Executive Director’s Message

“Looping backwards to leap forwards”

SASSCAL is currently transitioning from the first phase (SASSCAL 1.0) to the second phase (SASSCAL 2.0). This transition has been exciting to say the least. First phase research programmes are coming to a successful end as vividly shown by numerous peer reviewed publications and the SASSCAL Research Book that is currently being compiled. SASSCAL’s Capacity Development Programme has matured and we have witnessed the successful commencement of SASSCAL’s Masters Programmes. These MSc courses have been carefully designed and delivered at the right time in support of SADC’s Regional Integration Agenda (2005-2020) and the Africa Agenda 2063. A new and improved Open Access Data Centre (OADC) is under development, and plans are underway to handover the SASSCAL weather stations to relevant SADC countries. SASSCAL’s research agenda is positioning itself to respond to the “new norm”. Africa and SADC are getting hotter and drier, and it will stay the same in the future.

Even when it rains, it comes so unexpectedly resulting in floods, destruction of property, harvest and livestock. The warmer climates have favoured rearrangement of diseases and pests, and their reproductive rates are getting shorter and shorter, and because of the changes in the length and onset of the rainy seasons, we remain unprepared. The movement of people makes it even worse.

Because of excessive water use for agricultural, industrial and domestic use, our water resources are diminishing to vanishing point and because many of them are transboundary, no one country can address this predicament alone.

We can only save the Okavango Delta and manage better the Miombo Woodlands by using the integrated regional approach that SASSCAL adopts. This is because our SADC countries are interlinked by natural flows of biogeochemical cycles, ecosystems services and functions superimposed upon socio-economic drivers. This also demands an establishment of transboundary regulations and resource management within the region which is core to the SASSCAL 2.0 Research programme.

“Looping backwards to leap forwards” to SASSCAL 2.0 also demands a new calibre of scientists who have the required combination of subjects, geospatial analytical and visualization tools to detangle this complex phenomenon we are experiencing. It also requires knowledge brokers and science communicators to translate the science into information for decision makers.

Our impact depends on the needs of you; our stakeholder or customer. Your feedback will improve our product and service portfolio.

Thank you
Dr Jane M Olwoch
SASSCAL Executive Director
Africa’s Climate Change Science Centres discuss future sustainability

by Bianca Mutale
SASSCAL Regional Secretariat

On 19th and 20th of May 2017, the West African Climate Service Centre on Adapted Land Management (WASCAL) hosted a workshop on the Long-Term Sustainability of the organisation at the centre’s headquarters in Accra, Ghana.

WASCAL is a partnership of 10 ECO-WAS countries (Benin, Burkina Faso, Gambia, Ghana, Ivory Coast, Mali, Niger, Nigeria, Senegal, Togo) with Germany to address the effects of climate change. Like SASSCAL, this is done through the provision of climate services, climate research and capacity development.

The purpose of the workshop was to allow WASCAL management, research group leaders from its Competence Centre in Ouagadougou, Ivory Coast, and the Directors of the Graduate Schools in the ten member countries an open platform to discuss with stakeholders from various sectors, strategies, options and action plans for the future sustainability of WASCAL.

Participants at the workshop included Ghana’s Deputy Minister of Environment, Science, Technology and Innovation, Hon. Patricia Appiagyei, the German Ambassador to Ghana, H.E. Christoph Retzlaff, BMBF representative Mr. Gregor Laumann and Prof Jimmy Adegoke, WASCAL Executive Director.

Dr Jane Olwoch, the Executive Director of SASSCAL, was invited to provide perspectives from southern Africa. It is envisaged that both organisations identify common goals and work together for the sustainability of the respective organisations.

WASCAL and SASSCAL are expected to diversify committed income from BMBF by other sources in order to attain sustainability of the institutions. These sources include national contributions, the global donor community, traditional and non-traditional development partners, SADC, ECOWAS and the African Development Bank (AfDB).
The SASSCAL WeatherNet, a regional network of more than 140 Automatic Weather Stations (AWS), has been established as a central service facility that feeds weather data in close to real time via the cell phone or satellite network into the OADC that hosts a website (http://www.sasscalweathernet.org) providing weather information without time delay and free of charge. In addition, a number of statistics and other information is made available on the webpage at no cost.

The German Government has pledged to back the operation and maintenance of the network until October 2017. To ensure the long-term sustainability of the SASSCAL WeatherNet, a workshop was held in Windhoek from 4 to 6 April 2017 to review the current operational status of the network and to develop a strategy for its long-term sustainability.

More than 30 representatives from the meteorological services of the SASSCAL member countries and collaborating southern African and German universities, technicians and SASSCAL staff participated in the deliberations.

The representatives confirmed that, in addition to the improvement of the national weather observation efforts, the regional network and its online system are well received in the region and beyond. With the commitment of all delegates to ensure the stability of the network beyond October 2017, and implementing agreed upon models for the future maintenance and operation of the WeatherNet, SASSCAL is optimistic that the network will continue to provide real-time regional weather information to
the public and to the early warning systems operated by the national weather authorities in southern Africa.

Currently, the WeatherNet either transmits weather data from the AWS by GSM/GPRS or by satellite. The disadvantage of GSM/GPRS over satellite is the reliance on mobile service coverage and the associated monthly charges. For satellite transmission, however, no two-way communication to and from the AWS is possible and only small files can be uploaded.

The weather data created by the SASSCAL WeatherNet are made available via the WeatherNet website (www.sasscalweathernet.org).

The website was created and is still being maintained by the SASSCAL IT Team Hamburg. In addition, the team has ensured the efficient download, quality control and storage of the data.

The UHH team reported, that current challenges for the network include the occurrence of stations not transmitting and sensors being defect.

During the workshop, the Hamburg team reported on some exciting planned improvements to the website. These include enhanced data quality controls, additional graphical visualisations, the mapping of current weather data and enhanced data download functionality.

At the opening of the workshop, Dr Jane Olwoch, the SASSCAL Executive Director thanked the participants and informed that the value of an increase in the number of weather stations in SADC is a commendable step as it provides the much-needed climate observation that is critical in producing future climate change projections. In Africa, where there is an inadequate number of observation equipment, the SASSCAL weather stations are playing an important role.

She challenged the scientists to translate their climate observation into applications that are informing decision making in agriculture, water, health and other sectors - only then will their impact beyond scientific outputs be realised.

(Photos © Dr Katrin Josenhans)
Science and Meteorology for Sustainable Development

by Indie Dinlala
National Director of SASSCAL Zambia

The 18th Meeting of the International Council for Science (ICSU) Regional Office for Africa (ROA) Science Seminar was held at the Taj Pamodzi Hotel in Lusaka, Zambia, on 15th March, 2017, as a wrap-up to the main meeting that preceded it.

The Conference was held under the theme “Role of Science and Meteorology in Sustainable Development”, and the main objective was to understand the role Science, Technology and Innovation (STI), Telecommunication, Engineering and Meteorology is playing regarding sustainable development.

The seminar was officially opened by the Guest of Honour, Hon. Minister of Higher Education. Prof. Nkandu Luo and attracted participation from various Government departments and agencies, universities, the media and ICSU – ROA Board Members.

In her speech, Prof. Nkandu Luo, placed emphasis on the importance of science and technology for sustainable development in Africa. She challenged scientists to strive to always be adequately equipped to be able to swiftly respond to effects of climate change such as the recent infestation of army worms. Finding a solution to the problem will contribute to food security in the region. She further emphasised that science should be the backbone for the development of any country and that universities and research institutions should consider strengthening their research capacities.

SASSCAL supported and participated in the event, and Zambia National Node Director, Ms. Indie Dinlala, made a presentation titled “Towards Scientific and Evidence Based Decision Making”. In her presentation, Ms. Dinlala highlighted some key areas of achievement that SASSCAL has contributed towards the development of science in the region. She further indicated that ICSU and SASSCAL both have common goals and, therefore, urged ICSU and other science-based organisations to collaborate and complement each other in areas of research. Avoiding duplication will ensure maximising the available resources.

Mrs Susan Veldsman, Director of Scholarly Publishing Unit, Academy of Science of South Africa, gave a presentation on the African Open Science Platform that shares similar objectives with the SASSCAL OADC.

The seminar ended with a call for collaboration between ICSU and Zambian science institutions for the country to respond more efficiently to the effects of climate change.

In a speech read on behalf of the Permanent Secretary, Ministry of Communication and Transport, the Acting Director of the Zambia Meteorology Department, Prof. Joseph K. Kanyanga, cited that the role of science and meteorology in social and economic development is today more and more recognised and appreciated.
SASSCAL Agriculture Workshop

by Dr Kristin Krenkena
University of Hamburg

There are currently 20 SASSCAL research tasks focusing on assessments to understand the impact of land use on the environment under changing climatic conditions. The aim is to identify the resulting challenges and to gain insight through applied research in order to mitigate the negative effects and to find solutions that can be applied by farmers and stakeholders to better adapt to resultant environmental and socio-economic changes. Capacity development initiatives, including academic education and stakeholder training, are embedded as an integral part of the research tasks.

A technical workshop with 25 scientists representing Angola, Botswana, Namibia, South Africa and Germany, was held in Windhoek from 4 to 6 April 2017 to ensure an effective output of regional relevance with impact for SASSCAL stakeholders and to elaborate on the potential for synthesising the scientific research data, discuss options for joint publications and decision support for policy makers and farmers, and to identify potential future research topics based on the information gained.

The workshop focussed on four research topics:

1. farm management and crops, dealing with quantifying the effects of different management types on yield and seed production;
2. N-fixation through rhizobia, focussing on the use of legumes and associated bacteria to increase soil fertility and yields;
3. rangelands, considering the utilisation of rangelands as source for forage (game and cattle production) and mitigating problems such as bush encroachment, soil degradation, erosion, as well as the impact of fire as a management tool; and
4. socio-economic challenges, dealing with human-wildlife conflict and the challenge to households in buffer zones of conservation areas.

Working groups created protocols and timelines for joint publications in terms of data harmonisation and explored the potential for decision support in each of the themes. An important output of the workshop was the development of several integrated, overarching research questions for consideration under a further phase of the SASSCAL research portfolio.
SASSCAL OADC/KE Workshop

by Sylvia Thompson
SASSCAL OADC at Namibia National Node

Already at the beginning of the SASSCAL initiative, it became apparent that the southern African region was in dire need of a data centre that would ensure that information and the resources crucial to research and decision making processes are readily available.

Towards the end of 2014, the OADC/KE (Open Access Data Centre / Knowledge Exchange) materialised with the first two staff members being appointed at the Namibia National Node. Since then, every National Node of SASSCAL has employed OADC/KE colleagues and has established the infrastructure necessary to house data management systems and the relevant tools to develop products and provide services to its stakeholders.

“So, where is this OADC?” Well, you will see the OADC everywhere, where you see SASSCAL. Even though its team members can be found in the National Nodes of Angola, Botswana, Germany, Namibia and Zambia, you will see their work in many areas of SASSCAL.

Amongst others, the OADC created and maintains the SASSCAL website, the OADC compiles various publicity materials for SASSCAL, the OADC created this very newsletter, but more importantly, the OADC creates tools and portals such as the SASSCAL WeatherNet, the SASSCAL RainApp, and the SASSCAL Geo-Decision Support tool. Many SASSCAL Research Portfolio researchers have already benefited from the support of the OADC team.

In the next crucial five months of the SASSCAL 1.0 Research Portfolio, the OADC will ensure that the deliverables and products resulting from the invaluable research, conducted through 88 research tasks, will be assimilated, that essential descriptive documentation (metadata) on each product is available, and that the products are made accessible via an online catalogued platform, as far as possible and as fast as is permissible.

The way forward for the OADC was discussed from 22 to 24 May 2017 in Johannesburg during a workshop where experts from the industry, research organisations, service providers from various relevant IT and technical sectors, institutions of higher education and government departments shared their knowledge and experience from engagements in the southern African region.

Experts from the CSIR (Council for Scientific and Industrial Research), SAEON (South African Environmental Observation Network), PinkMatter, University of Jena, University of Hamburg, University of the Free State, the Zambia Research and Education Network as well as from the National Science and Technology Council contributed towards the future design of the OADC/KE.

The deliberations were supported by the presence of SASSCAL’s Executive Director, Dr Jane Olwoch, the SASSCAL Management Team as well as a representative of the Project Management Agency (DLR-PT), Dr Olaf Pollmann.

The Team

The technical Director of the OADC is Dr Jörg Helmschrott, who is the SASSCAL Director of Science and Technology.

The OADC team consists of technical experts, housed at each National Node of SASSCAL:

- Team Angola: Isáuí Quisindo
- Team Botswana: Charles Chibidika, Gadifele Thomas
- Team Germany: Gerhard Muche, Katrin Josenhans, Thomas Hillmann
- Team Namibia: Peter Erb, Sylvia Thompson, Michael Chamunorwa, Jose Junior
- Team Zambia: Benjamin Chifunda, Mutukwa Musole

These technical experts have either an IT background, data systems background or Geoinformation background.
The Immediate Priority

The team’s immediate priority is packaging the deliverables of the SASSCAL 1.0 Research Portfolio.

The scientists and researchers of the SASSCAL tasks are expected to produce a wide range of products, as per the original project definitions. Some tasks have already provided deliverables.

The OADC has to ensure that all these deliverables, ranging from reports, manuals and publications, to specialised data sets, data layers and even huge remote sensing products, are efficiently documented according to internationally accepted metadata standards, are quality controlled, are consistent and complete, and are safeguarded, but moreover, made available online via a catalogued data and information portal.

The Open Data Policy

SASSCAL pursues an open data policy. With the exception of very few instances, such as ensuring the intellectual property rights of data holders/scientists, all research results of the SASSCAL Research Portfolio will be made openly and freely available via online portals. However, pursuant to national laws and the pirating of SASSCAL’s data and information, a Data Sharing Policy will be put in place to ensure the fair use of SASSCAL data and products.

The SASSCAL IS

The OADC will use the SASSCAL IS (Information System) as its online data and information portal. In this regard, it is foreseen that the OADC will be collaborating with scientists of the University of Jena, who have created the SASSCAL IS. The SASSCAL IS is a web-based data management and data sharing platform, that was produced in the context of task 008 of the SASSCAL research portfolio. The look-and-feel of the SASSCAL IS will be adapted towards the SASSCAL corporate identity, but in its current form, it already makes available various hydrological data and information resources.

The Challenges

Even with technical expertise represented within the national teams, it remains a challenge to coordinate a team spread over two continents and five countries. In particular, in the southern African region, where internet speed and connectivity is unreliable and often intermittent, this presents a challenge.

Workshop participants also heard from the invited experts, that the internet challenges in the region still require a lot of creativity in providing access to data and information, especially when it comes to large data sets.

No doubt, another challenge felt by many regional institutions is the so-called brain drain effect. SASSCAL will ensure that the appropriate technical skills remain available in the team.

Beyond SASSCAL 1.0

As a regional non-profit institution, SASSCAL is in an unique position to cater for various transboundary or regional projects. The technical OADC team has already proven itself strategically indispensable to SASSCAL’s vision.

With a view towards the future and SASSCAL 2.0, the OADC will play a more active role in the composition of the new research portfolio.

Furthermore, the OADC will contribute to a number of projects, including an EU programme, SEACRIFOG, ARC/WFP, a platform for the Miombo Network, an environmental dashboard for the UNDP in Namibia and others.

The OADC also plays a role in regional capacity development, by providing stakeholders with the needed technical skills. A good example of this scenario was presented by Dr Francois Engelbrecht from the CSIR: within the context of SASSCAL Task 203, Climate Change and Impacts, he presented some of the anticipated climate change projections their project have produced. To a scientist, his maps and graphs clearly depicted a disconcerting future for our region. For the politician and policy maker, the results have to be assimilated in a format that ensures that the full implications are clear and understood.

Often, there is a strong need to bridge the technical gap between the researcher and scientists and the policy maker. The OADC will facilitate the creation of digestible products and services, to ensure that information and knowledge can be used for policy and decision makers.

Dr Francois Engelbrecht, from the CSIR, giving a riveting presentation on climate projections (SASSCAL Task 203: Climate Change and Impacts)
Regional Stakeholder Coordination Workshop:
Defining a Common Roadmap for Scaling-Up the Delivery of Weather-, Water- and Climate Services in Africa
by Dr Jörg Helmschrot
SASSCAL Director of Science and Technology

There are many actors in the weather and climate services field in Africa. International organizations, continental institutions, sub-regional and national entities are all implementing various programmes and projects with a view to improving the development, provision and uptake of weather and climate services. To emphasise the need for regional alliance around this important thematic area, the WMO, UNDP, the World Bank, the African Development Bank, AMCOMET, FAO and the Africa Climate Policy Centre have proposed a workshop to build synergies among key stakeholders on the continent.

Over 70 participants representing 34 organizations and 22 countries across Africa and the world attended the Regional Stakeholder Coordination Workshop in Saly, Senegal from 1 to 2 May 2017 to discuss the critical need for a coordinated effort in scaling-up weather-, water- and climate service delivery in the regions of Africa. The two main objectives for the workshop, namely

1. convene key regional stakeholders engaged in climate services to develop a common understanding of their initiatives, mutual roles and impact, and
2. define a Common Roadmap outlining how to deliver coordinated climate services by joining forces

were jointly addressed by productive discussions. SASSCAL contributed to the discussion by presenting the SASSCAL WeatherNet as a regional effort and its commitment to further contribute to the regional initiatives of the WMO, SADC CSC, the national meteorological services and research institutions in providing science-based weather and climate services for the SADC region.

The event was convened by the Global Framework for Climate Services (GFCS) and jointly organised by the World Meteorological Organization (WMO), United Nations Development Programme (UNDP), the World Bank, the United Nations Economic Commission for Africa (ECA/African Climate Policy Centre) and the African Development Bank (AfDB), expressing a common desire to work together to compile a common plan of action for improving climate service delivery.

More information can be found on: http://gfcs-climate.org/saly-coordination-workshop

(Arame Tall and Fatema Rajabali contributed to this article.)
The 37th International Symposium on Remote Sensing of Environment (ISRSE-37) took place in Tshwane, South Africa from 8 to 12 May 2017. The theme was “Earth Observation for Development and Adaptation to a Changing World”.

The 2017 Symposium was the second time in this millennium that the African continent hosted the ISRSE. It coincided with the implementation of the recently adopted African Space Policy and Strategy, as well as rapid development in the African space science and technology programmes.

Altogether 638 abstracts from 53 countries, covering 55 topics were received. The abstracts were reviewed and scored by the Technical Programme Committee which is made up of more than sixty leading research and industry experts.

There were five Plenary sessions: 1. Support of Space Agencies to the UN Sustainable Development Goals Plenary 2: Showcasing the Socio-Economic Impact of Earth Observation Plenary 3: Earth Observation for Global Change Science Plenary 4: The African Space Program Plenary 5: Trends in Commercial Earth Observation. Dr Jane Olwoch took part in the Plenary sessions 3 entitled Earth Observation for Global Change Science and specifically on the session on Implementation of Paris Agreement. This session featured speakers from the EC, CEOS, ESA and South Africa.


Dr Jane Olwoch also contributed to other sessions including support of the UN SDGs and the session on how commercial satellite companies can support capacity development in Africa.
Human Computer Interaction (HCI) Across Borders Symposium
by Michael Chamunorwa
SASSCAL OADC at Namibia National Node

In the April and November 2016 editions of the SASSCAL Newsletter, we featured one of our interns from the Namibian OADC who is doing his MSc thesis on using modern ICT tools to collect, catalogue and disseminate the indigenous Knowledge of the Namibian rural communities. So far, he has shared his work on various fora and presented the same at some international conferences.

During the week of 3 to 11 May 2017, he travelled to Denver, Colorado, to present a paper he co-authored at the Human Computer Interaction (HCI) Across Borders Symposium.

The Symposium was one of a wide range of activities that formed part of the CHI2017 Conference, an annual event sponsored by the Association for Computing Machinery (ACM). The Conference on Human Factors in Computing Systems (CHI) is the most prime event for Human Computer Interaction practitioners and specialists around the world and is usually graced by representatives from major corporations in the IT industry such as Google, Facebook, Amazon, Microsoft as well as IBM. In addition to being an academic and knowledge exchange platform, CHI also serves as a “head hunting arena” where some of these corporations allow potential graduates to apply for internships and knowledge exchange programmes.

The symposium was a two-day event where I had the opportunity to interact with researchers and members of faculty from various institutions from around the world, and engage in topics of discussion relating to the challenges and experiences that researchers faced in their work and locale. This was guided by way of focused group discussions together with fast-tracked workshops. In addition to these networking sessions, I also participated in group-based problem solving tasks where we were split into different groups and assigned scenarios modelled on real world problems for which we had to design possible solutions with a heavy reliance on the use of ICTs, e.g. designing ICT solutions to assist with the current refugee crisis being experienced in Europe. These possible solutions were later shared with the other groups and critiqued for improvement. The group activities also helped participants discover individuals with the same research interests as themselves and paved the way for the establishment of collaborations on projects regardless of geographical separation.

In addition to the experience and networking during the symposium, I also had the opportunity to meet some representatives from organisations such as Google, Bloomberg and Amazon. This was of great interest to me because I felt I could gain knowledge applicable to my work at SASSCAL because these organisations have perfected the way how to handle large data sets and provide solutions as well as stable products to their users.

My highlight of the conference was meeting some world renown authors who have written books and articles that I have been citing and referencing in most of my publications.

My overall experience was positive as it exposed me to some of the latest digital and technology trends that are being used in the IT industry around the world. I have already started reading more on these as well as determine how some of these technologies can be applied to the work we do at the SASSCAL OADC.

Top to bottom: The author (far left) his academic supervisor Prof Dr Heike Wünschiers-Theophilus (far right) and famous author and Computer Scientist Professor Ben Schneiderman from the University of Maryland (second from left). Professor Schneiderman is well-known for being the co-creator of the Nassi-Schneiderman diagram used by many computer programmers in academia and in the industry. He is also known for his pioneering work in User Interface design through his “8 Golden Rules of interface design”.

The author (second from right) With Professor Paul Dourish (second from left), highly acclaimed for his intersectional work in computer science and social science. He also gave me an autographed copy of his latest book.

The author (left) with Professor Jennifer Preece (centre), author of one of the most famous User Interface Design textbooks that is used by Computer Science students around the world.

The author (second from left), with Professor Alan Dix (third from left) British Professor and author on User Centred Design, Artificial Intelligence.
During the past five years, the 88 tasks of the research portfolio of SASSCAL 1.0 have generated a great deal of knowledge on various aspects of the social-ecological systems of southern Africa. We believe it is now the time to share this knowledge with the stakeholders and the wider scientific community. This gave rise to the idea of creating the SASSCAL research book that will bring together and integrate the results of SASSCAL researchers.

The aim of the book is to present the research outcomes in a format understandable to a diverse stakeholder community and to the general public, but at the same time being of high scientific quality. In the light of this vision, all SASSCAL researchers were invited in a call for papers at the end of March 2017 to submit proposals for articles for the SASSCAL research book.

The research that was funded through SASSCAL covers a large array of diverse topics. The declared aim of the book is to bring thematically related research from different corners of the SASSCAL region together or to jointly analyse data from various scientific disciplines from the same study area, thus fostering the collaboration within SASSCAL and to create synergies among the various tasks.

We will organize the book according to thematic chapters such as for example “food security through improved farm management” or “climate variability and change in southern Africa”. Each chapter will be composed of a series of scientific articles that will be subject to peer-review. As such, all articles will be treated as individual, citable scientific publications. They will appear in print in the book as well as online as open access articles. Within the chapters, the research articles will be ordered according to their thematic focus on

(a) the natural richness of the SASSCAL region;
(b) a region under rapid change;
(c) dangerous environmental change and emerging problems; and
(d) pathways towards solutions.

Many SASSCAL researchers followed the call for papers and made a lot of promising proposals for articles for the SASSCAL research book. Currently, the manuscripts are being submitted to the editorial board and will be sent out for peer-review. We are looking forward to publishing the book towards the end of the year 2017.

If you should have any queries, comments or suggestions regarding the book, please do not hesitate to contact the managing editor, Dr Rasmus Revermann, at books@sasscal.org at any time.
Impact of Household Decisions on Grazing Pressure in Northern Namibia
Modelling Approach for Sustainable Livestock Management

by Sarah Kampfl (Goethe University Frankfurt, Department of Geology),
Robert Luetkemeier and Stefan Liehr
(both ISOE – Institute for Social-Ecological Research & BiK-F – Senckenberg Biodiversity and Climate Research Centre)

Landscape and ecosystem degradation are severe challenges in Sub-Saharan Africa, particularly in semi-arid environments such as the Cuvelai Basin in northern Namibia and southern Angola. While natural processes like climate-induced drought events are an important driver of short- to medium-term ecosystem alterations, livestock grazing can be a major cause of long-term degradation. Overstocking and largely uncontrolled grazing of cattle leads to the loss of perennial grasses, bush encroachment and exhausted soils. This impairs the carrying capacity of the environment and hence feeds back on people’s livelihoods that strongly depend on reliable ecosystem services.

As part of research task 016, this master thesis takes a closer look into local decision-making processes on the household and village level to gain a better understanding of livestock management processes and how they relate to water availability. The core hypothesis of the study is that ecosystem degradation is primarily driven by unsustainable grazing practices that are the result of uncoordinated decision-making among the villagers. Both formal and informal agreements, here defined as cooperative or collective-action approaches, might have a positive effect on local ecosystem quality and hence on the living conditions of the population.

The approach to investigate the impact of household and village level decisions in livestock management on ecosystem quality involves two methodological steps: a qualitative social-empirical survey and a modelling stage. The surveys were conducted in four villages of northern Namibia that represent a gradient in environmental conditions (water availability and vegetation cover) as well as livestock management approaches (Figure 1). While the villages in the Oshana and Omusati regions practice traditional, rather uncontrolled grazing techniques, the villages in the Kunene region to the west of the Basin apply regulated activities such as rotational grazing and combined herding. These villages took part in the Community-based Rangeland and Livestock Management Project (CBRLM) and adopted these new management schemes that are carried out at the village level. The social-empirical surveys

Figure 1: Study sites in the Cuvelai Basin in northern Namibia.
took a triangulation approach and investigated livestock management using individual and group interview techniques (focus groups) as well as participatory mapping to assess preferred grazing pastures, natural and artificial water sources and other key environmental characteristics.

The second step takes up the empirical insights from decision-making processes and organizational characteristics of the different livestock management regimes and transfers the key variables into a modelling environment. This model is composed of an Agent-Based Model component (ABM) and a simple ecosystem model to depict the effect of cattle grazing on the ecosystem. While the households, configured as agents within the model, decide over stocking rate, selection of grazing pasture, cooperation with neighbours and many more parameters, their combined effect on the ecosystem can be evaluated. Several model runs will be conducted to understand the impact of varying decision-making processes and organizational structures on key ecosystem parameters such as biomass or the availability of perennial grasses. For validation purposes, satellite imagery time series will be analysed, i.e. considering the temporal change of the Normalized Difference Vegetation Index (NDVI).

The surveys were conducted from April to May 2017 in close cooperation with local Basin Support Offices, the Rural Development Centre Ongwediva (RDC) and the CBRLM project. The empirical material is currently under analysis but some preliminary findings can already be carved out. In this regard, it became obvious that social cohesion among the villagers and mutual trust is an important success factor for cooperative strategies. In particular, the role of external herders that take care of the combined livestock is critical, since cattle is a major asset and wealth component to the individual villagers. Furthermore, environmental conditions with respect to water availability and grazing grounds are keys to a successful implementation of new livestock strategies as the recent years of severe droughts rather impaired a thorough implementation.

Within the coming months, these decision-rules and the organizational characteristics will be identified in detail and then implemented into the combined ABM and ecosystem model. The results will enable us to give quantitative estimates of how different livestock management schemes influence ecosystem quality in the semi-arid Cuvelai-Basin. Recommendations for sustainable practices can be drawn from this and potentially be transferred to other areas.
13 Years of Deforestation in Huambo
by Virginia Quartin Universidade José Eduardo dos Santos (UJES),
Isaú Quissindo (SASSCAL OADC) & David Elizalde (former SASSCAL OADC)

SASSCAL’s research portfolio Task 137, “Deforestation monitoring in Huambo province from 2002 - 2012 using detection technologies and geographic information systems (GIS)”, aimed at using modern technologies for continuous forest monitoring, such as remote sensing and other instruments, to provide information on the current state of the forest in the central highlands of Angola, specifically the province of Huambo; to analyse the change of the forest during the period from 2002-2015 and through this, to examine the rate of deforestation, caused mainly by the charcoal exploitation in the region.

The Miombo forest is the most extensive seasonal tropical woodland and dry forest formation in Africa. It is made up of mosaics of dry forests and wooded savannas, characterized by a high diversity of flora and fauna, with average productivity and high social value in terms of wood fuel, construction materials, pasture, food and medicinal plants—not to mention its role in the fixation of atmospheric CO₂.

The Miombo forests form part of the Angolan Mopane Woodlands ecoregion, considered to be home to irreplaceable and threatened biodiversity.

In Huambo province, in addition to the analysis of the high resolution images, the following areas were studied during the forestry inventory: Chicala Choloanga (Sambo); Cuíma (Cachindongo / Gove sector); Bailundo (Chieta); Chiangua and surroundings. These areas show strong deforestation, mainly due to the exploitation of charcoal.

The alarming results of SASSCAL Task 137, from monitoring the Miombo forest dynamics in Huambo province, show a significant decrease in Miombo woodland area:

- In 2002, there were about 2,596,536 ha of the Miombo forest covered surface, that corresponded to 78 % of the total Huambo province area.
- 13 years later, in 2015, the Miombo forest covered area has decreased to 1,597,621 ha corresponding to 48 % of the total Huambo province area.
These numbers demonstrate an alarming loss of Miombo forest during the last 13 years of observation.

It is assumed, that the main factors contributing to this loss are basic needs such as firewood collection, charcoal production, expansion of agricultural fields and urban development.

The main loss of Miombo land cover can be attributed to the conversion of forest into agricultural land (792,204 ha) and thereafter, the conversion of forest into urban land or bare soil.

From all municipalities in the Huambo province, Bailundo has registered the highest rate of deforestation (259,161 ha), corresponding to 10% loss of Miombo forest, since 2002.

However, during the same period, also some expansion of the Miombo forest was registered in areas where land previously used for agriculture, urban settlements or bare soil, naturally started growing Miombo pioneer species.

Notably, Bailundo municipality has the highest rate of change from agriculture land to forest cover, while Huambo has the highest rate of change from urban or bare soil into Miombo forest.

The results from the degradation analysis of Miombo forest have revealed that in 2015, a considerable part of the forest (1,141,577 ha) was severely degraded, corresponding to 72% of all Miombo forest cover, as shown by the graph pie chart above.

Reference:
Experiences with the eBee Drone

by Dr Ben Strohbach
Faculty of Natural Resources and Spatial Sciences
Namibia University of Science and Technology (NUST)

Under SASSCAL Task 159, Biodiversity monitoring network in Namibia, we are faced with the dilemma that there are more observatories than our manpower is capable of surveying each year. To crown it all - we are able to determine the diversity of species, but are to date unable to track the life history of individual trees and shrubs.

In order to get to grasp this dilemma, we motivated for, and purchased a survey drone to at least obtain every year a high-resolution aerial image of each observatory. Here is a summary of our experiences to help other tasks interested in drone photography make wise decisions. Choices, Choices...

1. Choice of Drone

There are two basic purposes for drones, and two basic types of drones:

We make a distinction between surveying and surveillance drones. Surveying drones are meant for survey work - the individual photos are geo-tagged (i.e. a location is saved for each image taken), and the resulting images after stitching are geo-referenced. Depending on the model of drone, flying conditions, ground control points available as well as ground resolution, these images are geo-referenced to between 3 cm and 1 m accuracy. The important thing to remember, though, is that the imagery is not real-time, meaning there is a time-lag of between one hour and several days until the imagery can be analysed. The main purpose is surveying: towns and settlements, disaster areas, mining, infrastructure development, crop production, biodiversity (as in our case), etc.

Surveillance drones, in contrast, deliver real-time imagery and videos. These are typical the small hobby-drone you would use to spy on your neighbour (tsk, tsk!), or used in sport reporting on TV, or more serious applications like monitoring of poachers in game parks or even military drones. Yes, the photos can be geo-tagged and the imagery georeferenced, but the main emphasis is the real-time transmission of data.

We opted to buy the former type, a survey drone.

The second choice is between the two physical types: a fixed-wing drone (like a small aeroplane) and the multi-rotor type (your typical quadro-copter or hexacopter). Both have their advantages and disadvantages. The multi-rotor type can start and land in very confined spaces, but has a limited endurance and range. The fact that these are able to operate in confined spaces makes them ideal for building- and structure inspection, but also suitable to work in built-up areas or densely wooded areas. Fixed-wing drones, on the other hand, have a considerable longer range (and endurance), and are thus able to cover a far larger area. However, they need space to take off and land. The eBee typically needs at least 30 m for this, preferably as much as 100 m.

We opted for a fixed-wing drone - we have the space, but we also need the range (with an observatory being 1 x 1 km, or 100 ha, in size).

Even with these basic choices sorted out, there are a plethora of choices: drones for agricultural applications, high-precision survey drones (using differential GPS), multi-purpose drones, drones suitable for experimental cameras, etc. Your choice will have to consider cost, ease of use, support, and availability of supplies. We considered an out-of-the-box solution, completed with all accessories and spare parts, including a set of tested and working software for controlling the drone and processing the data.

2. Choice of cameras

With the eBee / eBee Ag, a variety of cameras are available. In the table on the next page, a summary of these models with possible applications is given.

The regular cameras (Canon, Sony) have been specifically adapted to be controlled by the Autopilot of the drone. This also includes the power supply of the camera - for the S110, the battery needs to be removed before flight, and for the G9x, the battery compartment has been closed. The Canon S110 cameras are the only range which has been modified with filters for specific wavelengths in the red-edge / near infrared range. Unfortunately, this camera is an end-of-range model. SenseFly is at this stage not considering the development of either the Canon G9x nor the
S.O.D.A. with such special filter adaptations; instead they are actively promoting the Sequoia as suitable alternative.

I have my drone - now what?

Obvious - unpack it, and get to know it! The provided manual will give you information on how to assemble and handle your drone. Take the time to work through this manual!

3. Control Software

You will likely be given a code allowing you to download software from the internet - in the case of SenseFly, the eMotion software to control the drone (multi-seat software, i.e. can be installed on several computers) and Pix4D to process the imagery (single-seat software - you may install it only on one computer).

eMotion allows you to simulate flights with different camera configurations in your eBee drone. This feature is an important tool to get to know your drone. Play with locations, landing sites, landing approaches, areas to be covered, using altitudinal data (especially important in mountainous areas), wind speeds and wind directions, and battery endurance. Remember - you will need to put in a safety margin for battery power - I found that, depending on altitude of the flight and wind speed, batteries last between 20 and 30 minutes. So rather plan two or three shorter flights than a single flight taking the drone to its limit. I still use the simulator feature extensively to plan flights in terrains I have not surveyed before.

Once confident with the controlling software, it is time to graduate to the real drone. SenseFly agents offer a short (2-3 day) training course in the use of the drone, or you can ask somebody with experience to show you how. It does help to get some practical training before the first solo flight! You will use the same software as when simulating the flight, and you will refine your flight planning skills. The starting is a totally new experience, with the prop blowing against you (frightening for many!), and if you don’t launch it correctly, the drone will crash-land ten meters on. Once successfully launched, the other big difference is that the drone actually flies off and looks rather flimsy up there in the wind. And it might just disappear out of sight as well! This is there the constant radio link with the drone, and monitoring of the screen becomes important.

4. Planning your Flight

Before going into the field, you will want to look at the site you want to cover on both Google Earth and on eMotion. eMotion uses Google Earth and/or Microsoft Satellite imagery from the internet, as well as a set of SRTM data readied for use by SenseFly. Remember to download the imagery and SRTM data onto your computer - in the field you will NOT have internet access to see these images (Microsoft Satelite imagery can be readily downloaded, Google Earth imagery not. You can also upload your own data once you have flown the area previously). It is rather awkward to stand in the field, after a couple of hundred kilometers of driving, to find that you forgot to download the imagery, and that you have to adjust your landing approach by good luck.

One of the first things to decide is your ground resolution. Here we have to consider serious trade-offs: the higher our ground resolution is to be, the lower the drone needs to fly, and the less area can be covered. For safety reasons, eMotion will not allow you to fly lower than 50 m above take-off (ATO). With the G9x camera you will roughly cover four to six ha in at a ground resolution of 1.7 cm flying at just over 50 m ATO in a single flight. If you need to cover a bigger area, you will likely have to consider flying at a higher altitude. For an observatory (100 ha, or 1 x 1 km), I usually fly at a planned ground resolution of 5 cm. With the G9x camera, this results in a flight altitude of 244 m ATO and a flight duration of between 24 and 30 minutes. With a Canon S110 camera (for NIR images), this will be done at 144 m ATO, and under fairly quite conditions, in a just over 30-minute flight. In most cases I split the flight into

<table>
<thead>
<tr>
<th>Camera</th>
<th>Resolution (MegaPixel)</th>
<th>Ground resolution at 100 m flight height</th>
<th>Bands (wavelength in nm)</th>
<th>Purpose, comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sony WX</td>
<td>18.2</td>
<td>2.8 cm</td>
<td>R 660 G 520 B 450</td>
<td>Supplied as standard with eBee. Not capable of saving RAW images. Regular RGB orthophotos, digital surface model</td>
</tr>
<tr>
<td>Canon S110</td>
<td>12</td>
<td>3.5 cm</td>
<td>R 660 G 520 B 450</td>
<td>Regular RGB orthophotos, digital surface model</td>
</tr>
<tr>
<td>Canon S110 NIR</td>
<td>12</td>
<td>3.5 cm</td>
<td>NIR 850 R 625 G 550</td>
<td>Supplied as standard with eBee Ag. NIR orthophotos, digital surface model, index maps</td>
</tr>
<tr>
<td>Canon S110 RE</td>
<td>12</td>
<td>3.5 cm</td>
<td>RE 715 G 500 B 450</td>
<td>Red Edge orthophotos, digital surface model, index maps</td>
</tr>
<tr>
<td>Canon G9X</td>
<td>20</td>
<td>2.4 cm</td>
<td>R 660 G 520 B 450</td>
<td>Regular RGB orthophotos, digital surface model</td>
</tr>
<tr>
<td>Parrot Sequoia</td>
<td>RGB: 16</td>
<td>3 cm</td>
<td>R 660 G 520 B 450</td>
<td>Regular RGB orthophotos, digital surface model, NIR orthophotos, index maps. Has a high-resolution RGB camera as well as 4 additional cameras recording at NIR, Red Edge, Red and Green. Has a sunlight sensor with which exposure and images quality is adjusted.</td>
</tr>
<tr>
<td>NIR, RE, Red and Green: 1.2</td>
<td>18.8 cm</td>
<td>NIR 790 RE 735 R 660 G 550</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SenseFly S.O.D.A.</td>
<td>20</td>
<td>2.3 cm</td>
<td>R 660 G 520 B 450</td>
<td>Regular RGB orthophotos, digital surface model</td>
</tr>
<tr>
<td>thermoMAP</td>
<td>0.328</td>
<td>37.8 cm</td>
<td>7 - 15 μm</td>
<td>Sensitive to between -40° and 160° C. Produces videos and photos for soil temperature related applications</td>
</tr>
</tbody>
</table>
two because of battery endurance/safety reasons.

Optimally, you will fly for a ground resolution of between 5 and 10 cm. Flying higher means that more energy is spent climbing - and in this way, you actually reduce the area you can cover in a single flight. For a 10-cm ground resolution, you can theoretically cover a 230 ha area in a single flight with the Canon G9x camera, flying at 423 m ATO (and default overlap settings). Remember also that the drone has to cover a considerable distance for such an endeavour - easily between two and three km from your start point before the mission commences at the furthest point away. Will the drone be near enough to reach your landing spot in case of a sudden battery failure due to an old battery? (From experience we know that this usually happens after 15 to 18 minutes in the air - if one of the three cells has a problem. See also the section on battery care later.)

One way to save energy is to allow the drone to climb during transit to the first waypoint, or to descend from the last waypoint to the home waypoint before landing. This avoids long times circling overhead to gain (or loose) altitude. Climbing during transit is NOT recommended in mountainous terrain - you will want to gain altitude before crossing over to the mission area.

5. Overlap and Image Quality

The next consideration is the degree of overlap between photos. The degree of overlap is important for successful stitching of the images later in Pix4D. Pix4D also calculates a digital surface model (DSM), using stereoscopic effects created by a high degree overlap. This DSM can be used for calculating tree heights and -volumes (amongst others), which is an important output from the drone imagery. Pix4D also uses the DSM to create an orthophoto from the stitched image. The higher the overlap, the better the resulting imagery and the calculated DSM.

Overlap can be set as lateral and longitudinal overlap. Lateral overlap refers to the degree the photos overlap between flight lines. Increasing this number will increase the number of flight lines, and thus will decrease the total area which can be covered in a single flight. Longitudinal overlap refers to the degree of photo-overlap between consecutive photos on a single flight line. As a default, I use a 60 % lateral, 75 % longitudinal overlap, with good results. You will find that with low-altitude flights you cannot use such a high degree of longitudinal overlap (as the camera cannot be activated fast enough by the autopilot between consecutive photos), and will have to compensate this either with an increase of lateral overlap, or by using perpendicular flights. If perpendicular flying is selected, eMotion will add a second set of flight lines perpendicular to the first, i.e. truly crossing the area. Perpendicular flights basically double the number of photos, but also double the flying time. If highly accurate DSMs are required (e.g. for volume calculations), or for small areas photographed at ultra-high ground resolution, perpendicular flying is recommended.

6. Starting and Landing

Next to consider are potential start- and landing sites. Whilst it is good to pre-select such sites before your trip, in practice you will find that things look different on-site. In selecting your start- and landing site, you need to consider the following:

- wind direction and speed
- an open, even site
- any obstructions

It helps at this stage to look at the default behaviour of the eBee at starting and landing:

The eBee starts best against the wind. After successful start-up, the eBee climbs as rapidly as possible to 20 m ATO and turns to the start waypoint. This is typically 30 m west of the take-off site. Here the eBee will circle to 75 m, and either climb further to working altitude (circling), or fly off to the first waypoint climbing en route to working altitude.

Once the mission is done, the eBee returns to the home waypoint. The home waypoint is by default the point where the eBee was started (i.e. the battery put in, and the first position fix taken by the autopilot). This is important to remember, especially if you assemble and start up the drone at your vehicle, as I do. Once over the home waypoint, the eBee descends to 75 m ATO. When it flies about 250 m out, turns, and starts its landing descend along the pre-set approach sector towards the home waypoint. Landing is generally within 5 m accurate on this point. The eBee lands on its belly, and will fall the last meter after switching off its engine just before landing.

If you need to start in confined spaces (e.g. in a dry river lined with tall trees), it makes sense to shift the starting waypoint in line with the launching direction. By also increasing the distance between launch point and start waypoint, you can increase the transit altitude to the start waypoint (e.g. from default 20 m to 50 m) to clear all obstructions before the drone starts circling to gain altitude. The start waypoint obviously needs to be adjusted before launching the drone.

The same holds true for the home waypoint. A grassy plain, sand or gravel are ideal (even a gravel road or farm path). Problematic however are big stones, rocks, shrubs and trees, etc on the landing spot. The home waypoint should be placed in such a way that the approach sector towards it is free of obstructions, especially no fences, large shrubs and trees within the last 10 to 20 m of the landing approach. The direction of the landing approach needs to be adjusted accordingly, also keeping in mind that the eBee lands best (most accurately) against the wind. As a matter of fact, it will choose the final approach path according to the prevailing wind direction (as determined whilst circling above the home waypoint) within the landing sector.

End of Part 1

This article will be continued in the next SASSCAL Newsletter Issue of September 2017.
Starting and landing in confined spaces (e.g. at Claratal): Here (a) directional take-off is selected, (b) the start waypoint has been moved ahead of the directional take-off line, and further out, and (c) the landing approach sector adjusted in such a way that trees near the dam wall are missed.

Bottom: View of the actual starting site at Claratal, 19 April 2017. Note the tall trees and steep mountains lining the river.

Screenshot of the landing planning tool in eMotion. The drone symbol represents the position of the drone prior to launching, the 'start' waypoint is a position by default 30 m west of the launch point. The home waypoint is the point there the drone will land. In this case it has been shifted away from the launch position so that it can land on a grassy plain. The approach sector is situated to the west of the home waypoint, and can be quite broad as there are no obstructions in the approach higher than 5 m.
Understanding the burden of sediment on ecosystems and national economy (SASSCAL Task 109)
Summary of Technical Progress Report

by Dr. Henry M. Sichingabula
University of Zambia

A survey of sedimentation on small dams is being conducted in Lusaka and the Southern Provinces of Zambia, to understand the burden of sediment on ecosystems and on the Zambian economy. This involves mapping of dams / reservoirs using Remote Sensing with ArcGIS applications, bathymetric echo sounding, sediment coring, digging sediment pits on reservoir beds, computation of water and sediment volumes. Other activities undertaken include the determination of water quality in the field and at the Environmental Laboratory at the University of Zambia, determination of the shape and surface areas of reservoirs, land use assessments and dam catchment area delineation using Google Earth images and ArcGIS 10.2 applications, as well as capacity development through research funding of three students, two MSc and one PhD students.

**Study of Small Dams**

To date, out of over 900 small dams located in Lusaka and the Southern Provinces, a total of 407 small dams have been surveyed and mapped (*Figure 1*) and location details compiled. The reported results are for four selected small dams located in the Lusaka Province (Goma Lake 1 (*Figure 2a*)) and in the Southern Province (Choma and Chifwepa dams in Choma District (*Figure 2b*)) and Chuwuka dam in Monze District (*Figure 2c*). The Goma Lake 1 which is located at the University of Zambia was used for training on how to use the remote-controlled boat facilitated by the manufacturer from Japan. Analysis is ongoing for the bathymetric survey data collected on seven (7) small dams (Chinkuli, Goma 1, Goma 2, Bmode, Mwaala, Halwiindi, Choma) together with the sediment data for seven (7) other dams (Makoye, Chuwuka, Kaya, Moonzwe, Nampayo, Choobe, and Chifwepa), collected by digging pits.

**Methods**

Using the remote-controlled boat, bathymetric, location and elevation data were collected for surveyed dams. The cleaned water depth point data in x-y-z format were assigned negative numbers and thereafter imported into ArcGIS 10.2 for further processing. The reservoir boundaries were converted to points and had default values of zero associated with each point. The created reservoir boundary point data was then merged with the survey data collected by the hydrographic boat using the merge tool in ArcGIS. Thereafter, interpolation was done on a continuous raster surface using the 3-D Analyst in ArcGIS.

**Area and Volume Computation in ArcGIS from Models**

Various interpolation methods that included Kriging, Spline and Natural Neighbour were used and results compared. In the end, the results of

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*Figure 1. Locations of surveyed small dams in Lusaka and Southern Provinces.*

*Figure 2. Illustrations showing (a) Google map of University of Zambia with Goma Lakes 1 and 2 used for training on use of remote controlled hydrographic boat, (b) Map showing Choma District with catchment areas of Choma, Chifwepa and Muzuma dams, (c) Google map covering Chuwuka dam located east of Monze town, (d) layout of sediment pits dug on dry Chuwuka reservoir bed.*
the TIN Model and the Natural Neighbour techniques were chosen.
Water surface areas and volumes were calculated using the Area and Volume tool under ArcGIS 3-D Analyst. Since reservoir surface boundary were assigned zero values representing water surface, the plane height was set to zero and all reservoir depths were turned into negative values. The computed areas and volumes associated with each depth were finally tabulated, graphed and mapped.

Generation of Data for Bathymetric Mapping and Catchment Area Delineation

Analysed data included reservoir bathymetric data, Digital Elevation Model (DEM), satellite imagery and GPS data on dam location and elevation. The Digital Elevation Model (DEM) was acquired from USGS for the purpose of delineating the catchment areas and mapping the topography of the surveyed dams. For generation of water level contours, 20 cm intervals were used for each reservoir. In addition, catchment contours were drawn for each dam using a reconditioned DEM. The catchment areas were delineated using Arc Hydro tools for ArcGIS 10.2.

Results - Bathymetric Mapping

Results for Goma Lake 1 (Figure 3a (i)) and Choma dam (Figure 2c) are presented below. The volume of Goma Lake 1 at maximum depth of 1.6 m with a surface area of 10,741.09 m² was estimated to be 7,207.84 m³ (Figure 3a (ii)). The hydro-hypsometric curves showing the relationships between measured depths and calculated water surface areas and reservoir capacity volumes are shown in Figures 3b(i) and (ii). For the Choma dam, the different methods used gave slightly different reservoir capacity volumes. As such, the estimated volume of 509,889.7 m³ was determined by averaging the results of the six methods. Figure 3(c) shows the bathymetric map of Choma dam, which is used for water supply to Choma town, for the surveyed part while the dotted lines show the extent of the dam at full capacity, thus, at the concrete spillway elevation of 1,257 m.

The Choma dam contour bathymetric map is shown in Figure 3(d). Note that Choma dam is fed by two streams shown as left and right arms of the dams that ensure sufficient inflows during the rainy season. Choma dam has never dried since it was constructed in 1955. However, the water holding capacity is expected to have considerably reduced given agricultural farming activities in the upstream catchments. This is why the Southern Water and Sewerage Company is presently exploring ways of increasing water supply to Choma town from other sources different from the existing Choma and Muzuma dams (Figure 2a) (Mr. Charles Shindale, Managing Director; Personal Communication, December, 2014). Hydro-hypsometric curves for Choma dam will also be constructed for estimation of reservoir water volumes from water level measurements, though infrequently taken by the Southern Water and Sewerage Company.

Results - Sediment Mapping

Sediment mapping has been conducted for seven dams (Makoye, Chuuka, Kaya, Moonzwe, Nampeyo, Choobe, and Chifwepa) but only results for Chifwepa and Chuuka (Figure 1b, Chuuka only) are partly reported in here. Sedimentation greatly reduced reservoir capacities of these two dams as evidenced by early drying and quickly filling up of dams with first rains. This makes cattle get fatigued travelling long distances to other wa-
tering points and/or getting stuck in deep muddy sediment (e.g. Figure 4a and 4b). Figure 1(d) shows the layout of sediment pits dug on Chuuka dam bed used to determine depth and volume of sediment (there is no sub-bottom sediment corer).

Based on depth data collected, sediment volume was computed using three interpolation raster models plus the TIN model. With the Area and Volume statistics tool, the bottom reference plane, starting from zero (reservoir or dam bed) to the deepest sediment (as negative values) was chosen. The sediment depth and volume maps constructed (Figure 4c and 4d) are preliminary because they are to be adjusted based on laboratory bulk density results of the sediments collected for each dam. Chuuka dam has a total surface area of about 34,284.82 m² of which 31,982.20 m² is covered by sediments estimated to be 24,658.60 m³ in volume; while Chifwepa dam, which is smaller than Chuuka dam and with a breached crest, has a total surface area of 4,809.95 m² with an estimated sediment volume of 1,396.28 m³ (Table 1).

Sediment hypsometric curves showing relationships between sediment depth and volume of sediment will also be constructed by the end of the project.

**Conclusion**

Task 109 has made progress on the implementation of the main activities. Two sponsored MSc students completed their course work and are currently doing research together with the PhD student.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Small dam/reservoir</th>
<th>Location, UTM</th>
<th>Surface Area (m²)</th>
<th>Sediment Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chuuka</td>
<td>-16.2593</td>
<td>31,982.20</td>
<td>24,658.60</td>
</tr>
<tr>
<td>2</td>
<td>Chifwepa</td>
<td>-16.5837</td>
<td>4,809.95</td>
<td>1,396.28</td>
</tr>
</tbody>
</table>
Capacity building in bee-keeping and honey production value-chain (SASSCAL Task 163)

by Mwape Malunga
Mulungushi University

Task 163 started with a beekeeping needs assessment survey (BNAS) in 2014. Central, North Western, Southern, Copperbelt and Lusaka Provinces were assessed. Gaps, challenges and opportunities in the beekeeping industry have been identified. The use of traditional beekeeping methods is dominant and there is inadequate training in modern beekeeping and quality control methods. In addition, there is a lack of documentation of Indigenous Knowledge Systems (IKS) on beekeeping as well as inadequate information, control and prevention of pests and diseases.

Emphasis is placed on harvesting honey and wax and not so much on other products such as royal jelly and propolis. There is an increase in absconding of bee colonies in recent years. Supported by the BNAS, the task has been testing the effect of hive position on bee occupation (Figure 1).

Preliminary results show that hives located on the eastern and western sides of the apiary tend to be occupied first. The 2017 overall occupation of hives is 45%, a 5.6% increase in occupation from 2016.

Bees wax, cassava powder and propolis have been tested as baiting materials. No significant differences in occupation rates have been recorded between wax and propolis. Cassava powder was found to attract insects such as black and red ants which may have prevented occupation.

Identification of bee pests and diseases in Agro-ecological zone II (Kabwe) and III (Kitwe) is on-going. Spiders, black / red ants, lizards, birds, and wax moth have so far been identified (Figure 2 and 3).

As an intervention, suspended hive frames with a capacity to carry 6 hives each have been designed and installed. This has reduced pest attacks by more than 60% (Figure 4, next page). Outputs of research are shared with beekeeping communities through workshops. Beekeeping communities have highlighted the negative effects of pesticides, bee predators, theft, inadequate product processing technologies and deforestation.

Local beekeepers have emphasised the need for capacity building in marketing, record keeping, new technologies, apiary management and the need to save the rapidly declining forests.

Honey harvesting commenced in 2015. Over 500kg comb honey has been harvested in two harvesting seasons (December 2015 and December 2016) against a planned maximum estimate of 1,200 kg per year (Figure 5). Tests will be carried out with results expected to feed into the honey quality assurance framework.

A beekeeping manual has been developed and is undergoing refinements. In addition, each research activity/concept carried out will have two outputs: a field technical report and a journal article.

Figure 1: Hive Orientation, Mulungushi University Apiary, 2014

Figure 2: Pest attack inspection, Mulungushi University, 2015
SASSCAL Intern dedicates herself to tackling invasive cacti in and around Windhoek

by Sylvia Thompson
SASSCAL OADC at Namibia National Node

Cacti are popular horticultural additions to the arid garden landscape: they require very little water, they are always green, they thrive in hot climates and they are particularly ornamental, especially when in bloom.

However, cacti are predominantly new world species with only one species of cacti (Rhipsalis baccifera) known to naturally occur in the old world (Africa and Asia), according to Novoa et al, 57 of the 1922 cactus species are considered invasive, with 35 of these species growing in South Africa.

Rosalia Joseph is an intern for SASSCAL’s research Task 059, which aims to improve the quality of plant and vegetation databases of the National Botanical Research Institute (NBRI) of Namibia, by the implementation of a Botanical Research and Herbarium Management System (BRAHMS) (Principal Investigator: Frances Chase).

Early this year, Rosalia organised an awareness-raising presentation on invasive cacti at NUST (Namibia University of Science and Technology) and then organised her first clean-up in early April, which was supported by NUST and UNAM (University of Namibia) students. (The Namibian, 06 April 2017)

To find out more about future cactus clean-up campaigns and this inspiring young lady, that spends her private time raising awareness on invasive species and also supports local waste management campaigns, I met up with Rosalia in Windhoek’s beautiful Botanical Garden at the National Botanical Research Institute (NBRI).

Why is it important to remove these invasive cacti plants?

Cacti are invasive species in the Namibian environment, because they thrive so well in these dry climatic conditions. Cacti have jointed stems, consisting of flattened parts called clado des. These take on the photosynthetic function. If these cladodes are broken off the plant they are capable of rapidly growing into a new cactus plant. They compete with native succulent and other native species, and thus displace them. Once native species are displaced, their ecosystem role can no longer be performed, which creates gaps in the ecosystem and alters the ecosystem function. In addition, many of the species are entirely inedible to large herbivores due to the presence of impenetrable spines on the cladodes.

What was the driver for you to organise the cactus clean-up initiative?

Rosalia explained that she is naturally passionate about our environment and aspires towards becoming an Environmental Manager. She first became involved with a cactus clean-up campaign when she volunteered at a clean-up of the Botanical Society. Further inspired by the initiative of Gunhild Voigts, who is the driving force behind an active cactus clean-up campaign in Windhoek, she decided that the youth of Windhoek had to become involved.

The inspiring Rosalia Joseph next to some prickly pears, Opuntia spp., a very common invasive species in Namibia
Why has the growth of these cacti become such an issue?

For many years, the growth of cacti has remained uncontrolled. Home owners plant cacti because they are fast-growing, drought resistant and popular ornamental plants. Few are aware of the invasive nature of some cacti species. This is why it is so important to raise awareness on the invasive species.

The good rains in the 2010/11 rainy season may have also encouraged further spreading of the cacti invasives.

How do the cacti spread and what encourages their growth?

Cacti will spread either vegetatively, where any part of the plant is able to develop into a new plant, or are spread by birds when they eat the fruit or seed of the plant.

Even though cacti thrive in drought conditions, their growth is also encouraged by rainfall.

When is the best time to remove the cacti and can the removal of the plant help spread them?

Cacti are best removed during the winter months, as the plant tissue contains less water and is lighter, making removal easier. In addition, in the dry winter months, the cactus plant stands out against the otherwise brown vegetation and is thus easier to find. Younger plants are also easier to remove at this time.

The plants are best removed with steel rakes, garden forks and/or barbecue tongs. It is important to remove the roots and not to leave any piece of the plant behind. If parts of the plants are accidentally left behind, these will create new plants.

Is the removal of the cacti a good solution and is it permanent or do the cacti just keep coming back?

Currently, there is no consensus on what is the best way to fight the growth of cacti and how best to remove them.

A NUST student who is completing a work placement program at the NBRI has begun a long term monitoring project on the removal of cacti (manual removal vs poison and removal). Here plots of two species of cacti Opuntia spp. and Harrisonia martini are being monitored and assessed, essentially to find out what the best practice is when removing cacti. (Mechanical refers to using rakes, forks and tongs, while Chemical refers to using a poison with a known active ingredient to kill cactus which will be administered accordingly (possibly directly injecting the plant with poison, in order to minimise effects to surround vegetation).

The cactus clean-up campaigns in Windhoek are removing the plants mechanically. If all the parts of the plant are carefully removed, this method is found to be effective. However, Rosalia reminds me that follow-up is essential, in order to ensure that no parts of the plant were left behind, missed or accidentally dropped, in order to sprout new plants.

Should the removed plants be disposed of in a special way to avoid further spreading?

Rosalia reports that the City of Windhoek supports the cactus clean-up campaigns by making skips (disposal bins) available and then disposing of the plants in specially isolated areas at the city rubbish dump sites.

Ideally, the plants should be burned to avoid any further growth, or be buried at one to two-meter depth. By no means should gardeners dispose of them on compost heaps.

What other invasive species should we watch out for and preferably not plant in our gardens?

When you plan a water-wise garden, please avoid the commonly known invasive species for your region or country.

Special thanks to Frances Chase from the National Herbarium of Namibia (WIND) and Dr Dave Joubert from the Namibia University of Science and Technology (NUST), for contributing with valuable input to this article.
Publications


Theses (submitted)

MSc thesis

### Upcoming Events

<table>
<thead>
<tr>
<th>WHEN</th>
<th>WHAT</th>
<th>WHERE</th>
<th>MORE INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 to 15 June 2017</td>
<td><strong>2nd AfriGEOSS Symposium</strong></td>
<td>Sunyani, Ghana</td>
<td><a href="http://geosec.limequery.com/index.php/328783/lang-en">http://geosec.limequery.com/index.php/328783/lang-en</a></td>
</tr>
<tr>
<td>27 to 29 June 2017</td>
<td><strong>Biodiversity and Health in the Face of Climate Change - Challenges, opportunities and evidence gaps</strong></td>
<td>Bonn, Germany</td>
<td><a href="mailto:jutta.stadler@bfn.de">jutta.stadler@bfn.de</a></td>
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<tr>
<td>26 to 28 July 2017</td>
<td><strong>2nd Multi/Interdisciplinary research Conference</strong></td>
<td>Windhoek, Namibia</td>
<td><a href="http://www.unam.edu.na/conferences/2nd-mutilinterdisciplinary-research-conference">http://www.unam.edu.na/conferences/2nd-mutilinterdisciplinary-research-conference</a></td>
</tr>
<tr>
<td>19 to 20 September 2017</td>
<td><strong>4th Satellite Soil Moisture Validation and Application Workshop and the CCI Soil Moisture User Workshop</strong></td>
<td>Vienna, Austria</td>
<td><a href="http://smw.geo.tuwien.ac.at/">http://smw.geo.tuwien.ac.at/</a></td>
</tr>
<tr>
<td>24 to 26 October 2017</td>
<td><strong>WMO International Conference on Automatic Weather Stations (ICAWS-2017)</strong></td>
<td>Offenbach am Main, Germany</td>
<td><a href="https://www.wmocimo.net/">https://www.wmocimo.net/</a></td>
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</tbody>
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**17 June**


The World Day to Combat Desertification, declared by the United Nations General Assembly, is observed to promote public awareness about international efforts to combat desertification and the effects of drought collectively.

The 2017 World Day to Combat Desertification (#2017WDCD) celebrations mark the power the land holds in giving people an opportunity and a future to stay resilient on their home ground. The number of international migrants worldwide has reached 244 million in 2015. These numbers are the consequence of environmental degradation, political instability, food insecurity and poverty. Losing productive land is driving people to make risky life choices.

In rural areas where people depend on scarce productive land resources, land degradation is a driver of forced migration. Africa is particularly susceptible because more than 90% of the economy depends on a climate-sensitive natural resource base. Source: http://www2.unccd.int/
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