GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

SALLnet

SALLnet Newsletter, August 2022

Dear SALLnet members,

In this last issue of the SALLnet Newsletter, we want to reflect on our achievements over the past four years of intense scientific collaboration. Therefore, we collected materials and impressions from our **final project meeting** which took place last June in South Africa, as well as various materials documenting our **interactions with local stakeholders** and **capacity building** activities. To start with, in a **letter of thanks and farewell**, we express our gratitude for your active participation and engagement in the many tasks that have been jointly completed so far and we look forward to continue harvesting the fruits of our work in the near future, as well as to, hopefully, engage together in future collaborative projects and activities.

The current issue of the SALLnet Newsletter contains information on:

A Letter of Thanks and Farewell from the Project Coordination Team

by Prof. Reimund P. Rötter

Dear "SALLnetters", colleagues and friends,

at the end of each journey it is a good habit to reflect on the good and bad things, on the achievements as well as the obstacles and mistakes from which we can learn. And when it comes to scientific journeys, last, but not least, it is also a good habit to provide an outlook on future possibilities, i.e. to build on what has been achieved and use the new scientific findings and insights to implement solutions in practice as well as for the further advancement of science. Moreover, it is the time for being thankful. We hereby thank all team members and project supporters for the professional achievements that have only become possible through highly motivated and dedicated individuals working together in a joint team spirit and effort. Among the nicest things in a successful project is, if one can be grateful for nice joint moments and experiences, good collegial relationships, possibly new friendships, and trust that has been built from working in a team with a common goal. We have come a long way together and it is time now to thank and wish you well in your various endeavors! The current (and former) members of the SALLnet Coordination team have enjoyed very much working with you and being your companions during this long joint journey, that for some of us has lasted not only four years but already started with the precursor (SPACES 1) project LLL in 2013 in Limpopo. We have started and will continue to harvest the rich fruits of this long-term unique research partnership still for some time to come (as indicated in this Newsletter) While there will not be a third phase of the SPACES program in the foreseeable future, the high quality and ample scientific output, strength and versatility of our research partnership, and the continued importance of the research topics we tackled (multi-functional landscapes, climate change adaptation, food security, biodiversity protection, etc.) warrant that sooner or later, we will find together in different partner constellations from this consortium to tackle new research challenges in future collaborative projects/activities of different formats. In this spirit, on behalf of the Uni Göttingen coordination team, I'd like to thank you once more for the great collaboration and joint achievements and - for the time being - wish you fare well!

SALLnet's Final Meeting

SALLnet's Final Meeting was held in Tzaneen (Limpopo, South Africa) **on 20-21 June 2022.** The overarching research question of our interdisciplinary research project is: ***"how can the resilience of the multi-functional landscapes in southern Africa be enhanced under the conditions of climate change and increased resource limitations?"***.
Six German and four South African partner institutions have been cooperating in SALLnet since 2018, under the BMBF-funded SPACES II program. The network has been coordinated by the University of Göttingen and involved researchers from a wide range of disciplines as well as stakeholders at different decision levels.

Focusing on the Limpopo region - selected because of its diverse land-use, biodiversity and high spatiotemporal climatic variability - we have been developing and testing new approaches and methods and carried out dedicated experiments and surveys for developing more sustainable land-use options at landscape level. Focus was on the interactions between the connected land-use types: arable lands, rangelands and tree orchards. Among our main objectives, one is to develop and apply integrative tools and modelling platforms to explore and discuss alternative land-use scenarios and associated management options in view of rural development goals and their trade-offs jointly with local stakeholders. This would, in turn, inform the discussion and debate on how to best enhance the resilience of the multi-functional landscapes to climate variability and change in the region.

Project outputs so far realized by SALLnet comprise, among others:
- more than 20 peer-reviewed scientific articles,
- more than 40 other scientific publications (conference proceedings, technical reports),
- co-initiation and editing of a book on sustainability of southern African ecosystems and contributing five chapters led by SALLnet scientists to this SPACES 2 Springer Book,
- numerous presentations (including many keynotes) at national and international scientific conferences, as well as in project meetings and workshops with stakeholders.

In terms of capacity building, 9 PhD theses are ongoing, while 13 MSc theses have already been finalized (more are ongoing). Finally, several trainings and courses (both in physical presence and virtual formats) have been organized by SALLnet researchers over the past years, mostly targeting students and stakeholders from southern Africa.

Main focus of the Final Meeting held at Tzaneen was on corroborating and extending preliminary findings by presenting scientific project highlights (the presentations can be accessed here) and discuss promising options and management recommendations from distinct land-use case studies. Exchanging with research colleagues from different disciplines on important research topics, synthesis of results, and their societal relevance, as well as planning further collaboration for achieving academic goals (e.g. scientific publications and capacity building) and identifying future research needs, were the main objectives of the meeting.

Key to transformation pathways is technological change - with associated management and policy changes - and analysis of goal achievements and trade-offs with stakeholders for alternative future "pathways" (i.e. environmental and socio-economic). Therefore, as part of our Final Meeting **on 21 June 2022, we organized a Stakeholder Day** to present our work to the relevant stakeholders, engage with them and ask for their feedback in terms of the applicability of the projects' results, as well as their relevance for developing meaningful management and policy recommendations. This was done in a "hybrid" format: most of the participants (about 35 people) joined physically in Tzaneen, while some more participated in virtual form. This allowed the participation of a very heterogenous group of stakeholders, ranging from the political sphere to academics and researchers, members of national and international organizations, extension officers and farmers (Figure 1 and 2).

Figure 1: SALLnet project members and stakeholders during the SALLnet Final Meeting in Tzaneen (Limpopo, South Africa) on 20-21 June 2022

Four main discussion topics were identified for the exchange with the stakeholders, namely:

(1) management recommendations for a more sustainable macadamia cultivation,
(2) interactions between smallholder livestock keeping and rangeland management,
(3) effects of mixed crop-livestock management scenarios in smallholder farming systems, and
(4) effects of technology change on farm household income and policy implications.

Figure 2: Some SALLnet project members and stakeholders joined the SALLnet Final Meeting in virtual form

Some **key messages** emerged from the discussions with the stakeholders for the different topics and land use types in the focus of SALLnet project:

- For a more sustainable management of macadamia orchards, water use efficiency needs to be increased by better targeting the tree water requirements and avoiding over-irrigation. Furthermore, keeping semi-natural habitats around macadamia orchards is important for pollination and pest control by bats and birds.
- In terms of rangeland management under drought, the duration of the latter is responsible for strongly decreases in rangeland productivity and the loss of perennial grass species. Small grazing exclosures dispersed over the rangeland may ensure seed production of palatable grass species.
- Improved technologies and management options for mixed crop-livestock farming include a later return of livestock to rangeland and the storage of crop residues to enhance rangeland growth and reduce feed gaps.

- Finally, the adoption of improved and innovative technologies, particularly irrigation, is economically viable for all small-scale farm types in Limpopo. Information about these technologies through extension services and access to credit to fund these technologies are the most important enablers. Yet, this information needs to complemented and underpinned by robust quantitative estimates /projections of future availability of water resources in the various catchments /sub-regions of Limpopo.

More detailed reports on the discussion with the stakeholders are provided below.

Overall, the meeting was considered successful by all participants (due to an ad hoc evaluation at the end of the workshop). The exchange between researchers and stakeholders proved to be stimulating and enriching for both sides. What clearly emerged from such discussions is that further research on certain topics is strongly needed and that, more generally, research findings need to be communicated in a more targeted way to the relevant stakeholders and policy makers (e.g. through policy briefs and lists of management recommendations / fact sheets).

Reports from the stakeholder discussions during SALLnet's Final Meeting

Management recommendations for a more sustainable macadamia cultivation

By Thomas Bringhenti

The rapid expansion of macadamia production areas in South Africa is associated with farm and landscape management challenges, including loss of habitat and biodiversity, excessive use of and resistance to pesticides, and increased pressure on water resources. Aiming at providing recommendations for mitigating the effects of such agricultural intensification, as well as of climate change, SALLnet has been conducting research in the subtropical growing area of Levubu (Limpopo), mostly focusing on biodiversity (pollination and pest control) and water-related ecosystem services in macadamia orchards.

During the Final SALLnet Meeting on 21 June 2022, an overview of the most relevant project findings and their implications in terms of management recommendations for a more sustainable macadamia cultivation were presented and discussed with a number of relevant stakeholders (Figure 1). These included researchers, representatives of the macadamia industry, extension officers and growers.

***Figure 1**: Stakeholders participating to the Final SALLnet Meeting on 21 June 2022*

Starting from illustrating how the regional projected decreases in streamflow and groundwater levels are posing a threat to future water availability for commercial irrigated farming in southern Africa, it was stressed that there is an impelling need to increase the water use efficiency of macadamia orchards. This can be done by better quantifying macadamia tree water requirements, by choosing water efficient irrigation systems (e.g. low flow drip irrigation system), by continuously monitoring the soil water status and by adopting water saving practices like mulching. Furthermore, long-term field experiments show that macadamia trees have a conservative water use behavior, strongly controlled by microclimatic factors such as vapor pressure deficit, and that in general they have lower water requirements than previously recommended amounts. In particular, macadamia trees do not respond to increased water availability (through increased irrigation) under hot and dry climatic conditions, which only leads to over-irrigation and reduced water use efficiency.

Figure 2: *Honey bee visiting a macadamia flower; initial nut set; final nut set*

When looking at pollination, the importance of semi-natural vegetation (hosting a diversity of bee pollinators) in and around macadamia orchards was stressed. By increasing flower visitation, an increased cover of semi-natural habitats within a 1 km radius around the macadamia orchards has a positive influence on macadamia nut set (Figure 2), which is generally higher at the edge compared to the orchard center. Additionally, flower visitation rates and nut set can be increased if macadamia trees are planted in vertical rows (perpendicular) to semi-natural habitats.

Natural and semi-natural vegetation also promote bat activity in macadamia orchards, and potentially bats' provision of the ecosystem service of pest control (Figure 3). Nevertheless, certain bat species have already been largely excluded from simplified agricultural landscapes. An economic model was used to quantify the avoided costs of bat predation on stinkbugs, considering both the reduced stinkbug damage and pesticide use. These amounted to US$57-139/ha/year, thus highlighting the importance of reducing the use of pesticides (which should be based on scouting rather than calendar spraying and timed in such a way to avoid direct contact with bees, bats and birds) and keeping a heterogeneous landscape in and around macadamia orchards, which provides connectivity, foraging and roosting sites for bat species and their ecosystem service provision. However, one of the disadvantages of preserving natural vegetation around macadamia orchards is the increased damage by velvet monkeys' raids, which was estimated to cause yield losses of about 26%. By comparing such losses with those resulting from prevented biocontrol by bats and birds (excluded from the orchards), it emerged that the latter were much higher, reaching up to 60%. Also in economic terms, the effects of biocontrol by bats and birds (USD ~5,000 ha/year) were more important than the losses of crop raiding (USD ~1,600 ha/year), thus indicating that the removal of natural vegetation to limit monkey abundances would also limit biocontrol service provision. Mostly related to the same topic, a policy brief on biological pest control by birds and bats - as well as by other beneficial organisms - in macadamia orchards was also presented by Prof. Peter Taylor and later discussed with the stakeholders.

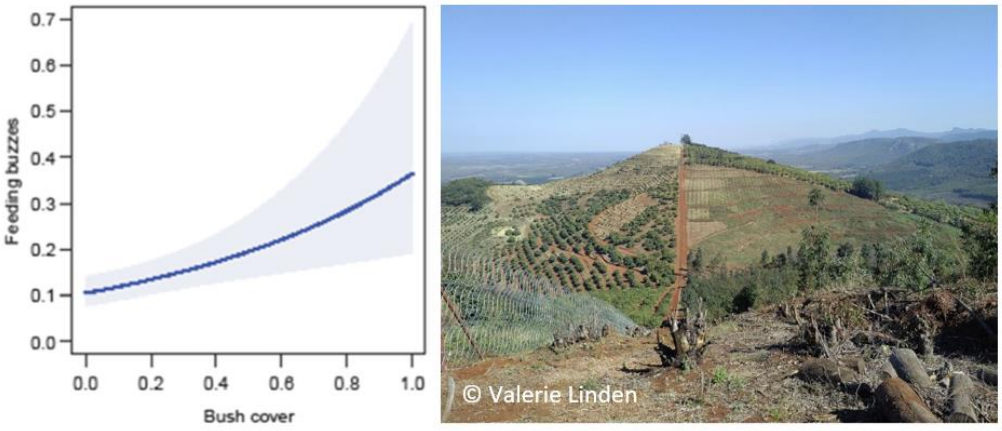

Figure 3: *The relationship between foraging activity of certain bat species increases with the habitat cover of bush in macadamia orchards, Levubu, South Africa.*

From the in-depth discussion with the stakeholders, it emerged how all the presented results need to be followed up and translated into concrete policies and management recommendations to macadamia growers. Therefore, the organization of such an exchange with the stakeholders was highly praised. In particular, according to the growers, the most urgent research needs are around the topics of stinkbug pest control, macadamia roots and their interaction with different soil types, and the shift of flowering time as a consequence of climate change. With regard to the suggested management recommendations, there was a general agreement on the need to increase irrigation water use efficiency and to maintain natural habitats in close proximity to macadamia orchards. On the other hand, although recognizing that the current practices are unsustainable and leading to the formation of resistances, there was more skepticisms about reducing the use of pesticides, because of the related risks of yield losses due to increased pest pressure. In general, it was stated how a continuous and open exchange between researchers and macadamia growers would lead to positive mind shifts and to the implementation of more sustainable management practices.

Interactions between smallholder livestock keeping and rangeland management

By Sala Lamega and Kai Behn

Smallholder cattle farmers in Limpopo province, South Africa, are experiencing feed gaps. Almost every farmer in the communal and smallholder sector is affected during the dry season. More frequent, prolonged and intense droughts additionally worsen the problem. Yet there are solutions to counteract.

During the Final SALLnet Meeting on 21 June 2022, an overview of the most relevant project findings on the topics of livestock and rangeland, as well as their implications in terms of management recommendations, were presented and discussed with a number of relevant stakeholders. These included researchers, extension officers and farmers. A joint presentation of work packages 1 and 3 looked at the interactions between smallholder livestock keeping and rangeland management aimed at bringing together different sides and perspectives: The “rangeland” or “supply” side and “feed gap” or “demand” side. Both sides were looked at from the smallholder farmers´ and scientists´ perspectives.

Figure 1: Undernourished cow in Limpopo province during dry season. Picture: Sala Lamega

Smallholder livestock farmers report several key issues, such as feed gaps, overgrazing and drought. These issues largely match with the rangeland scientists’ perception. They create a circle of degradation and feed gaps (Figure 2). However, not represented in figure 2 are livestock theft and difficulties to sell livestock during times of feed gaps, which were further named as major issues for farmers during group discussions.

Feed gaps: Forage demand exceeds forage availability
Rangeland degradation: Reduction of forage production, loss of valuable grasses/forage plants

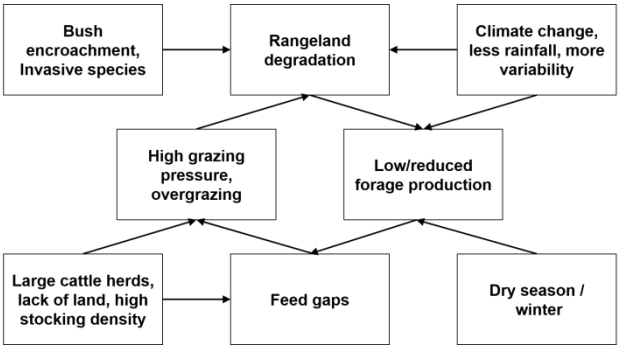

Figure 2: Simplified conceptual model indicating key issues for livestock farmers and major interactions between rangeland degradation and feed gaps. Note that not all interactions are shown, e.g. bush encroachment has several drivers that also include climate change and overgrazing.

Feed gap analyses (Lamega et al. 2021) show that almost all farmers experience feed gaps in the winter season, which results in cattle weight loss. Further analyses show that the forage supply available to small scale livestock holders in Limpopo province is only sufficient if the daily cattle dry matter intake (DMI) does not exceed 7 kg. This is however too little to sustain the cattle breeds kept in Limpopo throughout the year.

With increasing climatic risks such as droughts, the feed gap problems are likely to magnify. Results from the DroughtAct-experiment at the experimental farm of the University of Limpopo show a constant decrease of forage production under ongoing drought conditions. Particularly high-quality forage grasses such as *Digitaria eriantha* (Wooly Finger Grass) tend to decrease and even disappear.

Potentials to mitigate the combined issues of rangeland degradation and feed gaps may include:

- Support for farmers during times of feed gaps and particularly in drought times;
- Extension of feed supply beyond actual drought times combined with grazing restrictions to allow regeneration of rangelands;
- Participatory rangeland monitoring and management plans that include farmers, authorities, extension services and science;
- Acquisition of additional forage sources such as crop residues and forage made of bushes;
- Training and additional support on rotational grazing management and livestock breeding for farmers.

Such results were discussed more in depth with the invited stakeholders, whereby the following points emerged:

- Farmers need access to knowledge:

Farmers need training and knowledge transfer regarding cattle herd management and rangeland management. The interaction between farmers, extension service and science is important and generally well received. Of particular importance is also the farmer-farmer interaction for knowledge transfer. However, many smallholder cattle keepers do not identify themselves as farmers and are difficult to approach.

- Livestock breeding and management:

There are potentials for improved cattle herd management. That includes focus on more suitable cattle breeds and fertility management. Calving times should be controlled and directed to times when enough forage is available (no feed gaps) with the help of artificial insemination.

A further strategy to counteract feed gaps discussed is selling cattle during feed gaps times to feed lots and rebuying young cattle after time of forage scarcity is over. This strategy can help to reduce pressure on rangelands and reduce the risk of cattle mortality and hence the risk of financial losses, but though not acceptable for all farmers. Many livestock holders keep cattle as “pets” or “save” them for special occasions like weddings only.

- Closing Feed gaps:

As destocking is not for various reasons not always possible or desired, there are strategies needed to close existing feed gaps. A tactical or /and a strategical intervention may be needed depending on the farmers’ intentions (social or economic) and exposure to climate hazards. A tactical intervention should be a quick response to feed gaps (e.g. building better feeding systems (adding chopped shrub branches and leaves to feeding systems) , applying nutrient to local pasture to improve seasonal forage growth) while a strategic intervention should be a long-term transformation of the current rangeland biomass (e.g. changing the type of forage species that are grown).

- Improving rangeland health and promoting recovery

It is important to maintain rangeland health. Communal rangelands suffer from overgrazing, bush encroachment and loss of valuable grass species. Temporal resting that allows rangelands to recover need to be implemented. It is important that – particularly perennial grasses – get the chance to develop seeds. We recommend small grazing enclosures throughout the rangeland. Cut-off branches of spiny shrubs can be (and to some extent are) used for that. This can further act as a barrier against wind erosion.

Effects of mixed crop-livestock management scenarios in smallholder farming systems

By Simon Scheiter, Mirjam Pfeiffer, Reimund Rötter, Kingsley Ayisi et al.

Smallholder farming systems in southern Africa are characterized by low levels of management and integrated livestock and crop production. Low yields and dry-season feed gaps where feed demand exceeds feed supply are common. To meet growing food demands, sustainable intensification of these systems is an important policy goal. Mixed crop-livestock farming, where animals feed on rangelands during the cropping period and on crop residues after harvest, may improve productivity. Yet, we require a detailed system understanding to assess the performance of management practices and develop suitable intensification strategies.

Models can be used to evaluate different management scenarios and help identify management strategies. Therefore, we linked the APSIM model to simulate cropland and the aDGVM2 model to simulate rangeland. We investigated three different management practices: (i) current management practices, (ii) sustainable intensification (SI) for crop production (application of manure and small fertilizer quantity, weeding, crop rotation), and (iii) a rangeland only scenario where livestock only utilizes rangelands but not crop residues. We studied management in two villages, Selwana and Gabaza, where information on farming practices, livelihood conditions, crop types and livestock was obtained in village surveys.

We asked: Can feed gaps be reduced by joint management of cropland and rangeland?

We found that sustainable intensification increased yields in both villages (Fig. 1). However, the increase was moderate because we assumed only a minimum level of intensification in the sustainable intensification scenario. Higher levels of intensification, including for example irrigation, would further increase crop yields.

A comparison between scenarios with only rangeland grazing and mixed rangeland-cropland grazing, showed that feed gaps were reduced in the mixed rangeland-cropland farming (Fig. 2). Further, feed gaps occurred around 2 month later in the mixed rangeland-cropland scenario than in the rangeland only scenario. However, in all of the scenarios that we studied, feed gaps remained, irrespective of the management practice.

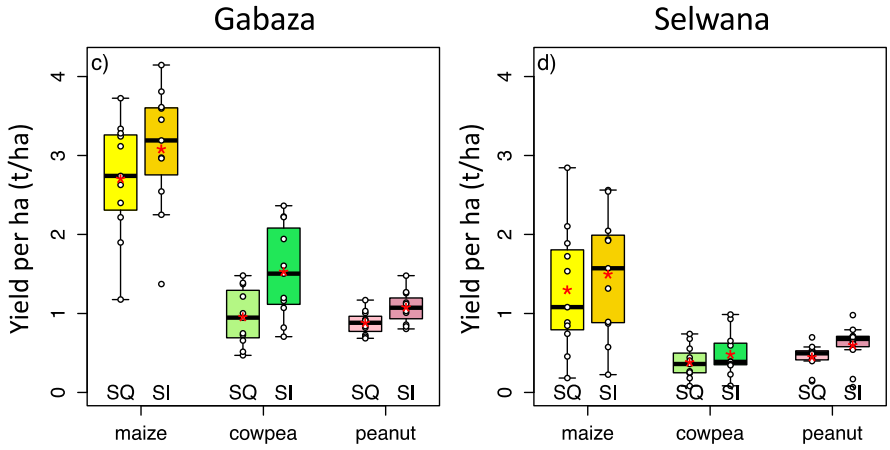

Fig. 1: Yields of different crops at Gabaza and Selwana for the current management practice (SQ) and sustainable intensification (SI).

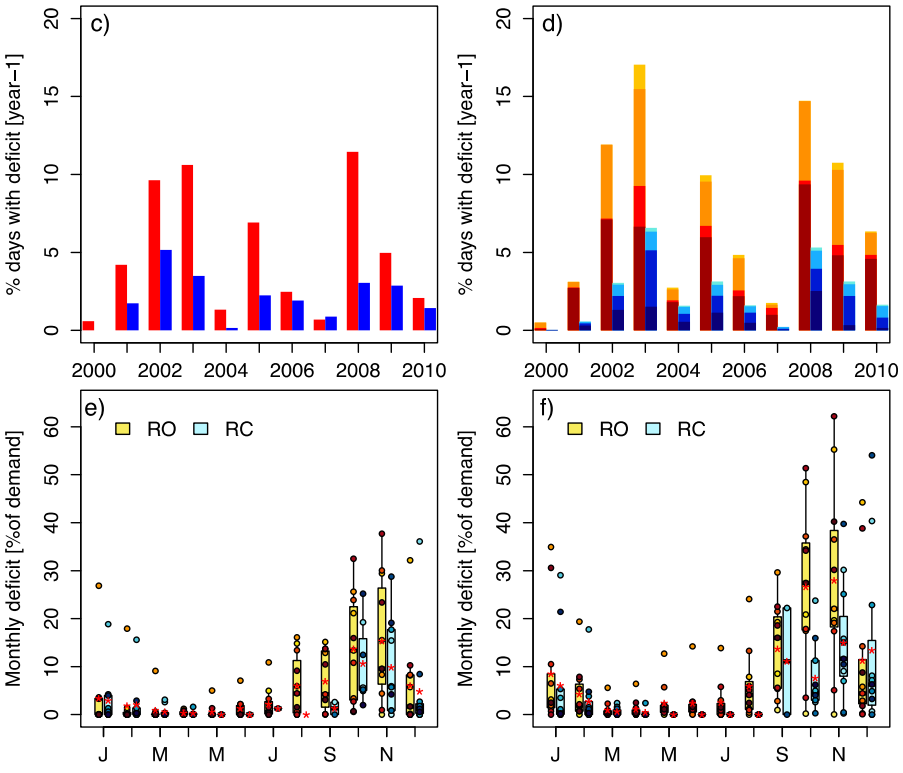

Fig. 2: Annual feed gap at Selwana (left) and Gabaza (right) for different years (upper) and aggregated for each month (lower) in the rangeland only scenario (i.e., no crop residue feeding, RO, red/orange/yellow), and the mixed rangeland-cropland scenario (RC, blue).

Conclusions and recommendations:

- We developed tools to assess management impacts in mixed cropland-rangeland farming systems.
- We can provide support and capacity building for application of these tools.
- Sustainable intensification increases crop yields.
- Mixed crop-livestock management reduces feed gaps and they occur later.
- Later return of livestock to rangeland or rotational grazing enhance vegetation growth in the early growing season and have high potential to reduce feed gaps.
- Storage of crop residues and residue feeding in the transition between dry to wet season improves the state of the rangeland and can reduce feed gaps.

Further Materials of the Final SALLnet Meeting

The following documents can be accessed here:

SALLnet Meeting, 20-21 June 2022

- Meeting program
- Progress reports: presentations of all WPs

Stakeholder day, 21 June 2022

- Stakeholder day: program
- Participants list
- Stakeholder day: presentations by SALLnet researchers
- Stakeholder day: fact sheets on management recommendations and policy briefs

Capacity building activities by SALLnet

SALLnet workshop: Socio-ecological modeling for multi-functional landscapes

From 6-10 December 2021, the SALLnet project hosted a training workshop entitled “Socio-ecological modeling for multi-functional landscapes”. This workshop was coordinated (lead: Dr. Scheiter) and run by scientists from the Senckenberg Biodiversity and Climate Research Centre (SBiK-F), Frankfurt, the TROPAGS working group, Georg-August-Universität Göttingen (TROPAGS), and agricultural science department, Fachhochschule Südwestfalen. Participants from seven different countries, including South Africa, Zambia, Ghana, and Germany took part in the workshop. Due to ongoing travel restrictions the workshop was planned and held fully virtual, using a variety of mediums such as plenary online discussions, video lectures, and online presentations.

The aim of the workshop was to familiarize participants with different modelling approaches that include and represent characteristic features of croplands, savanna rangelands, and socio-ecological systems. Although theoretical components laid the foundations of the course, a clear focus was on hands-on, practical sessions that got participants applying the models to their own individually devised use cases and research questions. The workshop focused on the process-based savanna and rangeland vegetation model aDGVM for the first two days led by SBiK-F scientists, followed by two days of the crop simulation model APSIM led by TROPAGS scientists, and agent-based modeling (ABM) for socio-economic applications lead by Jan-Henning Feil. The final day was comprised of presentations on recent aDGVM and APSIM model applications, time for participants to develop own research ideas and to conduct model simulations, and presentations of these ideas and first model results by the participants.

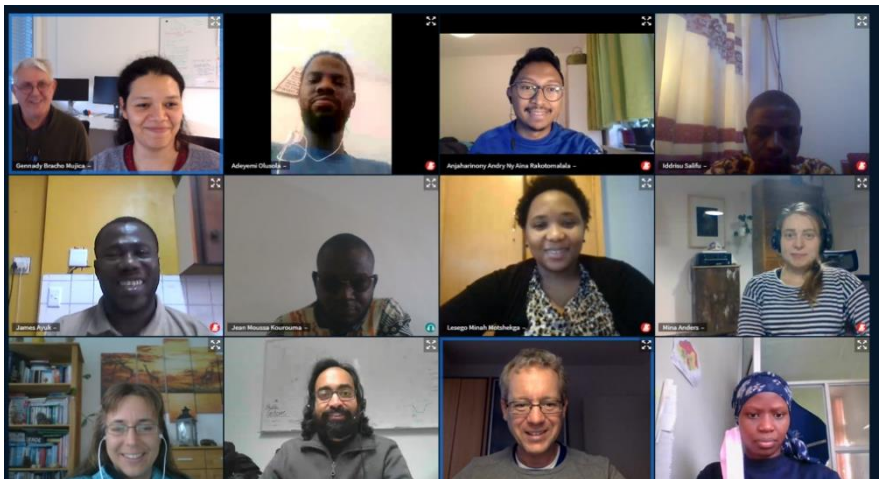

Fig: Participants of the online workshop: Socio-ecological modeling for multi-functional landscapes

The exchange between tutors and participants proved to be a great experience despite the virtual format of the workshop.

SALLnet workshop: Carrying capacity of the arid and semi-arid Limpopo rangelands in winter – Management options

The workshop on feed gaps and livestock production took place on 15-17 June 2022 and was planned and conducted by members of SALLnet’s work package 1 (Insitute of Grassland Science, University of Göttingen) with the support of Thünen Institut, University of Limpopo and University of Venda.

A total of 44 farmers, extension officers, researchers and students took part in the workshop in Polokwane (Limpopo, South Africa), which was very successful, with a lot of interaction and highly motivated participants. Problems and potential solutions around the topics of forage production for smallholder livestock farming systems were discussed with a special focus on the perceptions of stakeholders.

It is aimed to write an opinion paper summarizing outcomes from the discussions, which will be taken up for future works (e.g. virtual fencing).

Fig: Participants of the workshop “Carrying capacity of the arid and semi-arid Limpopo rangelands in winter – Management options” - Polokwane, 15-17 June 2022 (Image: Sala Lamega)

SPACES II Synthesis Meeting in Pretoria

From 14 to 16 June 2022, the final meeting of SPACES II took place on the Future Africa Campus of the University of Pretoria, South Africa (Figure 1). The three-day hybrid event was entitled: Earth system science informing policy – Policy needs guiding earth system science.

Figure 1: Participants of the SPACES II Project Synthesis Meeting at the Future Africa Campus of the University of Pretoria in South Africa (Image: ajraudiogear 2022)

Selected results of all SPACES II projects were presented at this event. The SALLnet project was represented by Prof. Dr. Reimund Rötter (virtually), Dr. Simon Scheiter (virtually) and Thomas Bringhenti (in person, Figure 2).

Figure 2: Joint presentation of SALLnet's results by Reimund Rötter, Simon Scheiter and Thomas Bringhenti and following round table discussion during the SPACES II Project Synthesis Meeting (Image: Thomas Bringhenti)

Upcoming Events

European Society for Agronomy XVII. Congress 2022, Potsdam (Germany)

29 August – 2 September 2022

Further information please find here.

Tropentag 2022, Prague (Czech Republic)

14-16 September 2022

Further information please find here.

4th Agriculture and Climate Change Conference, Dresden (Germany)

7-9 May 2023
Deadline for submission of abstracts: **11 November 2022**

Further information please find here.

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Information on SALLnet are as well to be found on our Website and on our Google Drive. Access to the Google Drive will be granted to everyone using the links implemented into this document. The Google Drive can as well be accessed via the link Project Documentation on our website for those of you who are registered. To register please send your google address to SALLnet's coordination.
We also recommend to visit the SPACES II website, where all capacity building courses of SALLnet and the entire SPACES II programme are announced (with access to the application platform).

SALLnet – South African Limpopo Landscapes Network

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