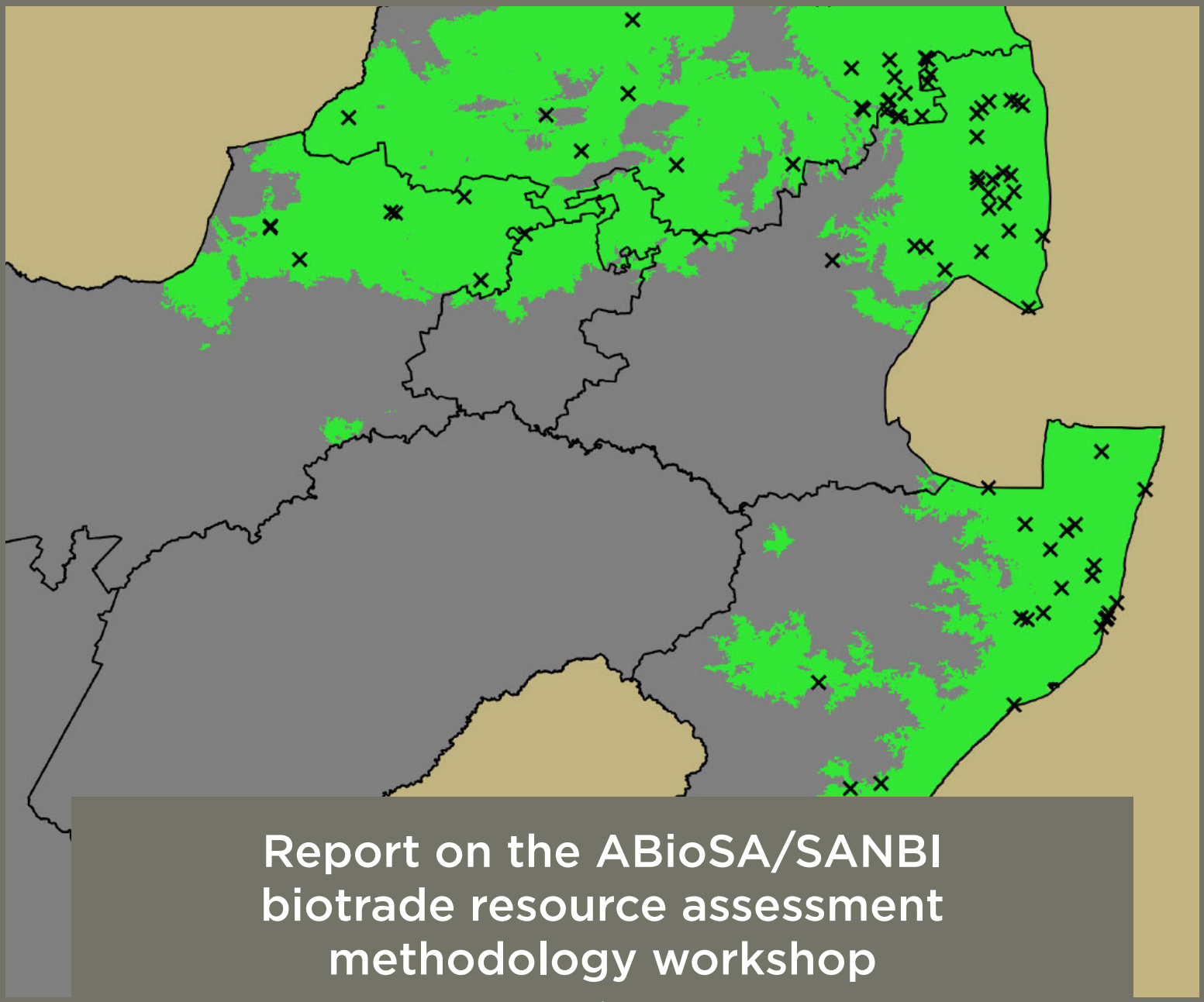

Report on the ABioSA/SANBI biotrade resource assessment methodology workshop

3 December 2020

environment, forestry & fisheries
Department:
Environment, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

THE ABS CAPACITY DEVELOPMENT INITIATIVE

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SANBI
Biodiversity for Life
South African National Biodiversity Institute

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Contents

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Introduction

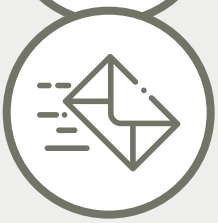
More than 100 delegates from the biotrade sector in South Africa and Southern Africa participated in a virtual resource assessment methodology workshop on 3 December 2020. This is the report on the workshop presentations and group discussions.

Participants included representatives of harvesters and primary producers, the development sector, academia, environmentalists, government and its implementing agencies, and people involved in the manufacturing and processing of plant ingredients, and marketing and sale of natural products.

The workshop was organised by the South African National Biodiversity Institute (SANBI) and the ABS Compliant Biotrade in South(ern) Africa (ABioSA) project, which is delivered by GIZ and funded by the Swiss State Secretariat for Economic Cooperation (SECO), in partnership with the South African Department of Environment, Forestry and Fisheries (DEFF).

The workshop agenda is in Appendix A

A list of delegates is in Appendix B



Copies of presentations have been distributed to delegates and are available on request from **serole.sehona@giz.de**

Summary of key points

Overview

- Sustainable biotrade requires an in-depth understanding of the scale and health of natural plant resources. This will inform their conservation for use by future generations.
- A responsible biodiversity economy is based on sustainable extraction, which requires tools for resource assessments, mapping and monitoring.
- Sector Development Plans require credible information about biotrade resources.
- Some aspects of current resource assessment and monitoring in South Africa are outdated and should be reviewed and improved. There is a general lack of robust data on national population stocks, trends, and sustainability.

Communities

- Communities need to be involved in, and responsible for, aspects of resource assessments and monitoring. They need to be enabled to create value, not just through harvesting and selling the resource, but by becoming more integral to the value chain, including active involvement in the monitoring of resource stocks.

Coordination

- Agreement is needed on what data we collect and how we collect it, how we validate the quality of the data, how it is interpreted, and how we share it.
- Activities need to be funded and coordinated. Assessment and monitoring methodologies need to be aligned and integrated, with local reporting feeding into national and regional initiatives.
- A stakeholder map is required to detail coordination roles. This needs to happen at national government level, particularly to select the assessment and monitoring methodology and standardise reporting requirements.
- Data from resource assessments and monitoring should be collated, updated and held centrally by an environmental authority and made available to the sector.
- National ministries of environment have an important role in coordinating regional approaches.
- Many African countries have not yet ratified the Nagoya Protocol so there is not a common understanding or importance attributed to resource assessments as a tool for sustainability management linked to access and benefit-sharing.
- Only SA and Namibia have strategies for their biodiversity economies, and it is difficult to engage with countries which don't have one.

Technology and methodology

- Any national or regional monitoring programme must draw on good science, available expertise, and consensus on methodologies and standardisation.
- Different technologies and methodologies are appropriate for different species in different landscapes.
- There are already diverse and established approaches to assessment and monitoring, many of which are relevant and useful for local biotrade subjects. In planning data collection approaches it is important to be informed by traditional practices and knowledge held by local resource users.
- Existing resource assessment reports often reflect uneven distribution scales, focus and methodologies, making them difficult to compare.
- Remote sensing techniques like satellite imagery can easily cover large regional populations that span international borders, but are limited to larger species like Marula and Baobab.
- Developments in remote sensing and imaging technology provide huge opportunities for effective resource assessments and monitoring. Field verification is boosted by citizen science using handheld devices.

Data for policy

- Data needs to be transformed into an appropriate format for policymakers. We need to consider what scientists or harvesters are measuring, versus what information policymakers need to develop practical policies.

Funding and investment

- We need to convince government why a resource assessment and monitoring plan needs investment. Access to funding will guarantee the sustained implementation of a national or regional programme.
- We need to develop partnerships with major environmental organisations (e.g. WWF, IUCN) and generate sector level monitoring and management plans.
- It is important to collaborate with industry, which should be committed to the implementation and financial support of resource assessments.
- Funding for assessments and monitoring may be included in a second phase of the ABioSA project, including establishment of governance and institutional arrangements.

Welcome address

Natalie Feltman

Director, Bioprospecting and Biodiversity Economy, Department of Environment, Forestry and Fisheries (DEFF)

DEFF has been at the forefront of ensuring the sustainable utilisation of indigenous biological resources and biodiversity, and is creating an improved environment for growth in the biodiversity economy.

The South African government realises the potential of the country's biodiversity and has given it focus through the National Biodiversity Economy Strategy. The aim is to build a robust economy based on indigenous biological resources and associated rich traditional knowledge; and to develop rural economies, create jobs and a drive for equitable growth.

Since the promulgation of the National Environment Management: Biodiversity Act (NEMBA, Act 10 of 2004, as amended), DEFF has been at the forefront of ensuring the sustainable utilisation of indigenous biological resources and biodiversity, and is creating an improved environment for growth in the biodiversity economy.

Implementation of the National Biodiversity Economy Strategy requires better coordination between various role players within the sector. The Department of Trade, Industry and Competition (dtic) and the Department of Science and Innovation (DSI) have partnered with DEFF to establish the Bio Products Advancement Network South Africa (BioPANZA).

BioPANZA is a coordinating network of partnerships to optimise development and enhance growth in the biotrade and bioprospecting sector. It supports the sector through:

- Pooling financial and non-financial resources to support SMMEs
- Facilitating coordination and collaboration
- Advocacy for the sector in South Africa and internationally
- Strengthening the capability of local value addition, innovation and product development

What will always be key to DEFF is the implementation of Chapter 6 of NEMBA and its regulations to ensure fair and equitable benefit-sharing through the utilisation of indigenous biological resources and associated traditional knowledge across the value chain.

To build a sustainable biotrade sector we have to understand the scale and health of our natural plant resource; and that in turn will help us to manage it sustainably and ensure it is conserved for future generations. This measurement and monitoring of our resources will give us a reliable baseline from which to build the sector.

Resource assessments require a great deal of collaboration between many parties, from government and communities, to land owners, ecologists, scientists and environmentalists. That is why I welcome you here today, with your experience, skills and insights. This workshop is an important part of developing a national and regional assessment and monitoring mechanism for our natural resources. I wish you luck in your discussions, and thank you for your contributions.

To build a sustainable biotrade sector we have to understand the scale and health of our natural plant resource; and that in turn will help us to manage it sustainably and ensure it is conserved for future generations.

Workshop background and aims

Adrie El Mohamadi

GIZ ABioSA Senior Technical Advisor

The objective of ABioSA is to contribute to job creation and the sustainable use of biodiversity in South Africa and the region by supporting SMMEs, indigenous peoples and local communities, as well as business support organisations.

The aim of this workshop is to explore the potential and viability of a long-term national and regional resource assessment and monitoring programme to ensure the sustainability of plant species in the fast-growing biodiversity sector in South Africa.

The objective of ABioSA is to contribute to job creation and the sustainable use of biodiversity in South Africa and the region by supporting SMMEs, indigenous peoples and local communities, as well as business support organisations. This is done through:

- Technical assistance to SMMEs and industry
- Financial assistance
- Advice and policy support

We work with 12 plant value chains:

Agathosma betulina (Buchu)

Image: Louisa Feiter

- Marula (*Sclerocarya birrea subsp. caffra*)
- Baobab (*Adansonia digitata*)
- Aloe (*Aloe ferox*)
- Buchu (*Agathosma spp.*)
- Mongongo/Manketti (*Schinziophyton rautanenii*)
- Umsuzwane (*Lippia javanica*)
- Imphepho (*Helichrysum spp.*)
- Cape chamomile (*Eriocephalus spp.*)
- Rose geranium (*Pelargonium var Rose*)
- Kalahari melon (*Citrullus lanatus*)
- Sour Plum (*Ximenia americana & X.caffra*)
- Mafura (*Trichilia emetica*)

These value chains were selected according to specific criteria:

- Traditional knowledge
- Ecological sustainability
- Market demand
- Potential for value-adding and job creation
- Participation of IPLCs and SMMEs

In collaboration with Natural Justice, ABioSA is working on BioCultural Protocols for communities around these species and value chains. For example, as Marula is a trans-boundary species, a number of different communities are involved.

Our expert consultants will report today on findings from their desktop analyses that identify principles and suitable approaches for:

- A long-term national monitoring plan for key biotrade species in South Africa
- A regional resource assessment and monitoring programme for Marula in Southern Africa, including South Africa, Eswatini, Namibia, Zimbabwe, Botswana and Zambia; as well as Mozambique, Malawi, Madagascar and Angola

ABioSA has also contracted consultants under the leadership of Kruger, Swart & Associates (KSA) to develop six sector development plans for a number of the abovementioned species.

The role of resource mapping and monitoring

Prof Neil Crouch

SANBI, Bioprospecting Economy, Biodiversity Research, Assessment and Monitoring

We have a constitutional obligation to be responsible about sustainable extraction. Sustainable management of resources provides for the long-term interests of individual species and their environments in a way that allows subsequent generations of South Africans to benefit from them the way we do.

A national biotrade resource monitoring programme is necessary for the scientific community to improve collaboration and coordination of activities in the national interest. Resource mapping and monitoring includes the development of tools which allow for the sustainable extraction of biological resources. This is critical to consider when developing the biodiversity economy.

National government partners are looking at it from the perspective of creating jobs and expanding GDP contributions. In all official documentation – whether it's the National Development Plan, the Biodiversity Economy Strategy or the outcomes of the Operation Phakisa Biodiversity Economy Laboratory – the sustainability aspect is explicit. While there is an intention to reduce rural poverty, increase GDP and jobs, this is all within the context of sustainable businesses and sustainable biodiversity.

What does sustainability mean?
We have a constitutional obligation to be responsible about sustainable extraction. South African law defines 'sustainable' as the use of biological resources in a way and at a rate that:

- Won't lead to its long-term decline
- Will not disrupt the ecological integrity of the ecosystem within which it occurs
- Will ensure its continued use to meet the needs and aspirations of present and future generations

In summary, sustainable management of resources provides for the long-term interests of individual species and their environments in a way that allows subsequent generations of South Africans to benefit from them the way we do.

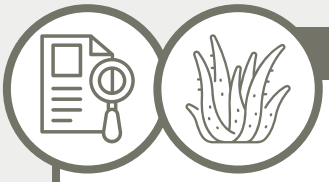
To achieve this, we look at a resource's:

- Regenerative and/or productive capacity
- Distribution
- Abundance
- Population structure
- Accessibility/ownership
- Autecology (ecological study of species)
- Management
- Monitoring

There are already some available tools which promote sustainability, such as harvesting field guides, industry best practices, biodiversity management plans and Non-Detriment Findings, but these are ad hoc and uncoordinated.

The Wild Honeybush Harvesting Field Guide is an example of such a tool. Produced by the Western Cape government, and applicable to both the Western and Eastern Cape, individual landowners can work out how much of a particular resource is on their property, how much they can extract, and how to go about harvesting.

This methodology for assessing the extent of the Honeybush resource on farms may not be appropriate for a national scale assessment to inform the Honeybush subsector. We accordingly need to consider how to make adjustments to our approach, whilst using the limited capacity and resources available.



Case study: Aloe Ferox

In considering Aloe Ferox we note an academic report produced by universities, SANBI and Kew that provides information that can feed into the development of management tools such as NDFs, industry best practices, red listing, BMPs and legislation/regulation; but it is a local scale project working at just two sites.

One site is in the Western Cape and the other in the Eastern Cape. Each province manages its resources differently, with only one requiring harvesting permits. Management in both provinces would benefit from a national resource assessment and monitoring programme. In the Eastern Cape, the methodology successfully applied in this study showed that over-harvesting was occurring in close proximity to the processing factory. It was shown that the closer one was to the factory, the more likely the plants were to be unsustainably harvested, and this despite harvesting guidelines being provided to harvesters, and training in harvesting having been provided beforehand.

Clearly, if that tool is not working effectively then one has to adapt the management approach to perhaps stipulate quotas, restrict the harvesting season, rotate access to sites etc. The point here is that adaptive management is based on ongoing monitoring and evaluation, and involves the generation and interpretation of good data. The data in this case is very local, and not applicable to a national approach to monitoring and evaluation. We need to identify ways that allow us to use similar methodologies to establish a monitoring programme that informs all stakeholders.

The more you know about a species, the more you can manage it, and the more likely you are to develop sustainable extraction methods.

How do we know it's sustainable?
The CITES permit is a management tool that indicates that the material traded with that permit has been sustainably sourced. There are approaches to assessing how sustainable a process is, and within the CITES context, use is made of Non-Detriment Findings. This process looks at aspects such as the biology of a species, its population trends, how much illegal access is happening, how much formal and informal protection is in place etc.

The more you know about a species, the more you can manage it, and the more likely you are to develop sustainable extraction methods. With Aloe Ferox, we found harvesting to be sustainable based on an NDF, and subsequently approached CITES for an amendment to its listing on Appendix II in order to ease aspects of the trade. This has relieved some of the regulatory burden on industry and so has helped to promote it.

The role of industry
To make good commercial decisions, you need good information. And while industry is about wealth creation, it is also about people. Without industry, there are no opportunities or livelihoods. Industry has historically funded many studies to identify cost effective extraction approaches. This effectively means that industry has determined the terms of reference, methodologies used, and analytical approaches involved when assessing resource stocks. Industry is understandably protective of its self-generated intellectual property, so feeding this data back into resource management at a provincial and national level has been problematic.

We need to appreciate that industry has a vested interest, while asking who should be undertaking, paying for and holding data from such studies in the future.

Appropriate assessments
In the Baobab subsector, a study has looked at the impact of harvesting and livestock on that species. While drivers may change the quantity and quality of material in the field, this differs for each species, so the methodology of assessment and monitoring will need to change. Climate change as a driver will also impact every species in South Africa, as will human-driven landscape transformation such as the development of farmland, dams and roads. Any assessment needs to consider that destroying suitable habitat erodes the resource and so destroys our economic opportunities from biotrade.

Sustainability from the end-users' perspective
European consumers in particular want to be certain that their products have been ethically and sustainably sourced, and will look to certification bodies like FairWild for an indication of this. As much as these organisations operate at the local level of extraction (e.g. a farm), they also need to consider the bigger picture and will be informed by national-level assessments.

Anecdotal data vs rigorous science

Many resource management tools are historically based on anecdotal data which can and should be reviewed and improved where possible. Anecdotal data is often the best information available at a particular time and is a great placeholder which allows for the generation of hypotheses. However, science and its evidence basis needs to underpin the work that we do. Any national monitoring programme must draw on good science, available expertise, and consensus on methodologies that robustly assess the quality and quantity of our biotrade species.

We need to standardise where possible, given our limited resources. Funding and activities need to be coordinated to maximise finances and goodwill, to establish a respectable monitoring programme that delivers for communities, industry, regulators, NGOs, policymakers, certification bodies and future generations.

Any national monitoring programme must draw on good science, available expertise, and consensus on methodologies that robustly assess the quality and quantity of our biotrade species.

Sector development plans

Sandra Kruger

Partner, KSA

The team working on sector development plans (SDPs) for ABioSA includes:

- Kruger, Swart & Associates: Socio-economic scientists
- Agrifusion: Agricultural economists
- Profound: Experts in the natural ingredients sector

The goal of this year-long sector development planning process is to have SDPs developed and taken up by industry and value chain actors, supporters, influencers and regulators.

SDPs and resource assessments

SDPs cannot go forward without credible and reliable information about biotrade resources. Sector development planning and resource assessment and monitoring are ongoing and integrated. The information obtained through regular assessment and monitoring feeds into the global and regional status quo of sectors, engagements and SDPs, which then feed back into resource assessment and monitoring.

Appropriate SDPs

Different species require different approaches, informed by the unique characteristics of the sectors they form part of. For example:

- Whether the resource is wild harvested, cultivated, or both
- What the regional spread is
- The value chain characteristics
- Active stakeholders and support organisations

Knowledge sharing platform

The information that goes into resource assessments and monitoring needs to be updated and collated, and held centrally by an environmental authority like SANBI, in collaboration with the academic community. Is there potential for a single national platform?

How this information is coordinated and shared at an individual and national level is important. We must ask ourselves what the roles of industry, value chain actors and other role players are in resource assessment and monitoring. What are the roles of the public sector, and academic institutions? How do we include these activities in sector development planning?

Standardising methodologies

The biggest challenge is standardising resource assessment and monitoring methodologies. Sector role players must be involved, as it is a shared responsibility. Resource assessments and monitoring cannot be imposed on a sector – each sector needs to take responsibility for its own information.

SDPs cannot go forward without credible and reliable information about biotrade resources.

Review of SA national resource assessment and monitoring

Derek Berliner

Consultant, Eco-Logic/LIMA

The goal of this consultancy was to:

- Review national scale resource assessments
- Profile target species
- Describe principles and approaches for national-scale resource assessments

Our work primarily focused on ecological sustainability, but there is overlap with issues such as social justice, economic sustainability and product quality.

Resource assessment needs to be clearly defined. Key questions include:

- What is the focus (e.g. ecological sustainability)?
- What is the purpose and use of monitoring – what detail is required?
- Can less rigorous qualitative monitoring be used, and can a range of groups be involved?
- What is the priority concern (e.g. over-utilisation, poor recruitment, climate change etc.)?
- Over what time scales do you want to detect change?
- Other than harvesting, what are the key drivers and threats of change for the target species?
- What technological tools are best suited to the chosen spatial and time scales?
- What indicators and methods of verification exist to standardise the process?
- How and where will ground-based monitoring sites be selected?
- What is the ideal frequency of monitoring?
- Who should coordinate and manage the monitoring, curate and analyse information, and act on the results?

What do we know?

We began with literature reviews and expert interviews of species profiles (yields, productivity, population trends, threats etc.) and species resource assessments. For the latter, we looked at what has been done, whether this information could be used as a baseline, and whether it explored the impact of harvesting on sustainability.

Data fields (see table below) were used to profile each species. These are a useful baseline.

Data categories	Data fields
Species life history	Life form, reproductive type, age at first fruiting, yield of harvested part of plant, propagation, domestication and cultivation, pattern of distribution, ecological role
Use	Part used, harvesting techniques and frequency
Management	Management plans, studies on harvesting pressure, studies to determine sustainable harvest levels, current monitoring
Conservation	Threats/drivers of change, trends over the last decade, status (red listed/ CITES/NDF), ecological experts
Institutional aspects	Key actors and mandates (government, industry, NGOs), projects/networks, certification

A summary of all papers was developed for each species. For example:

Literature review of all resource assessments
(e.g. Aloe ferox)

Location	Part used	Scale of assessment	Aims & Method	Results/findings	Reference
South Africa	Leaves	National	Estimated from distribution records	The species is estimated to extend across an area of 10 000km2	Donaldson (1989)
South Africa	leaves	National	Aims: Determine and map the current distribution of A. ferox Methods: stratified random sampling	(Work still in progress) Preliminary results include: Identification of monitoring sites	Palmer and Weideman (2020)

We considered the quality of each paper for future comparative studies, and where national assessments existed, whether they could serve as a baseline. These were value judgements, and only the studies for Aloe Ferox, Devil's Claw and Pelargonium meet the criteria.

We asked whether national resource assessments were available for the target species and if they could be used as a baseline.

Species	National RA available	Can this be used as baseline	Good data on optimal levels harvesting	Understanding of impact of harvesting & threats	Biodiversity management plans	Non-Detriment Finding study	Extent of cultivation
Aloe Ferox	Yes	Yes	Yes	Yes	In development	Yes	All wild
Baobab	No	No	Yes	Yes	No	No	All wild
Marula	Yes	No (?)	Yes	Yes	No	No	All wild
Buchu (A. betulina)	No	No	Yes	Yes	No	No	Most wild
Buchu (A crenulate)	No	No	No	No	No	No	Most wild
P. sidoides	Yes	Maybe	Yes	Yes	Yes	Yes	Most wild
Kalahari melon	No	No	Yes	Yes	No	No	Wild and cultivated
Devil's Claw	Yes	Yes	Yes	Yes	No	No	Most wild harvested. Cultivation increasing
Rooibos	Yes	?	Yes	Yes	No	No	Almost all cultivated
Honeybush	Yes	Many species	Yes	Yes	In development	Yes (?)	75% wild harvested

There is a general lack of robust data on national population stocks, trends, and sustainability.

Next, we considered the threats and drivers of change for each species, and scored them.

Threats	Aloe Ferox	Baobab	Marula	P. sideroides	Net score
Habitat loss and conservation	2	1	2	2	7
Legal resouce use/over-harvesting	2	1	2	2	7
Livestock trampling and overgrazing	2	2	1	2	7
Wild herbivores	2	2	2	1	7
Illegal harvesting unpermitted	2	1	1	2	6
Climate change related	2	2	1	1	6
Increase in fire frequency/intensity	2	0	1	1	4
Bush encroachment	2	0	1	1	4
Other wildlife (baboons etc.)	1	2	0	1	4
Diseases, pathogens	1	1	0	1	3
Threats to pollinators	0	2	1	0	3
Invasive alien species	1	0	0	1	2
Soil erosion, sedimentation	1	0	0	1	2
Subsistence/small scale use	0	0	0	1	1
Introduced genetic material	0	0	0	0	0

Scores: 0=Not indicated, 1=Potential, 2=Significant, 3=Major

Species were then grouped by their features, such as longevity, general distribution and resilience to over-harvesting.

Species	Life form/ size	Longevity (years	Reproduction	Distribution	Resilience to over-harvesting
Marula	Tree	100-200	Seeds	Scattered wide	High
Baobab	Tree	500-2500	Seeds	Scattered wide	High
Aloe Ferox	Small tree	10-20(?)	Seeds/shoots	Clumped/wide	High-medium
Honeybush C. intermedia C. subternata	Shrub	5-10(?) 30 Fire interval dependent	Resprouter Reseeder	Clumped/wide Clumped/localised	Medium Low
Buchu	Small shrub	5-10(?)	Seeds	Clumped/localised	Medium
Pelagonium	Small shrub	5-10(?)	Roots and seeds	Scattered/localised	Medium-low
Rooibos	Small shrub	5-10(?)	Seeds	Production mainly from cultivated plants	High-medium (wild populations)
Devil's Claw	Creeper	2-5(?)	Tubers and seed	Clumped localised	Medium-low
Kalahari melon	Creeper	Annual	Seeds	Production based on cultivation	Low

Groups of features with potential have been suggested for monitoring. Long-lived species like Marula and Baobab stand out, as well as small trees that tend to be clumped. These groupings also allow us to identify a gradient of the resilience for over-harvesting and time scales on which to identify change. For example, short-lived shrubs where root tubers tend to be harvested are most vulnerable to over-harvesting, and display changes on a short timescale. Long-lived trees where fruits are harvested are least susceptible to over-harvesting, and intermediate are plants like Buchu and Aloe Ferox, where leaves or the body of the plants are harvested.

General comments

- There is a general lack of robust data on national population stocks, trends, and sustainability
- Pelargonium, Aloe Ferox and Devil's Claw have good resource assessments which could be used as a baseline for future monitoring
- Several good studies exist at a local scale for most target species
- Recruitment rates for the two long-lived species are poor
- There is an upward trend of cultivation for species like Rooibos, Honeybush and Buchu

How much is out there?
For some species, it is possible to count every sheep in your herd. This is the case, for example, with large species like Baobab. For other species, however, other methods are needed.

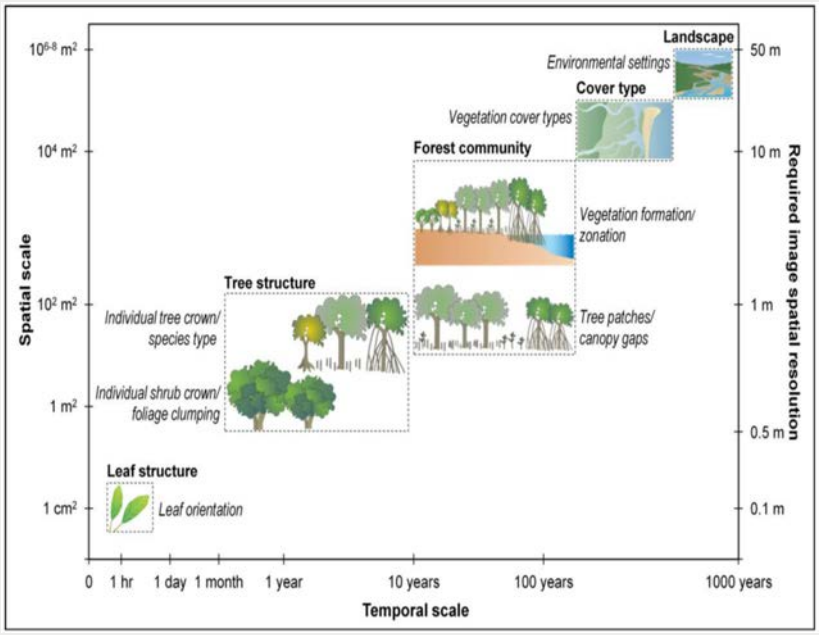
We distilled a number of steps that are generic to most national resource assessments. There's a lot of room for standardising some of these models:

Objectives	Methods	Scale
Determine distribution range	SANBI data bases (GBIF, PRECIS Database, National Herbarium) Other records from industry Expert mapping	Macro
Develop species distribution models	Frequency of records per unit area MAXENT probability of occurrence, see below	Macro
Improved distribution range based on secondary data analysis	Analysis of data from expert mapping and field mapping	Macro and integration of scales
Selection of monitoring supersites	First order stratification based on land use/land tenure classes, or alternatively density classes	Meso (landscape)
Selection of monitoring sites within supersite	Randomised, or use second order stratification using a) harvesting pressure, or b) drivers of change (e.g. grazing gradient)	Meso/Micro
Monitoring of sample sites	Ground based and/or remotely sensed (experimental design for adequate replication and statistical significance, avoiding pseudo replication)	Micro (ground)
Extrapolation of data from transects to estimate population densities and overall population size	Using ground data to calibrate GIS model to high, medium or low calibre densities across all distribution range Include: harvest records	Integration of scales

Key issues and principles: Scale

Scale is important in landscape ecology. You can evaluate change over a short time and space scale – e.g. the change displayed by an individual leaf within a few hours. You can then increase that to the changes observed by a whole plant, or whole community, over a year or a season, or an entire region over decades. At different scales, different information is accessed and different tools used, and we need to integrate information between scales.

Monitoring across multiple scales



At different scales, different information is accessed and different tools used, and we need to integrate information between scales.

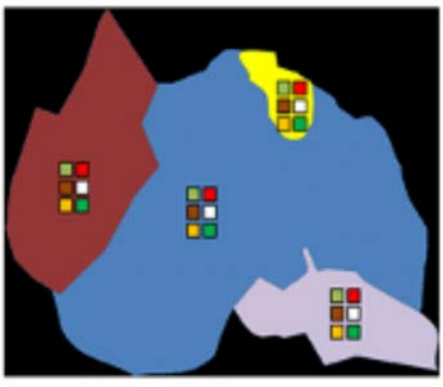
For example, at regional scale, you can use satellite imagery and involve national administrative bodies. This table includes a few more examples of how scales impact various factors:

Implication of scale of monitoring

Spatial scale	Time scale	Key tools	Who?	Administrative scale	Key limitations	Main advantages
Local	Annual, bi-annual	Sample plots/ transects	Community Research organisations NGOs Industry boards/ collectives	Community, village Forest section	Limited samples size, time consuming	Easy to replicate Additional data collected as well, such as yield Suitable for small species
Landscape	2-5 years	Aerial imagery, drones, Google Earth, road counts, LADAR	Local government researchers NGOs	Forest management unit, local community, district administration	May require ground-truthing Only certain species detectable	Habitat condition, landscape process analysis (erosion, overgrazing)
Regional/ national	5 years+	Satellite imagery, GIS modeling (MAXENT)	National government SOE's Researchers NGOs	Provincial, National, Regional	May only be feasible for certain species (trees or clumped distribution) Requires ground-truthing Absolute determination may not be possible	Possible to develop national level standarised methods For policy formulation, national quotas, trade agreements

The impact of variables

It's important to know what variables affect your target species, including harvesting, land use (e.g. agriculture or livestock) and climate change. These must be considered when selecting monitoring sites. Monitoring sites need to be stratified so that different drivers are isolated to specific areas. These strata need to be considered in monitoring design, because information cannot be extrapolated from one to the other.

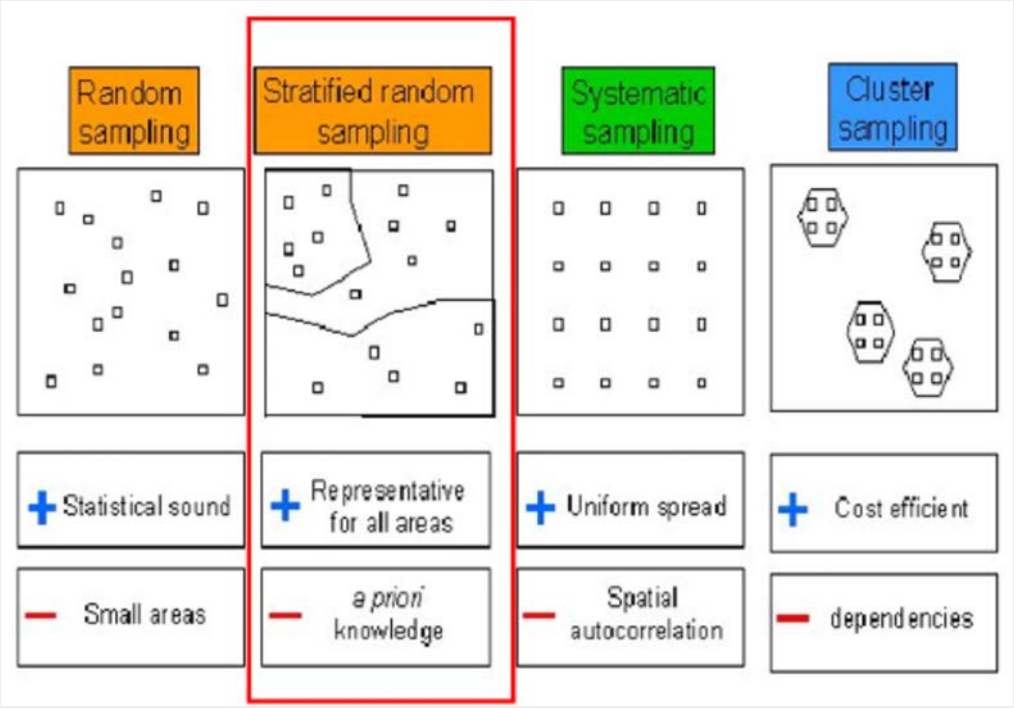


Hypothetical stratification of study area for allocation of motoring plots

What is stratification?

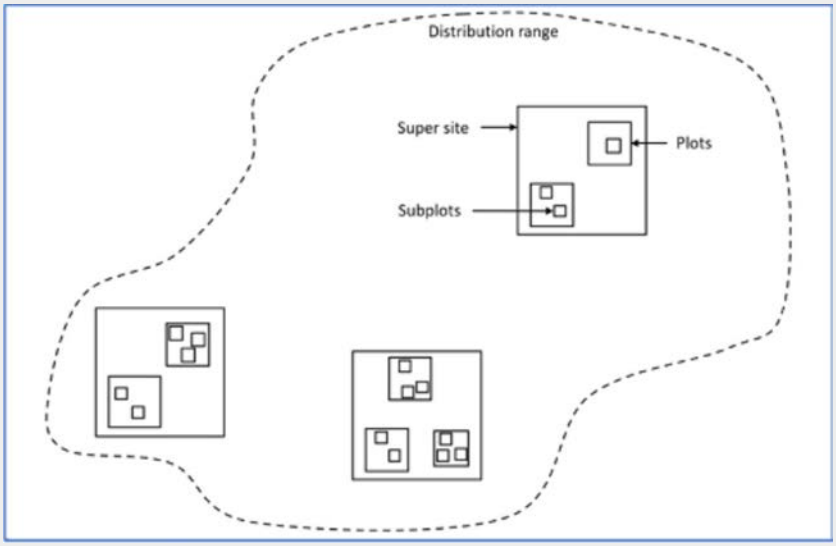
Stratified sampling involves the division of the target population into known smaller sub-groups with shared characteristics.

Other types of sampling:



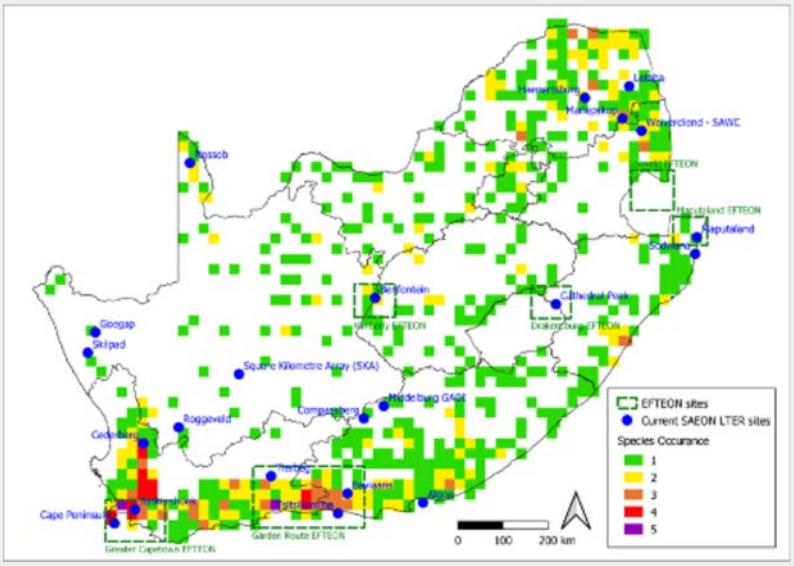
Supersites

Supersites advocate for a multi-scale approach to resource monitoring. The concept has been used by the Kruger National Park and the SA Earth Observation Network (SAEON) to monitor across different scales. Supersites are the largest unit of a set of monitoring plots. For example, the graphic below shows a distribution range, within which a supersite is selected. That supersite contains sub-lots, portioned by shared characteristics. Here, you can adjust the scale of study.



Monitoring should be integrated within the broader context of ecosystem services, rather than the individual plant. This considers how much ecological stock is available, how much yield it produces, the valuation of the resulting product, who benefits from that value, and how that value is shared.

Supersites can be optimised by locating them in areas where more than one target species occurs. The map below illustrates the overlap of the 11 target species, as well as the locations of SAEON's LTER long-term research sites, which should ideally be considered as well. Optimal areas where multi-species, long-term research and monitoring can be conducted include the Cederberg, Baviaanskloof and the Cape Peninsula.



Monitoring should be integrated within the broader context of ecosystem services, rather than the individual plant. This considers how much ecological stock is available, how much yield it produces, the valuation of the resulting product, who benefits from that value, and how that value is shared. In considering the broader context, monitoring can feed back into management planning.

What do you measure?

Monitoring components	Indicators
Total stocks	Plants per hectare, distribution extent
Population health	Recruitment rates, population size
Quality of natural habitat	Extent of land use change, degradation, biodiversity loss
Productivity of resource	Kg per plant/tonnes per hectare
Quality of harvested resource	Size of fruit, chemical composition of part harvested
Early warning indicators of overuse	Lower yields per area, higher prices, smaller and poorer quality products

Who manages data?
We conducted an analysis of mandates and made suggestions for roles and responsibilities. These include:

Organisation	Mandate	Suggested role in National Monitoring Progamme
UNCTAD BioTrade Principles and Criteria (P&C)	International monitoring and regulation of traded wild resouces	BioTrade P&C provide an overall framework for a long-term monitoring progamme for biotraded species
SANBI	Monitor and report regularly on the sustainable use of indigenous biological resouces, and threatened species. National Biodiversity Frameworks/bioregional plans	Coordinate, research and monitoring Reporting Curation and storage of monitoring data
DEFF	Leadership, alignment and adherence to national and international policy and legislation	Oversight, regulation and policy implementation around formalising biotrade and biosprospecting Administering and enforcement of permitting systems Oversee the development of biodiversity management plans for biotraded species Curation and storage of monitoring data
Universities Research institutes CSIR Consultants	Multi-disciplinary research and technological innovation for industrial and scientific development	Reseach and innovation in methods of resouce monitoring, harvesting, processing and potential uses of biotraded plants
SAEON	To detect, understand and predict environmental change in South Africa. Six regional reseach nodes	Monitor the impact of climate change on biotraded plants
TRAFFIC	Monitors and investigates wildlife trade and conservation policies and programmes, collaboration with the CITES Secretariat	Strengthening the implementation and enforcement of CITES Trade monitoring (import and export of biotraded species)
Industry/Producer Associations/Councils	Responsibly promote the respective industry and protect the interests of the consumer and industry stakeholders	Promote responsible harvesting and sustainable resource management amongst producers Support the development of sustainable harvesting guidelines and protocols Cooperate and collaborate in resource assessment and monitoring programmes Provide information on harvesting and quantities
Certification Schemes FairWild	Ensuring sustainable harvesting of wild resources	Principles, criteria and indicators to measure sustainable harvesting of biotrade species

Which resource assessment should we use?

There are three types of resource assessments. They are related, but the emphasis changes, and no standardised or repeatable methods exist:

- ***Total stock assessment*** - Useful for industry to know how much is out there, and what the potential annual harvest is. A good estimate may be good enough.
- ***Understanding direction trends in stocks*** - Is our stock increasing or decreasing, and why? Here one needs a higher level of accuracy and statistically sound samples.
- ***Sustainable harvesting*** - If we harvest X, does it recover completely? Here you may not need to know total stocks, but can rather do groundwork to determine an average.

The purpose of your assessment will therefore dictate the detail and method.

Recommendations

- Adopt an ecosystems approach to monitoring:
  - Integrated holistic research frameworks
  - Driving variables on target species
  - Structure and function of host ecosystems
- Develop statistically sound sampling, and experimental design protocols
- Develop multi-scale approaches that combine ground surveys, aerial photography and remote sensing
- Use of large-scale, permanent sampling sites:
  - Supersites with multi-scale nested plots
  - Multiple target species within one super site
  - Synergies with other long-term monitoring programmes (e.g. SAEON)
- Develop calibrated predictive models (e.g. density, productivity, yields, harvest rates)
- Explore technological advances (e.g. LIDAR, high-resolution multispectral imagery, AI, machine learning)
- Consider treating some wild biotraded species as ecological indicators in long-term environmental change monitoring programmes (Marula, Aloe, Baobab are possible keystone species)

Group discussions

Delegates moved into smaller groups to discuss the development of a national resource assessment and monitoring programme.

TOPIC: Aligning resource assessment and monitoring with legislation, regulations, strategies, BCPs and needs of all user groups; Governance and management of national resource assessments, monitoring and evaluation, roles and responsibilities

Participants
Cyril Lombard (moderator), Natalie Feltman, Errol Moeng, Lisebo Motjotji, Ntando Nondo, Pierre du Plessis, Sebataolo Rahlao

Summary
- Structures are required to get communities more involved and responsible for monitoring and resource assessments. They benefit from these resources, and once they take ownership and responsibility they have more reason to protect them.
- There are weaknesses in government systems in SADC, with roles and responsibilities not clearly defined.
- There should be coordination and communication between government, communities and industry to ensure resources are properly managed.

TOPIC: Technology and methodologies

Participants
Gillian McGregor (moderator), David Kinsler, Caroline Jacquet, Christoph Kleinn, David Harter, Derek Berliner, Glenn Moncrieff, Tony Rebelo, Sarah Venter, Ulrich Feiter

Summary
- We need more reliable resource assessments, but not everything is about new technology. In many instances, the appropriate way to collect information is on the ground.
- We need integrated systems, with local reporting feeding into national and regional reporting.
- Scale and plant type will influence the choice of technologies and methodologies. At farm-level, you need local knowledge and technology – like walking the site with a GPS device.
- We need to consider what scientists or local harvesters are measuring, versus what policy makers need to know. What do they need to develop sensible and practical policies?
- Data needs to be transformed into a usable format for policymakers.
- Technology requirements for the harvesting community, policymakers and industry are very different.
- Consider the objectives before selecting methodologies and tools - identify indicators of quality and quantity, and differentiate between local, national and regional mapping scales.
- Start with policies and methods already in place, and base new methodologies on available data. This will be challenging in other SADC countries.
- Who will collect and interpret different information sources? We need methods to determine accuracy and quality of data.

TOPIC: Expertise and support required

Participants
Neil Crouch (moderator), Marthane Swart, Dave Thompson, Wim Du Toit

Summary
- A range of expertise and support is needed for the development and implementation of a multi-stakeholder national resource assessment and monitoring programme, with collaboration, coordination and communication between all parties.
- We need to identify who is already involved and get clarity on what they are doing.
- Apart from technical expertise, we need a lobbyist to explain to government and others why a national resource monitoring plan needs investment.
- There is also a need for fundraising and communication functions. Other issues included the expertise which can be derived from communities (especially where access to land for surveys is concerned), and the role of international certification bodies (they have data and can support knowledge management).
- Other stakeholders and areas of technical expertise required:
  - Ecologists and naturalists
  - Statisticians
  - Experimental design and methodology
  - People keeping up with technology changes
  - Big data scientists who do large modelling exercises
  - Social scientists for the structuring and facilitation of multi-stakeholder processes
- It is important to get buy-in and involvement from industry, which should get involved in the development of strategies and methodologies.
- Access to industry-generated reports will go a long way in supporting resource assessments.

- SEAOPA has 116 members (25 wild harvesters) who can give access to land. It can verify information from members, and liaise between primary stakeholders and those involved in the national resource assessment and monitoring programme.

Other relevant stakeholders

- Land owners and managers to provide access to monitoring sites.
- Communities and organisations that work with them.
- Certification bodies do not usually employ scientifically-robust measures of resource assessment and sustainability, but have access to local data and international expertise.
- Provincial authorities, especially for access to sites and for the streamlined issuing of permits needed for resource assessment and monitoring.
- Economists to demonstrate the link between resource assessment, sustainable supply and market access, and motivate for resource assessment from a value chain point of view.
- International partners with access to data and resources.

Funding

- Access to funding will assist the implementation of a national resource assessment and monitoring programme. Expertise is needed on the funding environment and how a funding strategy can be structured.
- It is unlikely funding will come from government, so there is a need to engage international agencies who have a vested interest in promoting sustainably and ethically sourced natural resources for their home markets.
- Corporates could be lobbied to support resource assessments (e.g. Distell funding elephant research linked to its Amarula drink).
- In accordance with the Nagoya Protocol and national legislation (NEMBA), some ABS funds should be channelled into resource assessments and monitoring.

TOPIC: Coordination, collaboration and standardisation of approaches to assessments and monitoring; reporting, knowledge sharing and data protection

Participants

Sandra Kruger (moderator), Suzanne Herbst, Albert Ackhurst, Avril Harvey, Gus Le Breton, Jenny Wong, Kate Mole, Michele Walters, Preshanthie Naicker, Suhel al-Janabi

Summary

- Coordination needs to start at a national government level. SANBI chairs the Scientific Authority, and BioPANZA is the coordinating authority. The latter plays a role at provincial level.
- A stakeholder map is required to detail monitoring and coordination roles. Biodirection flow maps are also necessary.
- With respect to standardisation, there needs to be a specific monitoring focus across sectors. We need to consider different types of sustainability.

The following necessary steps and requirements were identified:

- Finalise goals, identify policy outcomes and develop a process flow.
- This planning needs to happen at national government level, particularly to select the methodology, research and its standardisation.
- Government, rather than industry, needs to identify control sites to ensure no bias.
- Resource assessment can also be done by paid community members.
- SANBI should conduct or commission resource assessments.
- BioPANZA has the coordination capacity. It can form hubs for different natural products in the form of Communities of Practices (CoP). Outcomes from the different CoPs will feed back into the national BioPANZA network.
- Regional and provincial hubs need to consider that some natural resources are wild harvested and some cultivated; and there are taste, appearance and quality differences between regions (e.g. Marula fruit tastes vary by region).
- All sectors need organisations to survive and grow. The sector organisations form a direct link between harvesting communities and other stakeholders.
- The sustainable supply clusters can set up regional monitoring.
- There is a need to map stakeholders and their roles in monitoring and coordination.
- There is a need for a monitoring architecture to see what resource assessments were done provincially; and this needs to feed into a scientific mapping exercise on a national level.
- There is a need for a flow map of the process of standardisation to link different sector associations through BioPANZA to national level; this will be useful when introducing a national standard for each resource.
- There is a need for specific monitoring practices across taxa and across sectors, as resource specific as possible; but satellite images for Marula can also be used for Baobab, so there are possibilities for standardisation within groupings.
- Union for Ethical Biotrade (UEBT), GeoBon and FairWild standards to be used as part of the indicators.

TOPIC: Integrating rural communities and local stakeholders

Participants
Serole Sehona (moderator), Jeanette Clarke, Allan Basajjasubi, Amy Blair, Karen Swanepoel

Summary

- The discussion focused on how local resource users can be involved. A number of people are involved at local level with communities. There are existing legal frameworks – both national and international – for involving local users.
- It is essential to build on existing practices and traditional knowledge held by local resource users – and to combine this information with scientific knowledge. Traditional knowledge is a gateway for involving local communities, but this group has historically been excluded.
- Stakeholders differ according to the context and type of resource. The longer the value chain the more stakeholders there are.

How do we involve stakeholders in resource management?

- Local users are at the start of the value chain and custodians of the resource.
- Build on existing practices and traditional knowledge in resource management.
- It is important to ensure equal distribution of benefits across the value chain.
- Traditional knowledge integrates social, spiritual and material values of the resource.
- Traditional knowledge is a gateway to involving users in management of the resource, through giving recognition and protecting rights.
- Develop access points and mechanisms for local involvement in resource management, acknowledging that top-down approaches have traditionally excluded local communities

Other priorities:

- Develop best practice guidelines to address inherent power imbalances.
- Establish communication channels.
- Ensure community spokespeople are given a voice from the start.
- Make use of existing legal frameworks to promote community involvement.

Discussion and Q&A in plenary

- We need to consider the role of academia and students, linked to training, and the contribution they can make to ongoing monitoring and assessments.
- There is a huge task to coordinate between communities, methodologies, technology, resources etc.
- Neil Crouch (SANBI): SANBI is very open-minded about its potential role and does have a mandate to become involved. We want to hear whether the community sees SANBI playing a leadership role. At the same time, we are looking around at other parties like SAEON, and whether we should support organisations with systems already up and running.
- Sebataolo Rahlao (SANBI): In terms of roles and responsibilities, we need to consider which institution has the strength or legal mandate to take matters forward. SANBI gets its mandate from NEMBA. SAEON gets its through NRF and DSI. Unless you have a mandate dashboard, you will not be able to assign roles and responsibilities, and incorrect bodies may be given incorrect duties.
- Glenn Moncrief (SAEON): The role of SAEON is long-term monitoring and there are various sites around the country, but activity is not necessarily going to expand to cover the sort of monitoring needed. SAEON is a repository for knowledge and data. People need to come to SAEON with needs and some sort of design; we cannot do it without stakeholders raising their hand.
- The high-level monitoring of low value resources that are not threatened is not sustainable.
- The only sustainable way of monitoring and closing the loop is giving the right to benefit, and obligation to monitor, to the community, and providing a clear understanding that monitoring is necessary for benefit.
- The traditional botanical models of assessment are not going to happen. Offer schoolchildren 20c airtime for information on every resource you're trying to monitor, increasing this amount the further the resource is from their village. Have the capacity to collect that information and map it spatially. There hasn't been money to monitor resources before, and after Covid-19, there will be other priorities. It's not going to work like other monitoring programmes.
- Natalie Feltman (DEFF): The DEFF can cover costs for resource assessments, and we need assistance to develop terms of reference. But we can only cover these assessments linked to the biodiversity economy. Other species - Cycads etc. – are not in scope.

Review of regional resource assessment and monitoring for Marula

Prof Gillian McGregor and David Kinsler, Rhodes University

Marula in a farming landscape in Mpumalanga, South Africa. Image: ABioSA/Jonathon Rees

The afternoon sessions focused on regional resource assessments and monitoring, with an emphasis on Marula.

This presentation covered a GIS-based approach to regional resource assessments, with reference to Marula in ten countries, and with examples from a South African data set. Resource assessments were considered at three scales:

- Regional - 1:15,000,000
- National - 1:5,000,000
- Local - 1:5,000 (individual Marula trees visible)

The presentation addressed assessment methods and their limitations, and provided some resource estimates for South Africa. It covered the development of principles and an approach to identifying sites for long-term monitoring.

Assumptions and limitations

- There are large differences and variables between different species in different territories, and many variables that a desktop approach can't cater for.
- There are multiple stakeholders, ranging from buyers of products to harvesters, for whom a resource is their only source of income.
- Existing research has an uneven distribution and focus, ranging from emphasis on plant biology to a focus on livelihoods, and so is difficult to compare.
- Resource assessments are characterised by uncertainty.

Some of the available software

- ArcGIS is available through commercial licence
- QGIS is free online and has a good support community
- MAXENT is also freely available, as are its datasets

Data sets

- High-resolution data sets in SA are freely available from government organisations like CD, NGI and SANBI.
- Many global data sets are available at good resolution and are improved annually, and can be suitable for use at a regional scale.
- Satellite imagery is available for any part of the world at varying resolution (and cost).
- Google Earth with 0,5m resolution is freely available for any part of the world.
- GBIF is a collection of species locality information from around the world that has been submitted by national museums, herbariums etc.

Methods used

- We have data inputs, then we process that data, and the output is in the form of a map from which we can get information about plant resources, concentrations, conditions etc.
- We used locality records for Marula from GBIF, selecting 300 good data points from 3,000 records for Southern Africa, then input bioclimatic variables such as temperature, rainfall, cold months, hot months etc.
- That locality data and searches across the spatial extent of the data, for sites which have similar characteristics, enables output of a modelled distribution map. This process is rigorous and has been tested internationally for 15-20 years, and the software is easy to use.
- The MAXENT model provides a regional or national scale map of Marula distribution, including probability of distribution. This is a rigorous and defensible method, but may produce results that need to be filtered out.

Probability of distribution

Out of a total area of the region of 6.3 million square kilometres, the model predicts Marula across 2.1 million square kilometres.

Sometimes the locality data is limited and biased – sometimes we get good data along roads or near research centres. It doesn't account for places where there is competition between species, or where species were removed or introduced. In some cases a probability map shows areas where there should be Marula but isn't, or where the model doesn't detect Marula that is present.

The second model uses standard GIS methods of selection according to criteria of thematic data layers relating to the occurrence of Marula. We combine this cartographic model with the MAXENT model to get a better output.

By mapping bioregions, elevation ranges and landcover types where Marula occurs, a refined map can be created based on a thematic analysis using GIS. At the regional scale, that's the distribution we get using only the WWF bioregions, and excluding areas which are densely settled urban areas.

Continued on page 26.

National scale mapping for Marula

Probability of distribution using MAXENT (SA)

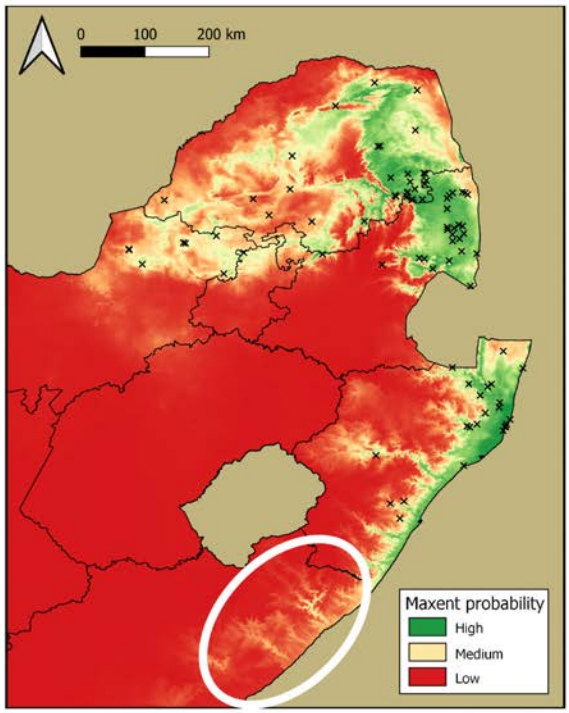


Figure 1: Full probability map

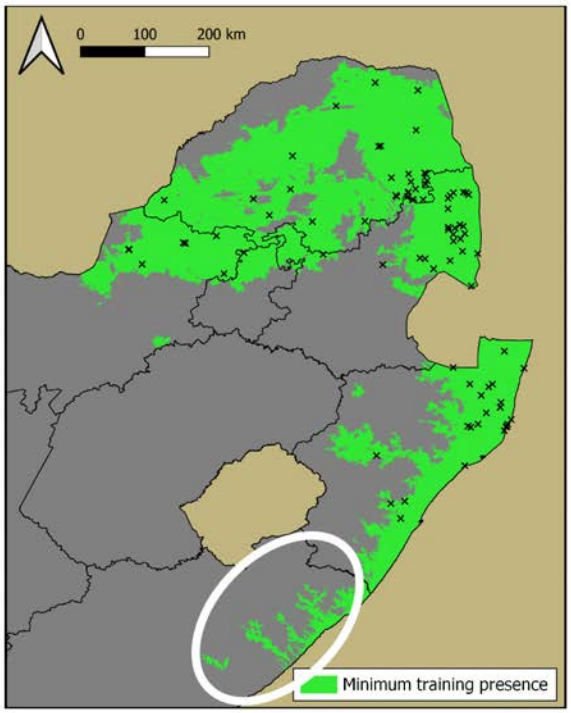


Figure 2: Binary map - High Probability vs Not Present *199 273 km²*

Marula distribution for South Africa

Regional scale mapping for Marula

Probability of distribution using MAXENT (SADC)

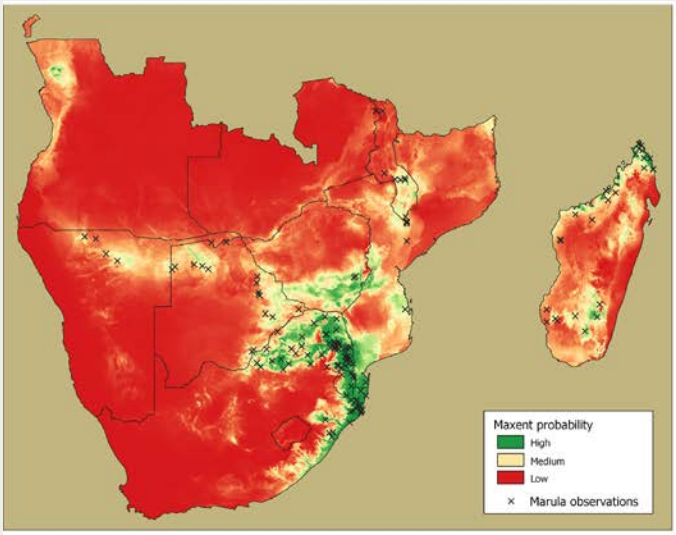


Figure 3: Full probability map

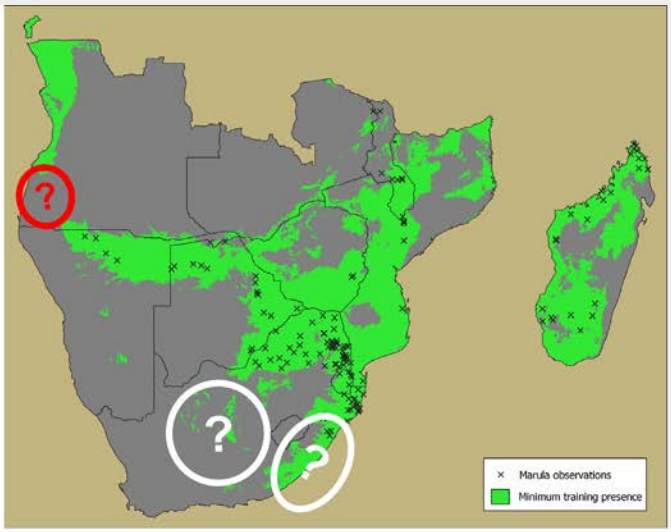


Figure 4: Binary map – Medium to High Probability vs Not Present *Xxxxxx km²*

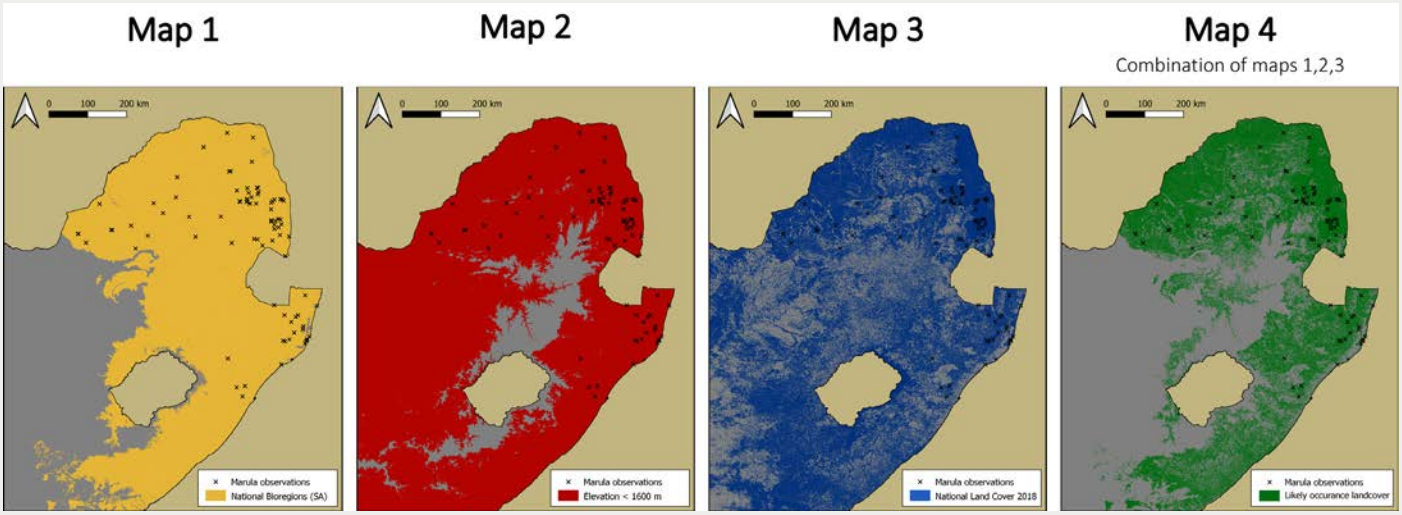
Marula distribution for SADC region

We combine those two cartographic models into a third model. We combine the GIS map and the MAXENT probability of distribution map, as well as expert inputs and local knowledge. We exclude protected areas (because we're interested in harvesting) and the output is a potentially harvestable area of Marula in SA of about 103 thousand square kilometres. It's an estimate we think is better than previous ones.

We then take the data on Marula yield and add it to our maps, providing a conservative estimate of what the yield might be. For example, we extrapolated a stem count and potential fruit yield, which in SA is 8.1 million tonnes. We've restricted this to harvestable areas in communal lands, because it's unlikely to play a big role in commercial farming where fields are often mechanically cleared with no consideration for Marula trees, versus communal areas where trees are often very well cared for.

National scale mapping for Marula

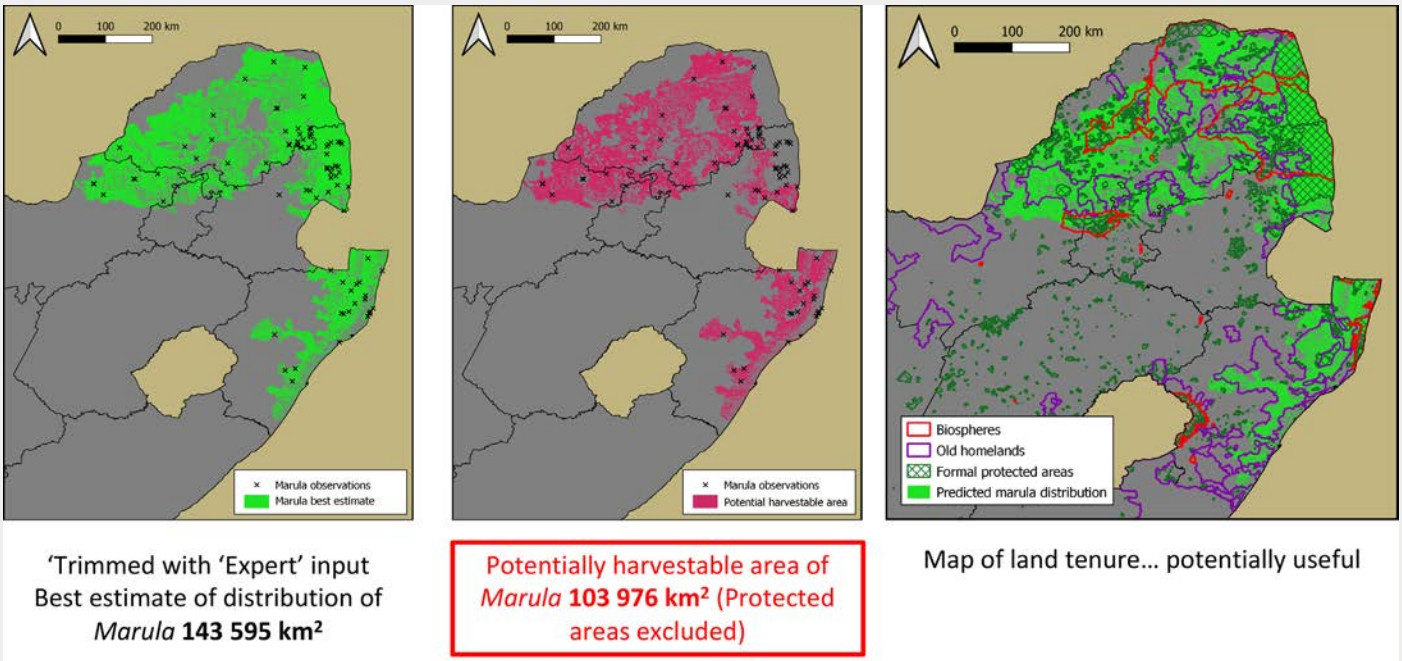
Distribution map using GIS



Likelihood of Marula distribution based on three variables

National scale mapping for Marula

Distribution map using GIS

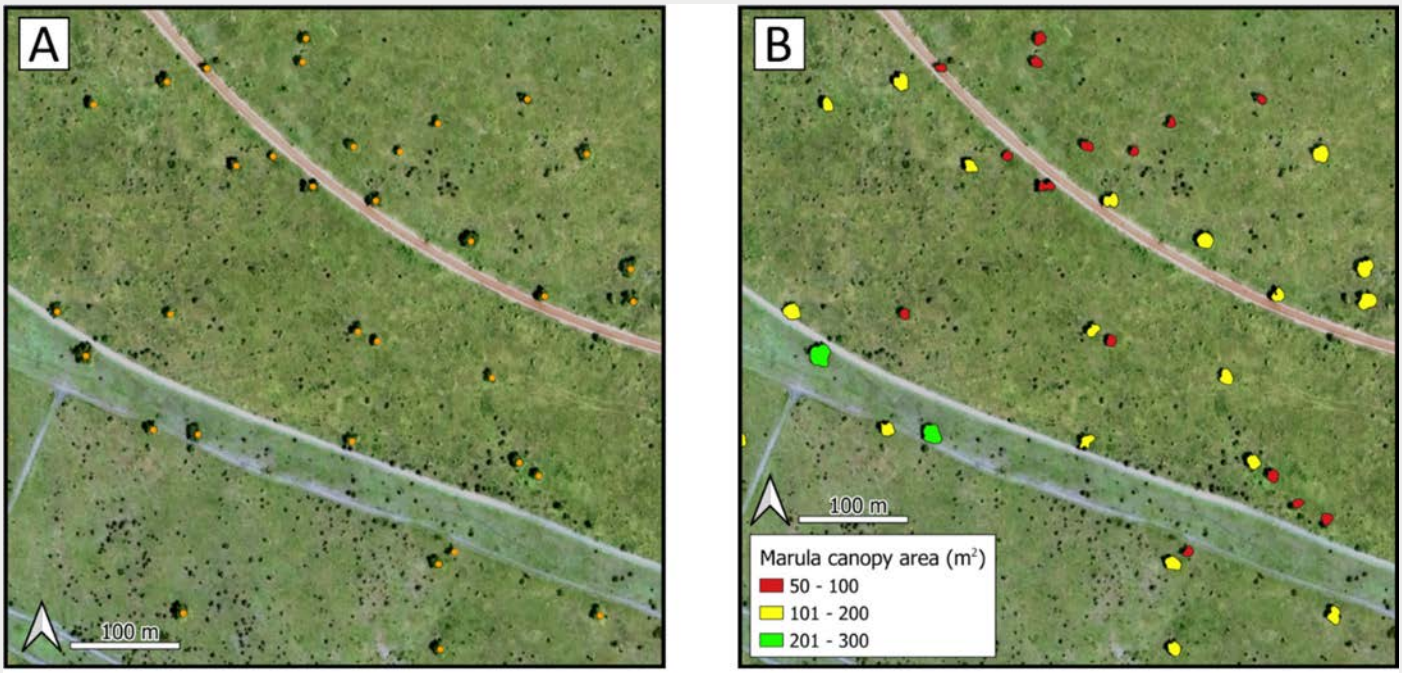


Combined MAXENT and GIS-based mapping give a best estimate of potential Marula distribution

Local-scale mapping
Methods and data sources are different for local scale mapping. There are different sources of high-resolution imagery. The most popular is satellite imagery that varies in resolution and price. For example, Sentinel is open-source and free but if you want high-resolution then Planet, Scope and Maxar are available at a cost. Some countries have access to good time series aerial photography via national mapping agencies. In recent years with drone technology we've had access to more imagery and that presents exciting opportunities.

Local scale mapping examples for Marula

Manual digitising

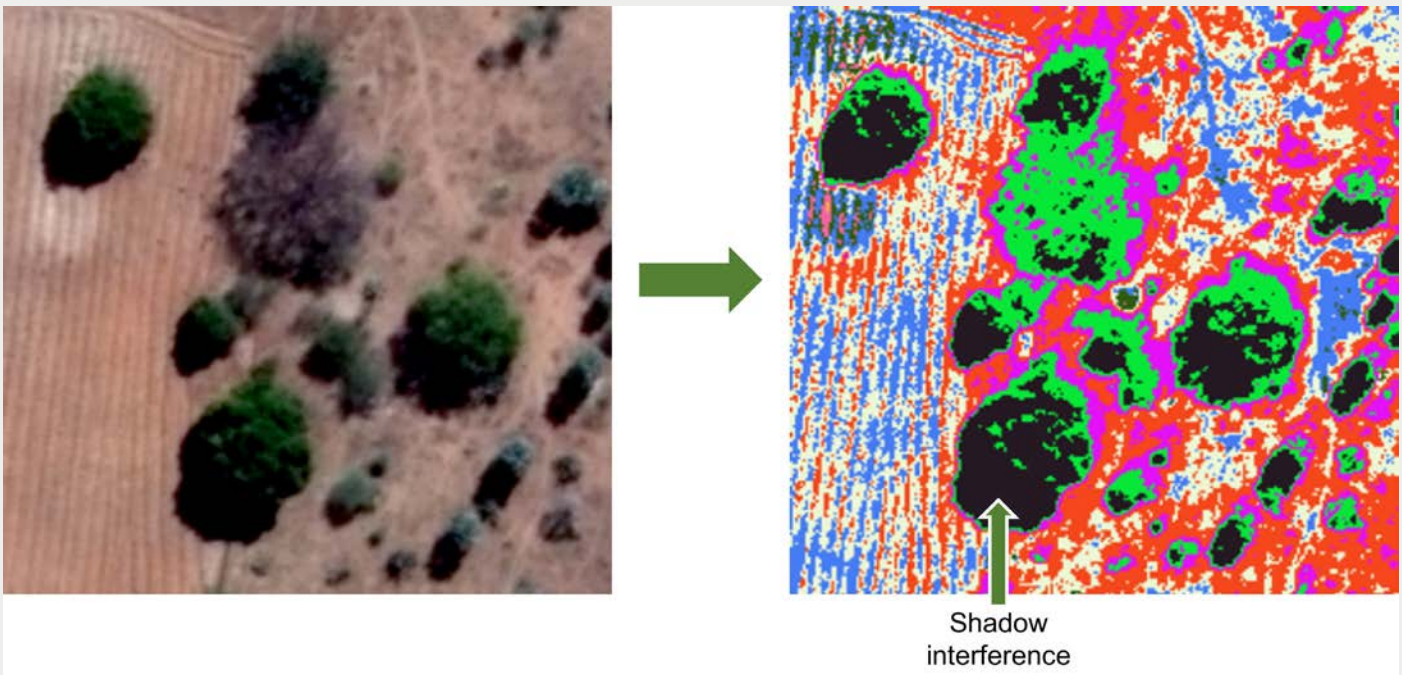


Worldview-2 Imagery, central Kruger Park, South Africa

Manual digitising requires only basic GIS training and software. A trained user can achieve very high accuracy with this method, particularly in areas where the plant species is spectrally similar to its background. This WorldView image from the central Kruger National Park illustrates such a case. There was high spectral similarity between trees and grassland so it was easier to digitise. Left is count data, right is area count of canopy, which can confirm age and fruit yield.

Local scale mapping examples for Marula

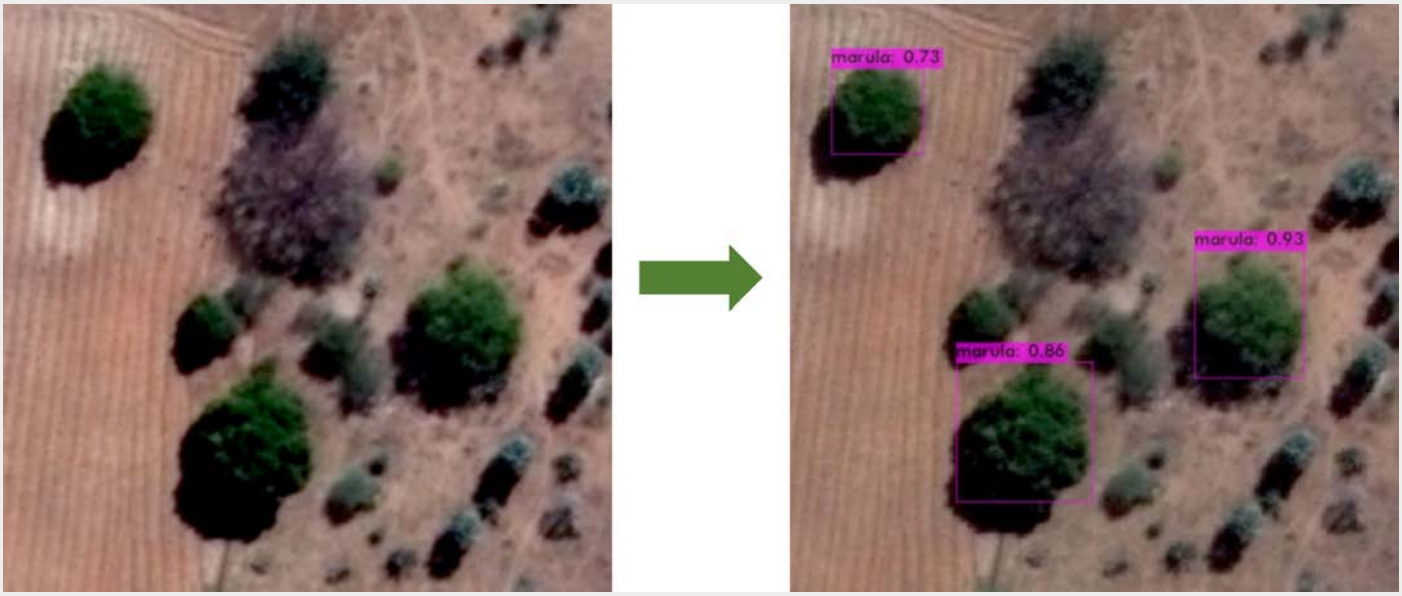
Image classification: e.g. Unsupervised classification



Automated image classification techniques are steadily improving in their scope and accuracy. Traditional image classification can still have limitations, like in this WorldView image from northern-central Namibia with heavy tree shadows. We recommend using a more advanced method, which is object-detection, a type of deep-learning technology only accessible in the last few years. The key to doing this is to train it on a lot of samples and teach the computer what a Marula tree looks like.

Local scale mapping examples for Marula

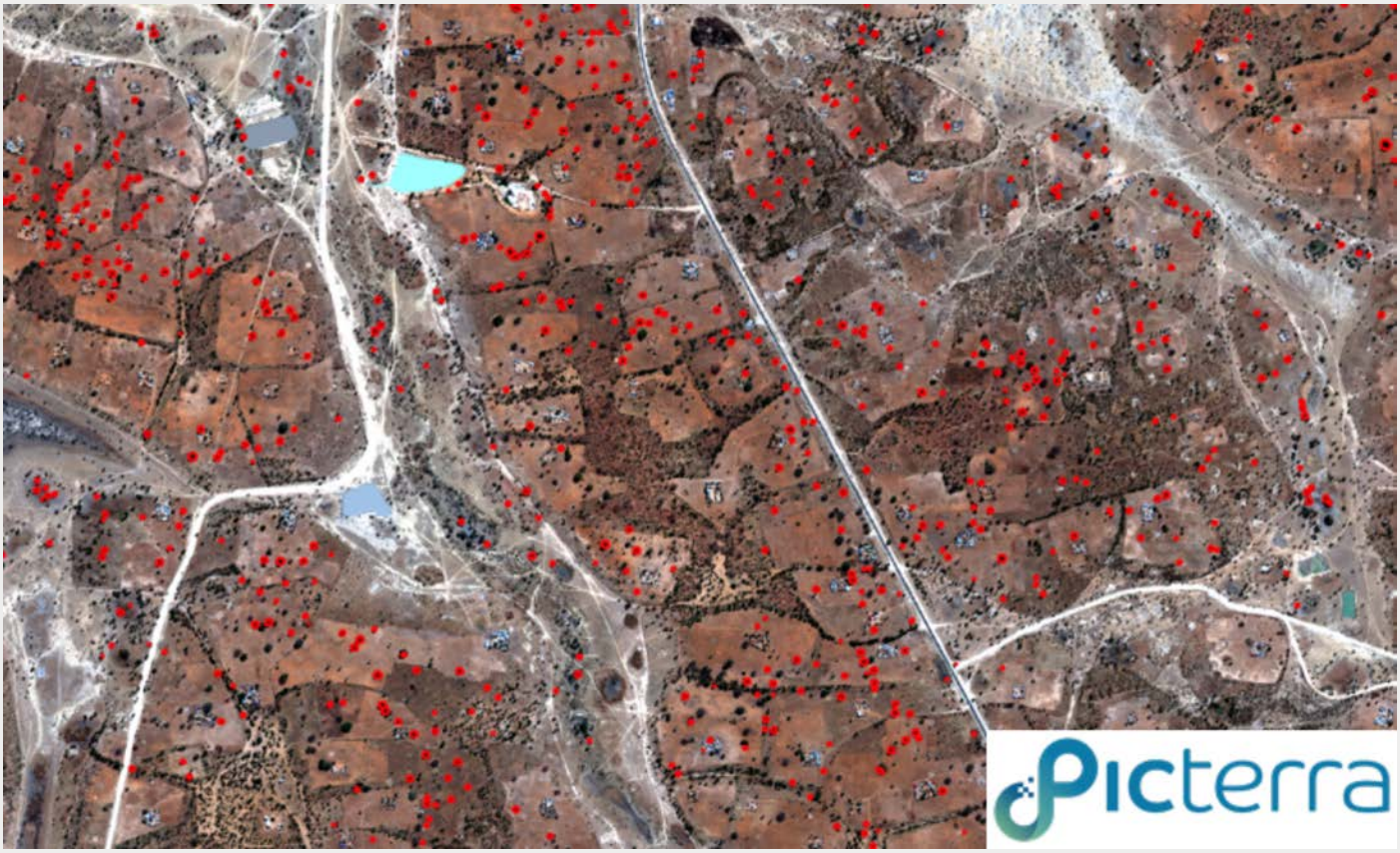
Image classification: Object detection



Another method of image classification is called object detection. Rather than individually classifying each pixel of the image into a specific category, it looks at the entire image and identifies certain shapes, colours and patterns it has been trained to identify. This is done through neural networks, a sub-category of deep learning. It requires training images from which it 'learns' to identify a specific tree. This method is most powerful when species such as Marula or Baobab are distinct from their surroundings.

Local scale mapping examples for Marula

Object detection



With object detection, using a service such as Picterra, we can train the system to detect objects across a landscape far quicker than a human user could.

Field verification

None of this remote sensing is worth anything without proper field verification. Species like Pelargonium are difficult to map from the air and need primarily - if not entirely - ground-based mapping approaches, but any species needs field verification.

Concluding comments

- There are many suitable and available resources that can contribute to a methodical and rigorous GIS-based desktop approach.
- Aim to use repeatable and reputable methods/tools/software at national and regional scale as a starting point for distribution mapping.
- National scale assessments can be done in greater detail depending on the availability of suitable and accurate spatial data.
- For local mapping there is tremendous potential for desktop method development, which can feed in to national/regional scale.
- Monitoring site selection should have a clear aim and consider species-specific requirements, logistics and existing focus areas.
- All of the above must be verified and supported by coordinated field data collection across various areas of survey.
- There is no recipe book of methods applicable to every situation.

Q&A with presenters

Q: Are you able to use similar techniques to determine density, or does that get overlaid from local knowledge or local surveys?

Gillian: We can get densities with some of the methods but need to verify the information with ground data to confirm that trees identified are in fact Marula.

Q: Is there any intention to investigate the impact of open mine tailings on Marula? The literature shows there were studies, but nothing done about the findings, including heavy metals in water, soil samples and fruit. Marula is mostly found in mining areas, specifically on the copper belt across Botswana, Namibia, Zambia and Zimbabwe.

Gillian: The human influence is difficult to factor in unless you get information from the ground. Software can be used to identify mining dumps and the associated presence of Marula.

Q: Would we not miss potential tipping points if we only focus on adult trees? Would we only identify a lack of recruitment when it was too late? There needs to be other sampling.

Gillian: We're looking at what we can see on an image. We can see young trees but no seedlings. Field surveys are the only way to get this information. You might monitor your sites with remote sensing, but need a scheduled annual visit to check recruitment.

Q: With respect to the costs of tools, what is a good mix? Where do we see the cost-related limitations in applying these tools sustainably.

Gillian: The regional and local scale methods described use freely available data and software - so you can produce that level of data at no cost. We can get 25cm resolution. We've got incredibly high-resolution free data. For other parts of the region, Google's imagery is 50cm resolution, which is free and pretty good. If you want better, you commission data sets, but then you're running into costs. A LIDAR survey of 50 square km is about R100,000. Drone surveys cost about R10,000 per day of flying and might cover a farm of 20 to 50 hectares, so those costs are high or prohibitive.

Q: What is the classification accuracy for these methods?

Gillian: Objective detection methods return a certainty value, with ranges from 75% to 100%, and you can set it to pick a level of certainty. But you have to go and check on the ground.

Comments from delegates

- The cultivation and harvesting sectors need to be able to make judgements about what tools to use, and whether current practices are good or bad, and to convince the authorities that they are sustainable. This requires a practical guide based on academic work, to show the options for local-scale resource assessments and monitoring.
- A survey done in Namibia used assumptions from Finland to say that trees would not be present on areas identified on a map as farmland, but this was wrong.
- With Marula, there's a lot of complexity with regard to human-ecological interface. For example, on commercial farms in Mpumalanga, Marula trees are not preserved, but in other areas they're very well looked after.
- There are legal implications for flying drones for surveys. There are complications with flying drones across private property. There can be legal obstacles to the use of technology.
- Remote sensing can detect the health of plants under different conditions, such as during a drought. NDVI is a common method of inferring plant health. Most of the data sources we spoke about are multi-spectral. You can get near-infrared and short-wave infrared, and these are useful in detecting plant health.
- How much we can harvest was a question in sustainable Baobab research. What came up as surprising was that it doesn't matter how much you leave for recruitment, if you have goats all the seedlings are eaten. We make assumptions about recruitment and fruit production, but there's so much micro information that needs to be fed into the resource-based monitoring. For example, with Marula and Baobab, trees are different from year to year. Within a landscape 50% of trees don't produce fruit at all. So there's broadscale information about

density, distribution, health and productivity. Fruit production is easy because you can count the fruit, but not if you are harvesting another part of the plant, which requires information about how fast the plant is growing, climate information, landscape management etc.

- That's really where the broadscale data can be made much richer by local knowledge, and using technology that contributes to the knowledge base. It needs a citizen-style approach. Assumptions are concerning - e.g. that you can have a Marula harvest of X and it's not going to change every year, an assumption policymakers will make. It doesn't matter how much you say Baobabs aren't dying of climate change, people don't believe it. You can't harvest the same Marula fruit size every year - sometimes not year on year, sometimes not for decades. How do we keep information current so it doesn't become dangerous to use?
- There are very smart traceability apps on smartphones that people distribute among farmers to take good photos of plant health, density etc. Those apps are looking at where people are harvesting or doing work etc; and they can centralise the data to the app's server, from which an analysis can be done.
- The situation is more dynamic than it's ever been before. In the past you could assume that a stock had a certain sustainable yield and if you stayed within it, you were fine. Now there's more at play with growing populations and climate change. Traditional methods have been overtaken by the pace of environmental change. You need a quicker iteration and shorter reaction time, and that argues in favour of local level monitoring.

Break-out group discussions

TOPIC: Regional-level opportunities and challenges for resource assessment and monitoring; Governance and management of regional resource assessment and monitoring - roles and responsibilities

Participants
Gus Le Breton, Jeanette Clarke, Kate Mole, Natalie Feltman, Neil Crouch, Sarah Venter

Regional-level opportunities and challenges for resource assessment and monitoring.

The opportunities for regional-level resource assessments are:

- Remote sensing techniques like satellite imagery can easily cover large regional populations that span borders.
- Collaboration with the NGO sector, in countries such as Zimbabwe, Namibia and Mozambique, focused on land-use and livelihood strategies.
- Some areas are covered by Trans-frontier Conservation Areas, allowing for cross border integration of resource assessments.

The challenges of regional-level resource assessments are:

- Without regional ground-truthing, remote sensing can get it very wrong. E.g. a remote sensing map showed a substantially-incomplete Marula distribution for Zimbabwe.
- The use of drones for resource assessments is difficult due to security sensitivities in African countries. Permissions are not easily granted.
- Assessment and monitoring data management is likely to be a challenge as each country has its own priorities and approaches.
- Duplication of resource assessments occurs due to poor communication.
- Coordinating and merging of data gathered from broad scale (remote sensing) and local level assessments is difficult to manage as it comes from different sources that vary in quality and type of data collected.
- Reliance on national herbaria records does not give a complete indication of distribution, nor does it reflect temporal as well as spatial aspects of distribution.

Governance and management of regional resource assessment and monitoring – roles and responsibilities.

Government

- Many African countries have not yet ratified the Nagoya Protocol, so there is not a common understanding or importance attributed to resource assessments as a tool for sustainability management linked to ABS.
- Regional coordination of assessments and data is easier between fewer countries and gets more complex as the number of countries increases.
    - Proposal: pilot a project in a few countries before involving the whole of SADC.
- There is very little political engagement between countries about resources. The discussions that are occurring are rather through sub-sector associations such as the Baobab Alliance.
- Coordination at SADC level is considered by some to be feasible, but only if the process is at a high intergovernmental level.
- National governments show no interest in resource assessment and management at a regional level. Only SA and Namibia have a bio-economy strategy, and it is difficult to engage with countries which don't have one.
- Embedding biodiversity economy strategies in states such as Zimbabwe and Botswana would allow SADC countries to find common ground for collaboration.
- The AbioSA project has helped to create national and regional cooperation. It has promoted subsector development planning and better governance and management practices.
- Governance and management could be picked up at SADC level, but would be more of a challenge at AU level.

Industry

- Industry has a vested interest in resource assessments, but the costs are often prohibitive.
- If industry does a resource assessment it owns the IP and has a competitive advantage.
- An industry or sector-driven regional resource assessment may be hard to validate given the IP aspects, and the international nature of the activity makes it difficult to regulate.
- Certification can play a role but it is expensive and can exclude small producers and under-resourced sectors. The certification principles involved in good governance and management could still be introduced into best practices for industry association members.
- Sectors can be self-regulated and this is worth exploring through NDF's and biodiversity management plans.
- Sectors that cover widespread regional species, such as Marula and Baobab, can manage regional data and resource assessments more easily than through regional governmental agreements. The governmental co-ordination route could take many years to establish.

TOPIC: Coordinating different regional approaches to collection and analysis of data; regional reporting, knowledge sharing and data protection

Participants

Caroline Jacquet, Lisebo Motjotji, Marthane Swart, Tony Rebelo, Sandra Kruger, Suzanne Herbst

Summary

- There are examples of coordination between countries, such as the Maluti Drakensberg Trans-frontier Management and SANBI Red List Assessment programme (Botswana and Mozambique)
- National ministries of environment have an important role, but are difficult to coordinate.
- There is a need for increased collaboration between national organisations working with regional species – perhaps through a regional coordinating body?
- There is a need to agree on what we collect and how we collect it, how we validate the quality of the data, and then how we share it.
- Most NGOs or academics would be happy to share data and information
- Different levels of data need to be treated in a different way for different audiences, but information sharing requires agreements. Locality-sensitive data is specifically protected.

TOPIC: Expertise and support required

Participants

Christoph Kleinn, Derek Berliner, Jenny Wong, Karen Swanepoel, Michele Walters, Ntando Nondo

Summary

- Funding is required for expertise and support.
- The scale will be different for each region, but the methods might be the same.
- Remote sensing and modelling will be required and will need to be verified.
- The goals and needs should be clear to avoid misunderstanding.
- Identification of tree species might be problematic as it is not always 100% correct.
- Smartphones, GPS and local knowledge of the environment should be combined.
- Testing of the models could be done by universities and research bodies.
- The approach must be one of adaptation as the research/project progresses.
- Citizen science was used effectively in similar initiatives.
- Sampling and technical support could be done with associations of groups within villages.
- Variation can be expected in different countries.
- Global forest management projects are a good example.
- High-resolution photos should be encouraged.
- TRAFFIC, CSIR, FAO, INAT, SAEON, DEFF should all be included as there is no representative body to do it all.
- Multilateral environmental policies are required in all decisions.
- The needs of the community and implementers usually only emerge at the end of a project.

TOPIC: Integrating rural communities and local stakeholders

Participants

Albert Ackhurst, Allie Douma, Amy Blair, David Harter, Friedrich zur Heide, Pierre du Plessis, Ulrich Feiter

Summary

- We looked at easy-to-use apps with which citizen scientists in harvesting communities could collect valuable data about the resource they are harvesting. People could be rewarded (e.g. with airtime) for every data point they provide.
- Focus should be placed on engaging the community and its members to take ownership of the resource they harvest and use or sell. A sense of stewardship needs to be developed – possibly via the Biocultural Community Protocol. Where possible, the resource holders and harvesters could be made to feel part of the value chain higher up – e.g. a link to the end user of a finished product.
- We explored buzz words like industry, communities, resources etc. - each is by no means cohesive or homogenous. Each community will have its own view on resource use.
- Access to land and land ownership plays a large role in how a group of harvesters will approach the crop in question. The concept of commonage as a 'free for all' is not enticing to anybody to invest into a resource.

TOPIC: technology and methodologies

Participants

Cyril Lombard, David Kinsler, Gillian McGregor, Jan-Peter Mund, Serole Sehona, Suhel al-Janabi

Summary

- The data is mostly found in SA, but a Namibian atlas of major trees is available.
- There is a lack of regional data sets.
- There is a Marula private sector operator in SA and Namibia that can be linked with resource assessments. Their objective is the traceability of the resource.
- There is a need to get industry/producers organised to collect basic information on species (e.g. how much of the resource is available, where it is harvested/ collected) as part of the SDPs.

What is clear is that a successful biotrade sector must have sustainability at its heart. That in turn requires adequate knowledge of the resource, how it is used, how stable it is, and what the drivers of change are. This is the role of a future coordinated resource assessment and monitoring programme.

- A challenge that was raised with mapping Marula in other SADC regions is the population variation.
- There are technologies that can track where people are harvesting, which are widely used in the fruit industry.
- It was suggested that remote sensing be integrated into the BCPs being developed by Natural Justice, and linked with traceability, quality etc.
- Remote sensing has improved and technology for gathering data on species is reaching the ground level. The key challenge with remote sensing is getting accurate taxonomic data without doing the groundwork.

Comments in plenary

- Communities need to be enabled to create value by not just selling the resource but becoming part of the future value chain.
- Coordination and communication are essential. Costs and funding are an issue. Different regions have different scales and licensing requirements.
- Smart phones and local knowledge can be combined, but skilled people are required to coordinate.
- All remote sensing has to be constantly verified. Harvesters using smart phones may face challenges with power and connectivity.
- Data collected requires a skilled process coordinator to do statistical modelling.
- Some regions have good NGO involvement and resource assessments are done willingly, but the challenge is a lack of resources and a need for training.
- Coordinating information is a challenge, and there are a lot of duplicated resource assessments.
- Another challenge is the quality of data collected, and how it is merged and compared between regions. There is a need for an accepted way to collect data for comparison.
- There is more opportunity at a regional sector level driven by industry, with industry-level monitoring and data management; that could be self-regulated or regulated by governments or by certification.
- The question is who should lead and maintain the programme, and who has the mandate to drive it. There is currently no clear leader with a mandate to take responsibility. The solution is to get all organisations to talk about their mandates, future roles, and collaboration.
- Resource assessments need to be integrated with industry, with the inclusion of industry organisations.
- There is a need for funding, but funders need a concept. This could be developed in a second phase of ABioSA, and could include the establishment of governance and institutional arrangements.
- Projects like ABioSA have a short-term lifespan, and will end before the conclusion of a long-term monitoring programme that should run for decades. South African and Southern African institutions and stakeholders are responsible for ensuring that systems for a long-term monitoring programme are in place.

Closing remarks

Delegates at the workshop agreed that communities need to be integrally involved in resource monitoring

Dr Sebataolo Rahlao
Director: Biodiversity assessment, SANBI

Thank you to the speakers, the organisers from SANBI and the ABioSA project, to the consultants, and to all of the delegates. I have been impressed by the high calibre of discussions, and the expertise on display from a wide range of disciplines along value chains. I am sure we have all learned a lot about the fast-moving technology and sophisticated methodologies which underpin resource assessment and monitoring.

What is clear is that a successful biotrade sector must have sustainability at its heart. That in turn requires adequate knowledge of the resource, how it is used, how stable it is, and what the drivers of change are. This is the role of a future coordinated resource assessment and monitoring programme. The opportunities for co-operation and collaboration at both national and regional levels are to be welcomed.

I believe we made significant progress today towards the workshop aims. We look forward to your future involvement in building the biotrade sector, on the basis of accurate, coordinated and useful data about our rich biodiversity in Southern Africa.

Appendix A: Workshop programme

Timing	Session	Speaker
09h00	Welcome and setting the scene	Natalie Feltman DFFE
09h05	Aims of the workshop	Adrie El Mohamadi ABioSA
09h10	The role of resource mapping and monitoring	Prof Neil Crouch SANBI
09h20	Sector development plans	Sandra Kruger KSA
09h30	Review of SA national resource assessment and monitoring	Derek Berliner Eco-Logic/LIMA
10h15	Questions for presenters	Moderator
10h30	Towards a future national resource assessment and monitoring programme	Group discussion and Zoom breakout rooms
11h30	Report back and next steps	
12h00	Break	
12h30	Review of regional resource assessment and monitoring for Marula	Prof Gillian McGregor & David Kinsler, Geography Department Rhodes University
13h15	Questions	Moderator
13h30	Towards a future regional Marula resource assessment and monitoring programme	Group discussion and Zoom breakout rooms
14h30	Report back and discussion about next steps	Moderator
15h00	Summary and close	Dr Sebataolo Rahlao Director - Biodiversity Assessment at SANBI

Appendix B: Workshop delegates

Name	Organisation
South Africa	
Cyril Lombard	ABioSA (consultant)
Adrie El Mohamadi	ABioSA (GIZ)
Derek Berliner	Eco-Logic/LIMA
Ullrich Klins	BIA (GIZ)
Motlatjo Maputla	BIA (GIZ)
Dr Moses Cho	CSIR
Michele Walters	CSIR
Sechaba Bareetseng	CSIR
Natalie Feltman	DEFF
Preshanthie Naicker	DEFF/GEF 6
Albert Ackhurst	Department of Environmental Affairs and Development Planning
Dr Sarah Venter	EcoProducts
Mark Thompson	GEOTERRA IMAGE
Claren Chan	IDC
Johan Botha	IDC, Senior Agricultural Specialist, Agro-Processing & Agriculture
Marianne Strohbach	Independent consultant
Errol Moeng	LEDET, Biodiversity Management
Jeanette Clarke	LIMA (Consultant)
Johan Eksteen	Mpumalanga Tourism and Parks Agency
Dr Mervyn Lotter	MTPA
Sobantu Mzwakali	Natural Justice
Allie Douma	Natural Justice
Farzana Rahman	Natural Justice
Allan Basajjasubi	Natural Justice
Ulrich Feiter	Parceval
Avril Harvey	Parceval
Amy Marshall	PhD student social & ecological drivers
Amy Marshall	PhD student social & ecological drivers
Jonathon Rees	Proof Africa
Anzet du Plessis	Proof Africa
Benjamin Harris	Proof Africa
Yethu Dlamini	Proof Africa
Prof Gillian McGregor	Rhodes University
Dave Thompson	SAEON
Glenn Moncrief	SAEON
Wim du Toit	SAEOPA
Karen Swanepoel	SAEOPA
Neil Crouch	SANBI
Dr Tony Rebelo	SANBI
Dr Sebataolo Rahlao	SANBI
Tasneem Variawa	SANBI
Sandra Kruger	KSA
Marthane Swart	KSA
Kate Mole	TRAFFIC
Elsie Meintjies	UNIDO
Lisebo Motjotji	University of Free State
Dr Wilfred Mbeng	University of Mpumalanga
Tony Cunningham	Darwin University/Ethno-Ecology Services
SADC countries	
Gus Le Breton	Bio-Innovation Zimbabwe
Caroline Jacquet	Bio-Innovation Zimbabwe
Saskia den Adel	CRIAA SA-DC
Ntando Nondo	GIS and Remote Sensing Expert, Zimbabwe
Dagmar Honsbein	NANCI
Pierre du Plessis	SADC, Namibia
Leonard Dikobe	Veld Products Research & Development
Europe	
David Hartner	BfN in Bonn
Jan-Peter Mund	Eberswalde University for Sustainable Development
Andreas Drews	Germany ABS Initiative
Hartmut Meyer	Germany ABS Initiative
Suhel al-Janabi	Germany ABS Initiative
Friedrich zur Heide	Germany ABS Initiative
Prof Dr Christoph Kleinn	Gottingen University
Dr Lutz Fehrmann	Gottingen University
Simona D'Amico	UEBT
Rik Kutsch Lojenga	UEBT
Maria Julia Oliva	UEBT
Dr Jenny Wong	Wild Resource Limited/UK