cost of feeding and management of the non-producing animals in the herd should also be included when estimating the production cost of milk. An easy way to do this is compile a list of all the different groups of animals in the herd, i.e. lactating and dry cows, heifers at different ages and young calves, the diet (forages and concentrates) and the feed intake per animal per day that each group receives. Dairy farmers should, on a monthly basis, compile all the costs required to produce milk as well as the herd milk income. Using only the concentrate feeding cost can be misleading as this may be less than 30% of the total cost of production per litre of milk.

Days in milk

The average number of DIM is based on the interval between the present date and the calving down dates for all cows currently in milk. This figure increases when a greater proportion of lactating cows in the herd is in late lactation. Cows calving down regularly keeps the average number of DIM at a lower level. The number of DIM usually increase because of reproductive problems in getting cows pregnant. This results in extending the number of days from calving to conception or days open. The lactation period then extends past the normal 300-day lactation period as cows are mostly milked until 50- 60 days before the expected calving date. Because of the lactation curve, milk yield is lower at this lactation stage and with more cows in the herd, the average milk yield of the herd is reduced. Milk yield (and milk income) decreases when the interval days open (or calving interval) increases. Modelling lactation curves for different calving intervals of 12, 13, 14 and 15 months, average DIM were 155, 170, 186 and 201 days and average milk yields were 30.0, 28.9, 27.8 and 26.8 kg/day, respectively. Missing one heat cycle (21 days) amounts to a milk loss of approximately 0.8 kg milk per cow per day.

Lactation number

The average lactation number of all the cows in the herd provides an indication of the age of a dairy herd. Heifers calve down for the first time at about two years of age after which cows should calve down every year. This means that a cow in fourth lactation is at least six years old. Actual age at the end of fourth lactation can be higher when age at first calving is later than 24 months of age and calving interval is longer than 12 months. The efficiency of production is reduced for cows at higher actual ages while at the same lactation number because of more unproductive days over the cows' lifetime. The reason why the age (average lactation number) of a dairy herd is important is because the lactation milk yield of cows increases from first to fifth lactation after which it decreases although not declining to the same production level as during first lactation. The efficiency of a dairy herd increases when there are a greater proportion of older cows in the herd.

First lactation cows

The percentage of first lactation cows in a dairy herd provides an indication of the replacement rate in a dairy herd as well as the culling rate in a dairy herd. For an expanding herd, i.e. increasing in size (the number of cows in the herd), the percentage of first lactation cows can be higher especially when sexed semen is being used. For a stable herd, i.e. not increasing in size, the percentage of first lactation cows can be lower although it is greatly affected by culling rate. At high culling rates the proportion of cows in first lactation is higher when aiming to maintain the number of cows in the herd. Increasing the percentage of first lactation cows in a herd would reduce the total (and average) milk yield of the herd because of the lower milk yield of first lactation cows.

In closing

There are several key performance indicators which can be estimated to monitor herd management. These indicators should be estimated on a monthly basis and the progress (change) should be presented as graphs. This would enable estimating trendlines over time to show progress or deterioration. These trendlines could be used as a basis for changing the standard of management and/or breeding programmes which may include sire selection and cow culling programmes.

'Rhino Coin': Can a Cryptocurrency Help Save Africa's Rhinoceroses?

South African ranchers who raise rhinos are supporting a virtual currency, backed by stockpiles of valuable rhino horn, to fund protection of the threatened animals. But their hopes rest on the long-shot gamble that the global ban on the horn trade will be lifted.

Adam Welz

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In a deep underground vault somewhere in South Africa is a well-guarded collection of rhino horns, each of which has been weighed, measured, photographed, and tagged with a microchip, and had its DNA sampled, decoded, and recorded in a database. Together, the horns — legally harvested from rhinos raised on private land — weigh 108 kilograms. "In terms of an undervalued asset, it's madness," says Alexander Wilcocks, a director of Cornu Logistics, the company that owns the stash.

Wilcocks is referring to the fact that illegally-traded rhino horn — used to make jewelry, or sold as "medicine" with no significant proven effect — is currently one of the most valuable commodities on the planet, going for up to $125 per gram on the black markets of Asia.

The international trade of rhino horn has been banned for decades. But that has not stopped Wilcocks and his partners, supported by South Africans who raise and protect rhinos on their own land, from devising a scheme that could net its investors massive profits should international trade one day be legalized. They've launched a new digital currency called Rhino Coin, through which almost anyone can own a share of the horn in Cornu's vault for about $4 a gram — a tiny fraction of the black market value.

South Africa has by far the world's largest rhino population, with an estimated 15,000 to 20,000 white and black rhinoceroses. But poachers have been killing more than 1,000 rhinos a year there since 2013, and many of the country's 330 private rhino owners — who care for more than 7,000 rhinos — say they are going broke paying for security to keep

Figure 1: Recently removed rhino horns on a private ranch in the North West province of South Africa. Photo: Mujahid Safodien/AFP/Getty Images

heavily armed poaching syndicates from slaughtering their animals for their horns. By selling Rhino Coin — a virtual currency somewhat like Bitcoin, but backed by rhino horn — Wilcocks says his company can raise capital for rhino protection. It's "cryptocurrency with a conscience," he says.

"Private reserves have spent well over 2 billion Rand (about $140 million) from 2009 to the end of 2017 in protecting their animals," says Pelham Jones, chairperson of the Private Rhino Owners Association. "We desperately require a revenue stream to pay for the conservation of these animals, especially when you put it in the context that we now own about 50 percent of the national herd."

"We desperately require a revenue stream to pay for the conservation of these animals," says a spokesman for rhino ranchers.

Rhino Coin lies at the bleeding edge of a debate that has raged for years about legalizing trade in rhino horn, a debate sharpened by ongoing, intense poaching. The international sale of rhino horn

Figure 2: A veterinarian examines a recently-dehorned rhino on John Hume's ranch near Klerksdorp, South Africa. Hume owns more than 1,600 rhinos, which are dehorned to dissuade poachers. Photo: Mujahid Safodien/AFP/Getty Images

has been banned under the Convention on International Trade in Endangered Species (CITES) since 1977, and the domestic trade within most Asian countries, including the major markets of China and Vietnam, has also long been illegal.

It's become common for reserves and ranches to de-horn rhinos to lessen the animals' value to poachers.

The majority of global conservation and animal welfare organizations are dead-set against legalizing trade, believing that it could drastically worsen poaching by generating uncontrollable consumer demand for horn. Conservationists say that the pool of potential Chinese buyers is so large that they would consume legal stocks faster than they could ever be replenished, incentivizing poachers to make up the shortfall. And experts argue that because poached horn products are difficult to distinguish from horn products legally harvested and traded within South Africa, a legal international trade could create conduits for poached horn to find its way to market.

South Africa — unusual among African countries — has a large private wildlife ranching sector. Ranching is a loose term: Some ranchers operate what can only be described as rhino feedlots, where they confine dozens of rhinos to a single corral and give them factory-made feed every day. John Hume, the world's largest rhino owner with a herd of more than 1,600 animals, keeps many of his animals this way. Hume has heavily backed the Rhino Coin initiative and is the leading contributor of horn to the system.

Other ranchers keep rhinos that are effectively wild, ranging over huge areas and feeding themselves. Almost all rhino ranches need security forces to ward off poachers, who wield increasingly powerful guns and even improvised explosive devices. Deadly firefights are common. Public and private reserves deploy rangers with automatic rifles and grenade launchers, miles of deadly electric fencing, light aircraft and helicopters, as well as military-grade radar, cameras, and listening tools. This has reduced poaching in some reserves. It's also extremely expensive, hence efforts to raise funds through selling rhino horn.

South Africa placed a moratorium on the in-country trade of rhino horn in 2009 because government agencies found it being used as cover to sell poached horn to international crime syndicates. Despite opposition from conservation groups, well-resourced South African private rhino owners pushed for re-legalizing trade, and last year they won a case in the South African Constitutional Court and overturned the 2009 moratorium. The government has now constructed somewhat cumbersome systems that can support in-country trade, such as a DNA horn registry, a national database, and a system of permits whereby registered buyers and sellers can legally trade horn within South Africa while the state keeps tabs on the ownership of each one. (Some 860 horns have been

Figure 3: The Rhino Coin logo

traded domestically this year, according to the Department of Environmental Affairs.)

Rhino Coin was launched earlier this year to simplify the process of legally trading horn and to create a revenue stream for rhino owners and rhino conservation in general. "Our concept was that it would be like the gold standard," says Wilcocks. But his plan uses cryptocurrency traded on the Internet instead of paper dollars, and rhino horn instead of gold. Most Rhino Coin buyers are speculators, betting that the international rhino horn trade ban will one day fall away, and that horn can then be sold at a stupendous markup in Asia.

Under the Rhino Coin scheme, a horn owner places horn into the Rhino Coin system by legally selling it to Cornu Logistics. The horn is weighed to the nearest gram, audited, and placed in Cornu's vault. One digital token — a Rhino Coin — is created for each gram of horn via blockchain technology, a means of creating a distributed database of records that are verifiable and resistant to corruption. Rhino Coins can be bought with South African Rands by domestic and international buyers and traded on the Cornuex exchange, where their price fluctuates according to supply and demand. The horn owner is given 54 percent of the Rhino Coins and can retain those tokens or sell them on the exchange for cash at any point. The rest of the coins are allocated to a conservation foundation, a children's home, and administrative costs, such as horn storage.

Wilcocks says that all the coins generated from the 108 kilograms of horn in Cornu's vault are in circulation, but that trade volumes have been low because they've not been doing any promotion recently. No coins have been redeemed for horn yet. He says he plans to launch a publicity campaign in January to increase interest in Rhino Coin, and an additional 500 kilograms of horns are waiting to be audited to add to the system.

It's become common for reserves and ranches to de-horn rhinos to lessen the animals' value to poachers and allow horns to be harvested. Rhinos are typically tranquilized with a dart gun by a veterinarian and their horns painlessly cut off with a small chainsaw a couple of inches above the base. This can be repeated every two or three years as the horns regrow. Jones of the rhino owners' association estimates that roughly 30 tons of horn are now stockpiled in South Africa — about 10 tons collectively owned by the private sector, and 17 to 20 tons sourced from national parks and other state-owned reserves and held in government vaults. Jones says that horn from this stockpile, continually replenished from rhino farms, could generate a colossal 65 billion Rand (about $4.5 billion) over five years if legally sold in Asia. (More conservative estimates place the potential value of South Africa's stockpile at more than $1 billion.)

Many rhino custodians — including certain government conservation agencies and the majority of private rhino owners in southern Africa — feel strongly that legal trade can further incentivize rhino conservation, and that Asian markets can be managed so that uncontrollable consumer demand doesn't lead to runaway poaching.

But conservation organizations often cite a 2008 legal sale of elephant ivory from Botswana, South Africa, and Zimbabwe to China and Japan as a reason not to sell rhino horn. Like rhino horn, the international trade in ivory had long been forbidden, but in 2008 CITES allowed a strictly regulated "one-off sale." Even though China rolled out sophisticated safeguards to monitor and control ivory from this sale, these failed, says Colman O Criodain, policy manager of wildlife practice for WWF International. Numerous unaccredited stores and ivory-carving workshops sprung up to take advantage of revived consumer demand, and "there was a parallel illegal market that they were either unwilling or unable to control."

Figure 4: Rhino horns being weighed and stored at John Hume's ranch in February 2016. Hume is the leading contributor of horn to the Rhino Coin system. Photo: Mujahid Safodien/AFP/Getty Images

Elephant poaching and ivory trafficking skyrocketed to supply these illegal outlets; by 2011, at least 15,000 African elephants were being killed annually. Following international pressure, China has cracked down on illegal trade and banned the domestic sale of ivory; elephant poaching rates have since dropped.

Although Hume portrays himself as a rhino-loving conservationist, his motives have often been questioned. He owns tons of horn, and might make hundreds of millions of dollars if he gets to sell it in Asia. He has in the past sold rhinos to be shot by trophy hunters and also has sold the animals to two brothers, who are suspected rhino poachers and horn traffickers, according to the Organized Crime and Corruption Reporting Project.

Rhino coin is "not really mainstream conservation in any sense of the word," says one expert.

Some observers say that since buyers can purchase tokens from anywhere, CITES might view Rhino Coin as a form of international horn trade and try to constrain it; after all, the treaty's text regulates wild species "and their derivatives." Tom Milliken of TRAFFIC, the wildlife trade research organization, says "I don't have a lot to say about Rhino Coin other than it is an attempt to get funding to support a private rhino farmer who is quite a controversial figure, but it's not really mainstream conservation in any sense of the word. It will probably not demonstrate any traction in financial markets as time goes by."

WWF's O Criodain says he would not bet on the trade in rhino horn being legalized internationally or within China because of powerful global resistance. Rhino Coin speculators may never realize a profit, he says. He points out that on October 30 the Chinese government announced that it would be lifting the ban on rhino horn use in Traditional Chinese Medicine (TCM), a possible first step to open trade. But it soon backed down under a storm of protest from conservation organizations, announcing on November 12 that "the detailed regulations for implementation" of the October legal change had been "postponed after study" and that the strict ban on sale and use of rhino horn remained in effect. It's not clear whether regulations to allow TCM use will ever be written.

Although rhino deaths appear to be declining slightly in South Africa this year due to better anti-poaching measures, recorded incursions into reserves and attempts to poach continue to rise because transnational criminal syndicates are still buying horn. Meanwhile, private and government stockpiles continue to grow, further increasing the incentives to sell.

Lablab purpureus: A dry-season feed in eastern Kenya

Arnold Kerina

Current Address: University of Eldoret, Eldoret, Kenya
E-mail Address: arnoldkerry@yahoo.com

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Fodder production in semi-arid eastern Kenya is characterized by low farm inputs and outputs. Drought and low soil fertility are major limiting factors in forage production. Farmers normally use stover from cereals such as maize and sorghum or from legumes like lablab, common beans and cowpeas as fodder during the dry season.

In Kenya, *Lablab purpureus* or 'Dolichos bean' is popularly called 'Njahi'. It is a dual-purpose legume primarily grown for grain in eastern Kenya. It is good fodder for livestock.

Particularly under semi-arid conditions, lablab herbage dry matter (DM) yield is usually higher than that of beans and cowpeas. It can yield up to 6 t/ha of herbage DM. Thus, lablab is drought-tolerant and can grow under relatively low soil fertility conditions.

It is grown as a companion crop to maize or as a cover crop. It will also improve soil fertility by fixing atmospheric nitrogen to the soil.

Forage use

In eastern Kenya, lablab is mainly used during the dry season when animal feeds are in short supply. The whole plant is utilized in different ways. It can be grazed directly as a pasture, cut and directly fed green to livestock, stored as hay or used to make silage. As it stays green during the dry season after grain harvest, the plant is highly palatable to livestock. Lablab hay is employed to supplement maize or sorghum stover, which are of poor nutritional quality. Lablab stems are more fibrous than those of other legumes, e.g. beans and cowpeas. As a result, livestock tend to eat leaves, which are soft and tender, but leave back the stems. Lablab fodder has high crude protein content. It's also rich in calcium, phosphorous and vitamins A and D. The Kenyan KALRO has released a few cultivars; but only KAT/DL-1 was found on a significant scale in the region due to both high grain and herbage yields. Biomass yields of KAT/DL-1 under rain-fed conditions were up to 3 t/ha in on-farm trials in Makueni County in 2014. Grotelüschen (2014) tested and identified other dual-purpose accessions with potential for the region: Q6880B, CPI 81364 and CPI 52513 from the Australian tropical forage germplasm collection.

Developing multi-purpose Lablab in Tanzania

Over the past four years, staff from the Canadian Foodgrains Bank and the Nelson Mandela African Institution of Science and Technology, in Arusha, have been experimenting with inter-cropping and sole-cropping of both local Tanzanian and introduced lablab accessions with maize.

From their work they anticipate several multi-purpose varieties will be released as cultivars in Tanzania by early 2020.

Contact

Neil Miller, Arusha, Tanzania at E-mail: nrmiller@foodgrainsbank.ca.

Figure 1: Lablab on a farm in eastern Kenya. Photo: A Kerina

Figure 2: Experimenting to intercrop maize with lablab: Conservation Agricultural Officer Neil Miller at a trial site near Moshi, northern Tanzania. Photo: BL Maass

Using genome diversity for the environment, livelihoods and tropical grasslands

Pat Heslop-Harrison (with collaborators listed below) examines why it's not just humans that need better crops.

Pat Heslop-Harrison

Current Address: Professor of Molecular Cytogenetics and Cell Biology at the University of Leicester, Chief Editor of Annals of Botany.

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Tropical grassland grazing by cattle provides food for millions of people, and livelihoods for huge numbers of farmers and smallholders in developing countries. Pasture and rangelands have a profound influence on the environment. As the dominant vegetation over much of the world's land, covering areas from floodplains to high uplands, grasslands are some of the most environmentally important and sensitive vegetation types.

Grasslands are grazed by animals used for human food, and are often unsuitable for other agriculture so, despite the recent call from the Intergovernmental Panel on Climate Change for people to eat less meat, animal production on grasslands will remain important for economies and food supply for the foreseeable future. Furthermore, grazing is often critical to maintaining landscapes and maximizing grassland biodiversity. Grasslands provide ecosystem services such as stabilizing soil, preventing erosion, and purifying and slowing the flow of water. It is vital that grasslands are as productive and environmentally sustainable as possible. Farming must be efficient to minimise land use while ensuring reliable food production and maintaining livelihoods in a changing climate.

Even small improvements in the performance of pasture by genetic improvement of grasses can deliver both economic and environmental benefits, whether through the impact of the grasses themselves, including the reduction in use of herbicide, pesticide and fertilizer, or through reducing pressure to increase farmed areas. Better grazing can reduce the need for growing field crops, about a third of which are fed to animals. Improvement of grasses can come from exploiting genetic biodiversity, finding and bringing together traits of ecological benefit and increased productivity. Our research project involves a partnership between CIAT (The International Center for Tropical Agriculture) based in Colombia, and the UK institutions, University of Leicester, Rothamsted Research, Earlham Institute and the Centre for Ecology & Hydrology.

We are taking a three-pronged approach to improving tropical forage grasses, with a focus on the Panicum and Brachiaria (Urochloa) genera: we are measuring the genetic diversity present in the species; identifying critical traits related to environment, productivity, and the rural economy; and developing improved approaches for breeding and selection, to identify the best characters that will improve grass varieties for farmers.

As well as productivity and disease resistance, we are looking at the importance and genetic basis of a range of characters related to the environment and sustainability. Our work is of global importance but in the short-term will help the world-class grass breeding programme at CIAT. Traits to be investigated include genetic characteristics related to soil nitrification, drought resistance, waterlogging tolerance, allelopathy (how plants compete with neighbours using their own chemicals), and insect resistances (particularly to the sap-sucking spittlebug).

We will also look at grass genetics related to grazing animals such as leaf lipid content, which affects cow methane (greenhouse gas) emissions, and cell wall modifications affecting digestibility. Traits such as grass productivity and digestibility determine how many cattle the pasture can support, and increased production reduces pressure to convert biodiverse natural habitats such as forests to farmland. Our project will also provide an analysis of reasons why farmers do not use improved grass seed; this analysis will provide key information to ensure the best use of the knowledge gained during the project to support future grass breeding efforts at CIAT. This project, therefore, helps economic development by improving livelihoods and the environment for farmers and wider communities.

CIAT has one of the most comprehensive genebanks of the tropical forage grasses, and these germplasm resources are central to finding new and useful characters to exploit. These resources are available for the benefit of the world. Since the Nobel Prize winning work of Norman Borlaug at CIAT's sister institute, CIMMYT (International Maize and Wheat Improvement Center) based in Mexico, we have seen the positive global impact of genetic improvement. In our project, we have measured the diversity of all the genes in more than 10% of the germplasm collection.

This huge amount of data – well over 500 billion DNA bases –was released publically in January 2019 (http://www.ncbi.nlm.nih.gov/bioproject/513453). Another challenge is working out which plants have the potential to be crossed together for breeding and the next phase of the project we will use modern techniques to work out which are the best grasses that can used for breeding programs. We will use information about the grass genes to develop a

Figure 1: Forage grass flower, Brachiaria. Photo: Pat Heslop-Harrison

genotyping 'platform' which will speed up the methods for choosing plants to act as parents for producing improved varieties. Genotyping platform technology is revolutionising plant breeding and our project will enable us to apply genotyping and molecular assisted breeding technology to tropical forage grasses.

As Dr Ruben Echeverria, Director General of CIAT, has written, "Livestock provides much of the protein needed for the balanced nutrition of the world's population and is an important part of the economy in rural areas. At the same time, it is usually associated with environmental problems such as deforestation and high emissions of greenhouse gases.

We believe that sustainable intensification of livestock production will reduce the environmental impact while responding to the requirements of protein food of a growing population worldwide." Professor Alison Goodall, Head of Department of Genetics and Genome Biology in the University of Leicester, UK, adds "The proposed research aligns strongly with the major themes of food security and research that supports the economic development of developing countries, generating solutions to global challenges through world-class research and impact activities."

Breeding better crops is a long-term undertaking, and CIAT already has breeding pipelines for tropical forage grasses. Our project is designed to supplement and accelerate breeding by exploiting wide biodiversity and the latest cost-efficient, genomic technologies, leading via improvements in forage grasses, to increased food security, reduction of rural poverty, and efficient, sustainable use of land as pasture.

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The project is a collaboration between co-PIs Dr Rowan Mitchell (Rothamsted Research), Dr Jill Thompson (Centre for Ecology & Hydrology CEH), Dr Jose de Vega (Earlham Institute) and Pat Heslop-Harrison (University of Leicester) with particular contributions to the research from Dr Paulina Tomazewska (Leicester) and Dr Till Pellny (Rothamsted). The partners from CIAT involved in the research are Dr Michael Peters, Dr Valheria Castiblanco, Dr Jacobo Arango, Dr Stefan Burkart, Dr Lou Verchot, Dr Joe Tohme, and Dr Juan Andres Cardoso.

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Perspective on environmental issues and livestock production

Michiel Scholtz

Current Address: Agricultural Research Council
E-mail Address: GScholtz@arc.agric.za

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Prof Michiel Scholtz, specialist researcher in applied animal genetics at the Agricultural Research Council, shares a South African perspective on livestock production and how it relates to greenhouse gases and water usage.

"Quoting percentages does not always make sense. In industrialised countries the Greenhouse Gas (GHG) emissions for agriculture are less than 6%, simply because the contribution of their energy sectors, mines, etc. to GHG emissions is very large. In non-industrialised countries the relative contribution by agriculture can be 40% to 50%, but the actual contribution can be considerably less than the 6% of the industrialised countries.

When considering mitigation options, it is obvious that a 10% reduction in GHG emissions by the energy and mining sectors would be far more effective than a 10% reduction in the 5% to 10% contribution of agriculture. So, the proposed "meat free once a week" argument will not do much to rectify the problem, as other sources of protein for human consumption are required, and they may have an even higher carbon footprint.

Livestock has been accused of using large quantities of water to produce beef and milk. Some of the assumptions used to calculate the water footprint, or the amount of water required to produce livestock products, are questionable. In studies with more realistic and justifiable assumptions, the water requirement for red meat production and for the production of total milk solids in whole milk and in skim milk powder, is much lower.

It must be realised that ruminant livestock are important to mankind since most of the world's vegetation biomass is rich in fibre. Only ruminants can convert this high fibre vegetation into high quality protein sources (i.e. meat and milk) for human consumption. This needs to be balanced against the concomitant production of methane. Despite this important role ruminants play, they are specifically targeted and singled out as producers of large quantities of GHG that contribute to climate change.

Livestock production and greenhouse gases

Livestock agriculture is the world's largest user of land resources and Sub-Saharan Africa is no different to the rest of the world. In South Africa, approximately 84% of the surface area is available for farming, but only 13% of this area is arable. The greater part of South Africa (71%) is only suitable for extensive livestock farming. In Africa, subsistence farmers farm livestock for multiple purposes. Rural households depend on livestock for milk, meat, hides, horns, fertiliser and income, making it central to the livelihoods and wellbeing of rural communities.

Although primary beef cattle farming (cow-calf production cycle) is largely extensive in South Africa, more than 75% of cattle slaughtered in the formal sector are finished in feedlots on maize and maize by-products. The cow-calf portion of the production cycle (the extensive part in South Africa) accounts for 72% of the nutrient requirements from conception to harvest. Under natural rangeland conditions, decomposition of manure is aerobic, leading to the production of carbon dioxide (CO_2)) and water (H_2O) as end products. Part of the CO_2 released from the aerobic digestion of manure is absorbed during the regrowth of the surrounding vegetation, rather than released into the atmosphere. The carbon sequestration measurement of this has been neglected and therefore the quantitative effect is not known.

This is in sharp contrast to intensive systems in large parts of Europe and North America, where great quantities of manure are stockpiled, often for long periods. These manure piles undergo anaerobic decomposition. Anaerobic decomposition of manure, as found in intensive cow-calf systems, feedlots and intensive dairy systems, produces methane (CH_4) as one of the major end products.

It is also relevant to consider calf finishing systems, or the post weaning phase. Cattle in South Africa are fattened in feedlots for approximately 110 days, which means that they produce GHG for only 110 days before being slaughtered. Cattle on rangeland/pasture need more than 200 days to finish to the same carcass classification, because of the lower quality feed [they take in] compared to a feedlot diet. Furthermore, there is substantial evidence indicating that organic production systems consume more energy and have a bigger carbon footprint than conventional production systems.

For example, grass-fed cattle require roughly three times more energy per kilogram of weight gain and release more than double the quantity of GHG per kilogram of weight gain than conventional feedlot cattle. Most consumers purchasing organic products do not know that such systems may have a higher carbon footprint [than that of conventional systems].

The effect of methane from livestock on global warming is totally overplayed by groups with their own agendas. They frequently quote values and figures that are based on questionable assumptions or they are just wrong.

The most important greenhouse gases are:

- Carbon dioxide – 49%
- Methane – 18%
- Nitrate gases – 6%

Sources of anthropogenic methane production:

- Gas and coal mining / Natural gas – 19%
- Enteric fermentation (ruminants) – 16%
- Rice cultivation – 12%
- Biomass burning (veld fires) – 8%
- Landfills (dumping sites) – 6%
- Animal waste (including manure) – 5%

A simple calculation can be made using this information. Ruminants contribute 21% of anthropogenic methane production (16% from fermentation and 5% from waste). However, methane forms only 18% of GHG, and 21% of 18% is less than 4%. Thus, the contribution of ruminants to GHG is less than 4%.

It should, however, be noted that the global warming potential of CH_4 is approximately 23 times more than that of CO_2, but its atmospheric lifetime is 12 years, compared to the 100 year to 200 year lifetime of CO_2. Although it has a larger effect, the duration of the effect is much shorter. This is a frequently ignored aspect.

It is also important to ask the question, what will happen to the vegetation if it is not consumed by productive (meat, milk, fibre) ruminants? There are three possibilities:

- It can be consumed by other animals that will also emit CH_4
- It can burn and produce CO_2 that is released into the atmosphere with an atmospheric lifetime of 100 years to 200 years
- It can rot and produce Nitrate gases with a global warming potential of approximately 300 times more than that of CO_2.

Livestock production and water usage

The water footprint or the amount of water required to produce 1kg of product is of relevance. Some of the assumptions on which published figures are based, are debatable. For example, in one calculation where it is claimed that the water requirement is 15 500 L/kg beef, it is assumed that it takes three years to produce 200kg of boneless beef.

In the estimate, only 155 L of water were calculated for drinking, cleaning and post farm gate activities; the remainder was accounted for by irrigation of the crops used for cattle feed and the rain that fell on the property. The estimates of water utilised for 1 kg pork (4 800 L), 1 kg chicken (3 900 L) and 1 L milk (1 000 L) also appear extreme. These figures have been widely quoted by anti-livestock activists. In studies with more

Figure 1: Livestock grazing on rangeland

realistic and justifiable assumptions, it was calculated that the water requirement for red meat production was 18L to 540 L/kg, and 80L to 320 L/kg. The significant variation is due to differences in production systems and management efficiency. The water requirement for the production of total milk solids in whole milk, and in skim milk powder, is respectively 14.4 L/kg and 15.8 L/kg.

In extensive conditions (such as those found in Sub-Saharan Africa) the water need of the animal itself is a major contributor to the total requirement, which amounts to about 4 L per kg feed dry matter intake, with a 50% increase in hot weather.

The argument is sometimes advanced that the water used in livestock production should rather be channelled to crop and vegetable production which requires less water, but this is not true for areas where crop and vegetable production is not viable. In South Africa, agriculture takes up 74.5% of the rainfall. From this, 60% is utilised by the natural vegetation, 12% by dryland crop production and 2.5% by irrigation.

However, natural vegetation (rangelands) and dryland crop production uses only 'green' water, which is rain water stored in the soil after precipitation. It is called 'green' water because only green plants growing in the soil utilise this water. It cannot be used by, or for, anything else. In extensive grazing systems the natural vegetation, which is the food source of livestock, uses only 'green' water.

This water cannot be used for crop production. It is often in areas unsuitable for crop production because of inadequate rainfall and/or the poor quality of soils. The quantity of water used for livestock production (e.g. kgs meat) in the extensive rangeland areas is therefore irrelevant in the calculation of water consumption for beef production. Natural rangelands not utilised by livestock or game would result in water being wasted.

In terms of food production, it means that green water can only be used for the production of meat or other animal produce under extensive grazing systems on natural rangelands, as is the case in South Africa. These systems are critical for the provision of food security in such areas, which dominate almost all less-developed countries. Natural rangelands in these areas do not use 'blue' water (runoff water to streams, dams etc.) or water stored in underground aquifers.

This is completely different from the intensive systems of Europe and North America. Since only the rain that infiltrated the soil is used, there is no water cost for the production of the rangeland. Nothing needs to be done to capture or extract this water other than applying good rangeland management to ensure a dense basal vegetation cover, thus avoiding excessive runoff that would lead to damaging floods, erosion and silting up of dams.

A balance between food and nutrition needs

In addition to the formulation of strategies aimed at greener food environments, health considerations (such as nutrient-density), in addition to carbon footprint calculations, should be considered. Choosing nutrient-rich foods and reducing the intake of nutrient-poor, energy dense foods is one way of reducing the amount of food (and resources) required to meet nutritional needs.

Food systems should produce more nutritious food, not just more food, and guarantee an adequate supply of animal source foods. Any reduction in the consumption of meat and dairy products may compromise the dietary intakes of those nutrients that meat and dairy products supply in relatively large proportions.

The risk is greatest where those nutrients are already in short supply or where there is evidence of low nutrient status. For children in South Africa this includes energy, protein, vitamin A, vitamin C, thiamine, riboflavin, niacin, vitamin B6, folate, Vitamin B12, iron, zinc and calcium.

The lower bio-availability and quality of these nutrients from plant-based sources should also be taken into consideration when comparing different food sources. In terms of protein produced per unit of water, animal products are more efficient than fruit and other food crops such as grains and vegetables. It is therefore important not to overlook the importance of animal products in providing bio-available mineral nutrients.

Differences in production systems between countries and regions can affect the carbon and water footprint of livestock products. Current methods to estimate these footprints are largely based on generic values from northern hemisphere countries, that do not make provision for different production systems. – Prof Michiel Scholtz, ARC.

For more information, contact Prof Michiel Scholtz at GScholtz@arc.agric.za.

Dr David F. Joubert

21.11.1959 – 15.12.2018

Figure 1: Dr Dave Joubert sharing his knowledge

Dave Joubert passed away unexpectedly on 15 December 2018, during an operation in Cape Town. He had been a member of the GSSA since 2013 and his wisdom, humour, friendship and humanity will be sorely missed by the whole Rangeland Fraternity.

Dave had been a teacher for most of his life: he started out at Duneside High School Walvis Bay in 1985.

Since 1994, he had been a lecturer in the Department of Natural Resources and Tourism at the Polytechnic of Namibia (Now the Namibia University of Science and Technology).

He will be remembered by countless students and researchers, whom he inspired and mentored.

Dave was known for his interests in rangeland management (and had developed an expert system for rangeland management with an emphasis on bush encroachment).

He was also interested in invasive plant species as well as the dynamics of bush encroachment.

In 2014, he completed his PhD through the University of the Free State, looking at the dynamics of bush thickening by Acacia mellifera in the highland savanna of Namibia.

In 2012, he was on the scientific committee for the 47th GSSA Congress in Langebaan where he developed a special bush encroachment session.

His impact on research in the savanna and his contribution to the functioning of Namibia's natural systems will be greatly missed among the ecological community and our condolences go out to Dave's family and friends.

Upcoming events

10 - 15 March 2019

African Conference for Linear Infrastructure & Ecology. Centred on the theme 'Building Partnerships and Investing in Nature: the Linear Way in Africa.

For more details, contact Wendy Collinson at wendyc@ewt.org.za

24 - 27 March 2019

International Forage & Turfgrass Breeding Conference in Orlando, FL, USA.

This is the 1st joint meeting of the 10th Molecular Breeding of Forages and Turf Conference (MBFT) and the 6th International Symposium of Forage Breeding (ISFB).

Visit http://bit.ly/MBFT2019 for more, or contact bmt@ufl.edu.

8 - 9 May 2019

30th SANSOR Congress, Umhlanga, KwaZulu-Natal. For more information, visit the website on www.sansor.org or e-mail genman@sansor.org.

3 - 5 June 2019

11th SA Large Herds Conference. The Boardwalk, Port Elizabeth. See www.largeherds.co.za or contact Julie McLachlan, the MPO Events Manager, on 083 740 2720 / 012 843 5638 or julie@mpo.co.za for more.

1 - 4 July 2019

Grassland Society of Southern Africa 54th Annual Congress in Upington. Abstract submissions now open! See the website for more: https://2019gssa.dryfta.com/en/

7 - 10 July 2019

39th Congress of the Zological Society of Southern Africa (ZSSA). Skukuza, Kruger National Park. Contact Dan Parker: Daniel.Parker@ump.ac.za or web for more: https://zssa.co.za/zssa-2019/

2 - 7 Sept 2019

International Long Term Ecological Research Network 2nd Open Science Meeting. Hosted by Helmholtz Center for Environmental Research, UFZ. In Leipzig Germany. For more visit: http://ilter-2019-leipzig.de

22 - 27 Sept 2019

8th World Conference on Ecological Restoration to be held in Cape Town, SA. Visit https://ser2019.org/ for more.

15 - 19 Oct 2019

Veld Management Course by Africa Land-Use Training. Cost: R4,950. For more, contact Frits van Oudtshoorn at 078 228 0008 or courses@alut.co.za.

Looking further ahead: 25 - 30 Oct 2020

Joint XXIV International Grassland (IGC) and XI International Rangeland (IRC) congresses to be held in Nairobi, Kenya. The theme is 'Sustainable Use of Grassland/Rangeland Resources for Improved Livelihoods'. Information is available here: http://bit.ly/Kenya2020

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

CONGRESS 54: FEES

GSSA CONGRESS 54 REGISTRATION FEES			
	Early bird payments received before 16 April 2019 **LESS 40%**	Normal paymants received before 4 June 2019 **LESS 25%**	**Full fee** for all payments received after 4 June 2019
GSSA Members Full Registration			
Full congress, including Monday RSW or full day tour	R4,440	R5,550	R7,400
Non-Members Full Registration			
Full congress, including Monday RSW or full day tour	R5,040	R6,300	R8,400
Full-time Students / Interns / Retireess Full Registration			
Full congress, including Monday RSW or full day tour	R3,774	R4,717.50	R6,290
GSSA Members Congress Registration			
Congress attendance only, ie NO Monday RSW or tour	R3,960	R4,950	R6,600
Non-Members Congress Registration			
Congress attendance only, ie NO Monday RSW or tour	R4,500	R5,625	R7,500
Full-time Students / Interns / Retirees Congress Registration			
Congress attendance only, ie NO Monday RSW or tour	R3,366	R4,207.50	R5,610
Day Delegates Registration Fees			
One day attendance	R1,560	R1,950	R2,600

25 January
Registration to attend opens

25 January
Abstract submission opens

28 February
Special Session and Workshop proposal deadline

8 April
Abstract submission deadline

16 April
Early bird payments

28 May
Preliminary programme

4 June
Normal paymants

17 June
Registration deadline

5 Jule
All other payments due

Grassroots

Newsletter of the Grassland Society of Southern Africa

Photo competition

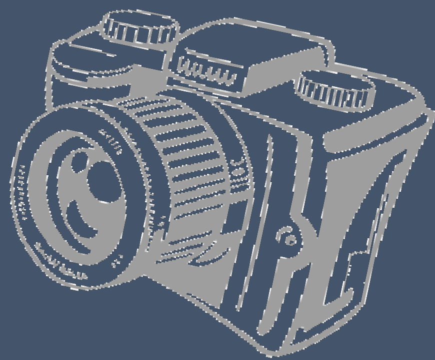
Are you a keen photographer? Have you recently taken unique photos while doing field work?
Enter them into any of the following two categories and your photo can be our next ***Grassroots* cover**!

"Cover" photos

Any high quality photos that are related to rangeland ecology and pasture management in southern Africa

"Research in Action" photos

Any interesting photos taken while collecting data or doing field work that are related to rangeland ecology and pasture management in southern Africa



Winning photos will feature in the next *Grassroots* and the overall winning photo will be on the cover!

Competition runs for the next 3 Grassroots editions of 2019!

How to enter:.

- Choose one of the above categories.
- Photos must be in jpg format and not exceed 10 MB.
- Email your entries with your name and contact details to **photos.grassroots@gmail.com.**
- Include a title and information on where and when the image was taken.
- Email your photos before 17h00 on the following dates:
    - 10 April 2019 (*May edition*)
    - 1 July 2019 (*August edition*)
    - 1 October 2019 (*November edition)*
- You will receive a confirmation email upon entrance.

For additional information, send an email to **info@grassland.org.za**

***Terms & Conditions:**

- Anyone is welcome to enter, except the *Grassroots'* publication team and their immediate family. Photos will be judged by the publications team.
- More than one entry is allowed.
- A participant who is announced as a winner may not enter the competition for the following editions.
- *Grassroots* holds the right to use entered photos elsewhere in *Grassroots*, the GSSA website, or for future marketing purposes without compensation to the photographer.
- A photographer will receive the necessary recognition if any of his/her photos are published by *Grassroots.*
- Winners will be notified a week before publication.