



Ensuring Rangeland Health through Sustainable and Digital Monitoring

Learning from Namibia

September 2025

Ethiopian  **ATI**
Agricultural Transformation Institute
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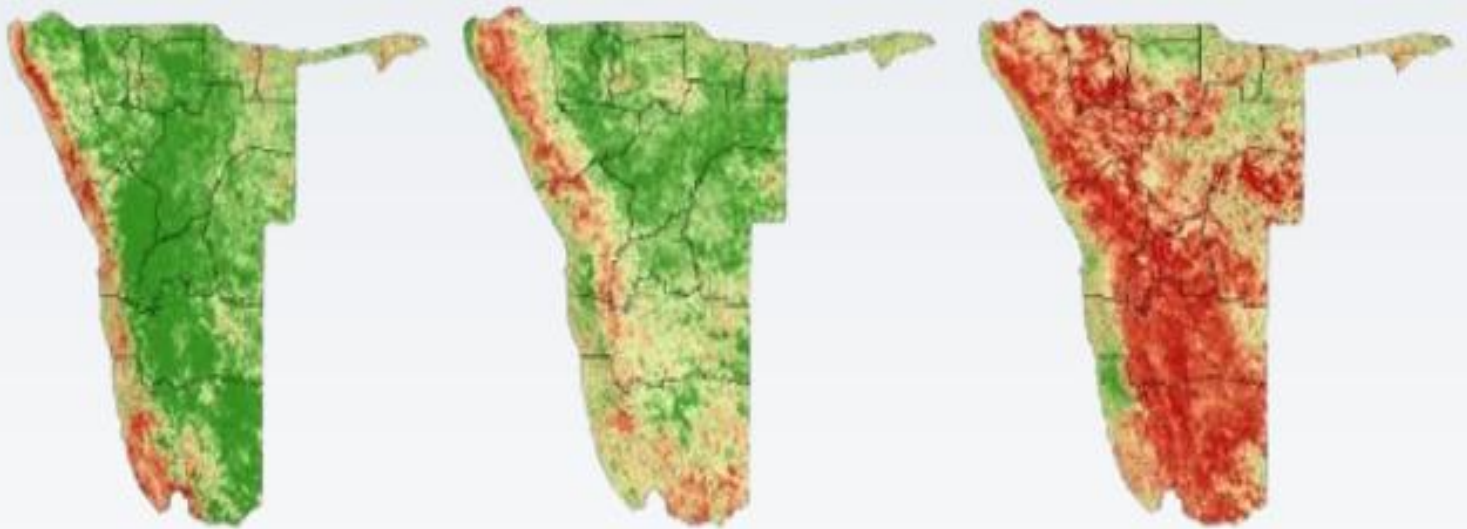

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LOWLANDS
SUSTAINABLE RANGELAND MANAGEMENT
INITIATIVE



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Prepared by: Participants of the Ethiopian delegation

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1. Introduction

Rangelands are the backbone of pastoral and agro-pastoralist livelihoods in Ethiopia. However, they face mounting pressures from land degradation, bush encroachment, recurrent droughts, and climate variability. These challenges threaten pastoral and agro-pastoral livelihoods, reduce livestock productivity, and undermine resilience.

In response, the Ethiopian Agricultural Transformation Institute (ATI), in partnership with the Lowland Livelihood Resilience Project (LLRP-II) and with support from the World Bank and the International Fund for Agricultural Development (IFAD), is developing a National Rangeland Monitoring System (NRMS). This initiative aims to strengthen sustainable rangeland management, enhance early warning capacities, and promote data-driven decision-making in pastoral and agro-pastoral areas.

As part of Ethiopia's effort to strengthen the National Rangeland Monitoring System (NRMS), a learning visit was organized to Namibia. Namibia is one of the countries in the region that has developed and implemented a comprehensive rangeland monitoring and early warning system over the past decades. The country's approach integrates scientific data, community observations, and decision-support tools to inform adaptive rangeland management. Learning from Namibia's practical experience is, therefore, expected to guide Ethiopia's ongoing efforts to operationalize and institutionalize NRMS.

1.1. Background

Namibia is among the Southern African countries with vast rangeland resources that are vital for the livelihoods of pastoral and agro-pastoral communities. The country has a long history of recurrent droughts, land degradation, and variability in rainfall. These have affected livestock productivity and rural livelihoods, instances similar in Ethiopia. To respond to these challenges, Namibia has developed a national rangeland monitoring and early warning system to track rangeland health and guide management decisions including:

- **Early Warning and Monitoring:** Early Warning System (EWS), SASSCAL ObservationNet, and satellite-based tools that provide near real-time data on forage availability, water point monitoring, and drought stress.

- **Grazing Management Systems:** Implementing adaptive practices such as the Split-Ranch System (SRS), Holistic Planned Grazing (HPG), and rotational grazing to align livestock numbers with ecosystem capacity.
- **Livestock Mobility and Traceability:** Applying digital tagging systems to monitor livestock movement and health, supporting compliance with export market requirements.
- **Bush Control and Biomass Utilization:** Transforming invasive and encroaching bush species into value-adding products (charcoal, biochar, fodder, and energy) while restoring grazing land.
- **Community and Institutional Models:** Namibia's conservancy model integrates livestock, wildlife, and tourism, ensuring community incentives for sustainable land use.

The lessons from Namibia's experience are, therefore, relevant to Ethiopia as the country develops and institutionalizes its own NRMS framework.

1.2. Objectives

The main objective of the Namibia learning visit was to gain practical understanding and insights into Namibia's operational rangeland monitoring and early warning systems.

Specific Objectives

- Examine how rangeland monitoring data are integrated into decision-making and early warning systems.
- Understand methodologies and tools used for data collection, analysis, and dissemination.
- Learn from Namibia's integrated rangeland management strategies, including bush-to-value chains, adaptive grazing systems, and restoration interventions.
- Learn about Namibia's institutional arrangement and governance structure for rangeland monitoring and data sharing
- Explore livestock traceability systems and rangeland-based livestock production models.
- Engage with local communities and institutions to understand practical application, user-centered design, and adoption pathways.
- Build partnerships with Namibian institutions, government agencies, and research institutions to support future collaboration.
- Identify best practices and lessons that can inform Ethiopia's NRMS development and implementation.

1.3. Scope of the Visit

The learning visit took place from September 1 - 5, 2025, and involved key experts and officials from the Ministry of Irrigation and Lowlands (Lowland Livelihood Resilience Project, LLRP), Ethiopian Agricultural Transformation Institute (ATI), Space Science and Geospatial Institute (SSGI) and the World Bank. The delegation was composed of technical and policy experts involved in the development and operationalization of Ethiopia's National Rangeland Monitoring System (NRMS). The visit covered both institutional and field-level engagements, including meetings with the Ministry of Agriculture, Water and Land Reform (MAWLR), the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL), and regional offices in Omaheke region. Field visits were organized to selected rangeland monitoring sites and community-based management areas to observe practical applications of Namibia's rangeland monitoring and early warning systems.

2. Detail Observations and Insights

Day 1: Opening Program and Discussion on Rangeland Monitoring System

The Ethiopian delegation arrived in Windhoek on 31 August 2025 and was welcomed by Mr. Evert Strydom, CEO of Rangeland Consulting & Services. The Ethiopian delegation kicked off its learning mission at the Mercure Hotel in Windhoek with an official opening program that set the tone for a week of South–South cooperation between Namibia and Ethiopia. The proceedings opened with welcoming remarks by Dr. Kenneth Shoombe, Chief Veterinary Officer at the Ministry of Agriculture, Water, and Land Reform (MAWLR), who underscored the central role of livestock in Namibia's rural economy and the shared challenges of recurrent drought, land degradation, and bush encroachment. He emphasized the importance of cross-country learning as a pathway to building resilient rangeland systems and conveyed his best wishes for the Ethiopian delegation to have a fruitful and enjoyable stay in Namibia.

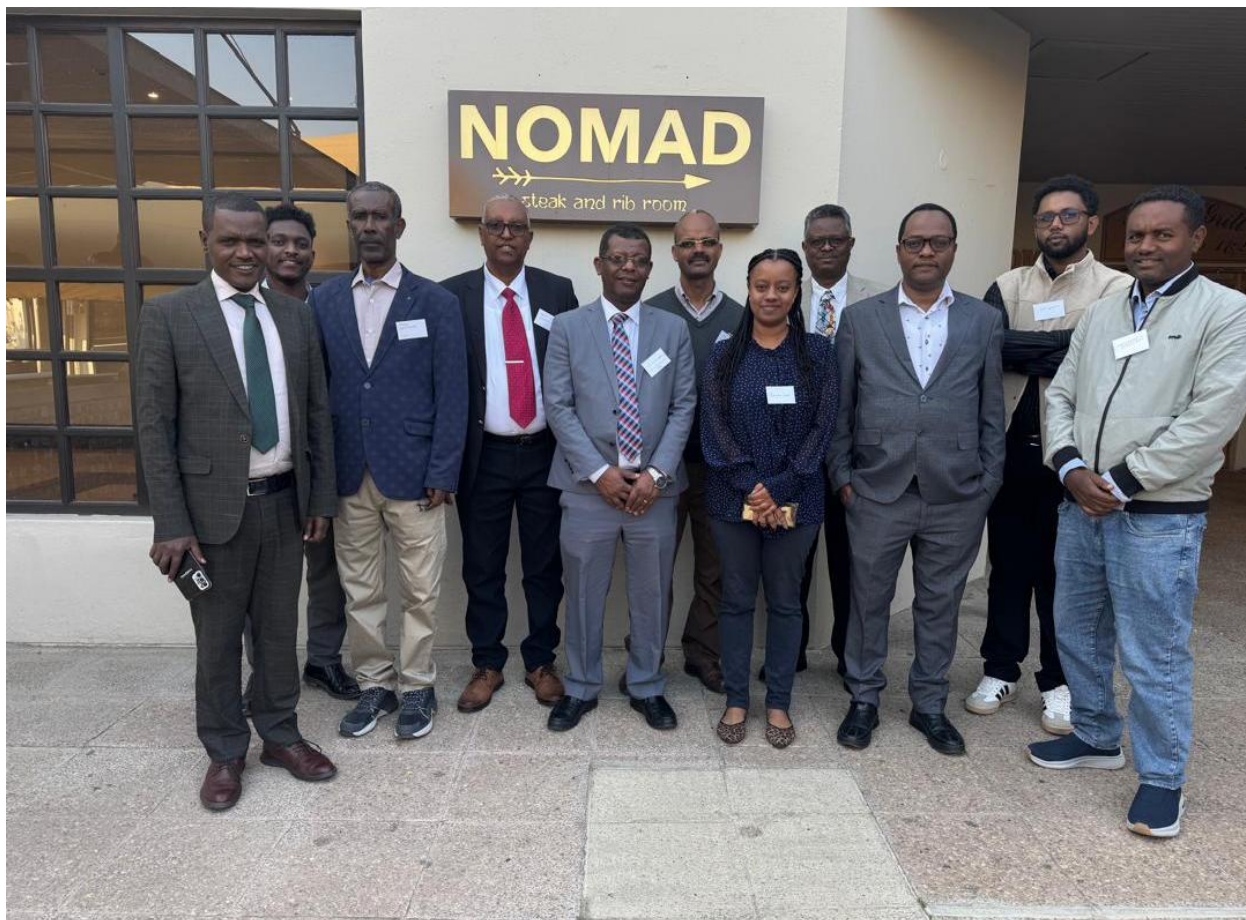


Figure 1. The Ethiopian delegation kicking off the mission with a group photo



Figure 2. Dr. Shoombe delivering the opening remarks at Mercure Hotel

On behalf of the Ethiopian delegation, Dr. Dagnachew Luel, Senior Director at the Agricultural Transformation Institute (ATI), presented the statement of purpose. He highlighted Ethiopia's objective of establishing a National Rangeland Monitoring System (NRMS) and the mission's aim of drawing practical lessons from Namibia's Early Warning Systems and institutional arrangements. He also expressed appreciation to the Namibian team for their warm welcome and hospitality.



Figure 3. Dr. Dagnachew outlining the purpose of the Ethiopian mission

Building on this, the morning discussion moved into a technical session with Dr. Deidre Januarie, Deputy Director for Livestock Research and Production, providing an overview of Namibia's agricultural sector. She emphasized that although agriculture contributes only about 5% to the national GDP, livestock dominates this share, accounting for nearly 90% of the contribution. With a national cattle herd of approximately 2.8 million, beef production and exports remain central to rural livelihoods and a key source of foreign exchange. Namibia's livestock base is diverse, ranging from indigenous Sanga cattle to numerous transboundary breeds, reflecting both commercial and communal production systems. Yet the sector faces pressing challenges, including climate variability, recurrent droughts, and bush encroachment. To address these, government and stakeholders are advancing a range of initiatives of rangeland restoration under the National Rangeland Policy and Strategy, community support through breeding animal distribution,

livestock auctions, and the Swakara Support Scheme, as well as small stock and poultry improvement programs, all aimed at strengthening resilience and sustaining productivity.



Figure 4. Dr. Deidre delivering a presentation on Namibian agriculture and rangeland

This was followed by Mr. Esayas Nigatu, Representative of the World Bank, who outlined the Bank's regional initiatives on climate resilience and agricultural transformation. He described ongoing projects currently supported in Ethiopia and reaffirmed the World Bank's broader commitment to advancing development initiatives across the continent. In his remarks, Mr. Esayas encouraged the Namibian team to explore opportunities for future collaboration with the Bank, noting the importance of aligning rangeland monitoring efforts with wider regional and continental frameworks.



Figure 5. Mr. Esayas presents the World Bank perspective on supporting development initiatives

Dr. Yoseph Mekasha, Director at the Agricultural Transformation Institute (ATI), then presented Ethiopia's perspective. He described Ethiopia as home to Africa's largest cattle herd and vast rangeland resources, much of them concentrating in the lowlands that sustain millions of pastoralists and agro-pastoralists. These areas are central to Ethiopia's food security and livestock economy, yet remain highly vulnerable to drought, land degradation, and climate shocks. Dr. Yoseph introduced ATI as the country's catalyst for agricultural transformation, highlighting its role in driving flagship initiatives and, most recently, leading the design of a National Rangeland Monitoring System (NRMS). He emphasized that the mission to Namibia was not only about learning technologies, but also about drawing lessons on how strong institutions, trusted data, and effective market linkages can translate monitoring into action on the ground. In this regard, he noted that Namibia's experience is directly relevant to Ethiopia's ongoing efforts to unlock the potential of its lowlands through sustainable rangeland management.



Figure 6. Dr. Yoseph presenting Ethiopia's agricultural perspective and introducing ATI

After a short break, the program continued with Mr. Evert Strydom, CEO of Rangeland Consulting and Services (RCS), who provided a detailed orientation on the week's agenda. He clarified logistical arrangements and explained how each visit would contribute to the mission's overall objectives.

The technical highlight of the day was the presentation by Dr. Cornelis van der Waal, Ecologist, who introduced Namibia's Early Warning System (EWS). He explained how satellite-derived vegetation indices such as NDVI and VCI, rainfall data from the WeatherNet station network, and

local field observations are combined to generate near-real-time assessments of forage and water availability. It is worth stressing that the system goes beyond analysis by providing advisories to farmers, enabling them to destock early and avoid catastrophic losses during droughts. This linkage of scientific data to farmer-level decisions stood out as one of the system's most innovative features.

Dr. Cornelis also described EWS's institutional journey. The system was initially developed between 2015 and 2018 with financial support from the European Union and Agribank of Namibia and implemented by Agra Provision together with Agri-Ecological Services. From 2018 to 2019, it was maintained with funding from Agribank and Agra Provision. Since 2019, it has been supported by the Namibian Chamber of Environment, continuing to be implemented by Agri-Ecological Services. Designed under Dr Cornelis' leadership as Principal Scientist, the platform integrates diverse data sources into a user-friendly digital interface accessible to farmers, researchers, and policymakers alike.

Key features of the platform include:

- Integration of satellite imagery, ground observations, and local knowledge for validation.
- Real-time monitoring of vegetation cover, soil moisture, and grazing conditions.
- Use of indices such as NDVI to assess rangeland health and predict grazing conditions.
- GIS-enabled mapping of rangeland use patterns, linking land management to ecological outcomes.
- Customized dashboards and advisory outputs, ensuring usability by both policymakers and farmers.

Through these features, Namibia has succeeded in making its EWS not just a scientific platform, but a decision-support tool for drought preparedness, market management, and sustainable rangeland use.

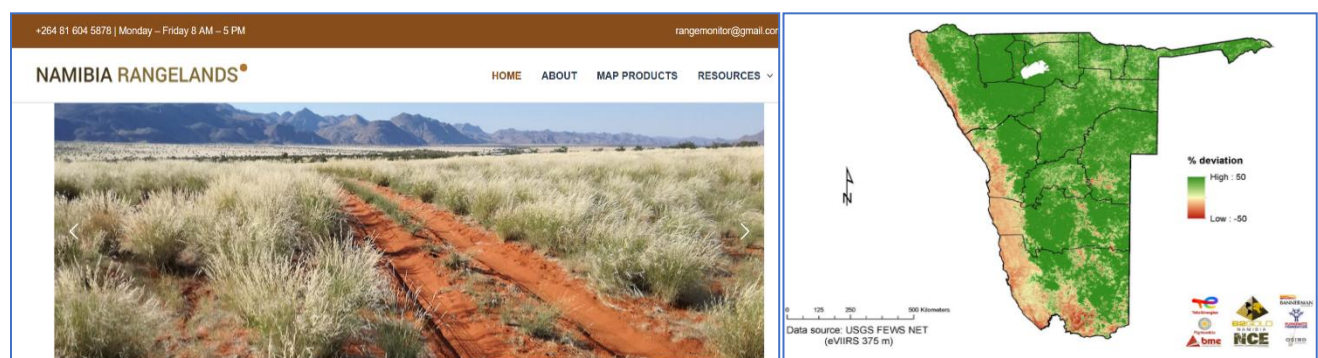


Figure 7. Namibia's Early Warning System interface, Source: EWS webpage

The Ethiopian delegation engaged actively with Dr. Cornelis in a lively Q&A, raising questions on the system's architecture, governance model, and strategies for user engagement. The questions particularly focused on:

- How the EWS integrates different data sources such as satellite-derived indices (NDVI, VCI), rainfall data from the WeatherNet network, and local field observations to generate reliable, real-time information.
- How GIS tools are applied to map rangeland use patterns and assess ecological changes over time.
- How complex datasets are translated into actionable outputs through dashboards and advisories that can be understood and applied by both policymakers and farmers.
- What institutional arrangements ensure continuity of the EWS beyond donor funding cycles, and how responsibility is shared among key institutions.
- How farmers' trust is built and maintained, particularly through participatory approaches that validate satellite outputs with local knowledge.
- How market signals are integrated so that advisories encourage timely destocking and restocking, avoiding panic sales and stabilizing incomes.
- How the system balances national planning priorities with local usability, ensuring that information is relevant and practical at multiple levels.

Responding to these questions, Dr. Cornelis explained that Namibia's EWS integrates remote sensing tools such as NDVI and VCI with rainfall data from the WeatherNet station network and field-level observations, enabling near real-time assessments of rangeland conditions. The system's technical backbone is supported by Automated Weather Stations and GIS tools that allow for mapping rangeland use and ecological change over time. Governance continuity has been promoted by gradually embedding the system within Namibian institutions, with sustained support from the Chamber of Environment and ongoing collaboration with MAWLR and local partners. On the community side, Namibia has piloted training initiatives in regions such as Kunene, where smallholder farmers are engaged in hazard detection, monitoring, and dissemination of warnings. This participatory validation strengthens trust in the system and ensures that advisories are grounded in local realities.

At the same time, Dr. Cornelis acknowledged that certain challenges still remain. Sustainable institutional takeover is still evolving, with questions about long-term custodianship across government agencies. He also noted that the system initially relied heavily on donor funding, making continuous financing for technical maintenance and upgrading an ongoing concern. Furthermore, while community engagement initiatives have been effective, scaling them across the country remains a work in progress.

For the Ethiopian delegation, these thoughtful reflections were especially valuable. They demonstrated that while Namibia's EWS is a strong example of how science, institutions, and farmers can be connected, its evolution has also required confronting sustainability and ownership challenges. Ethiopia's NRMS design will, therefore, need to anticipate similar issues, ensuring long-term institutional anchoring, financial sustainability, and strong farmer engagement alongside technical excellence.



Figure 8. Q&A session with Dr. Cornelis on Namibia's Early Warning System

In the afternoon, Mr. Dylan Dentlinger, Agricultural Expert at MAWLR, provided a broad overview of Namibia's agricultural sector with emphasis on the EWS's role. He explained that agriculture supports nearly 70% of Namibia's population, creating direct employment in production as well as indirect jobs across the value chain. He situated rangeland monitoring within

the wider agricultural economy, underscoring how early warning is most effective when aligned with livestock markets and food security policies.



Figure 9. Mr. Dentlinger delivering a presentation on Namibia's agricultural sector

The day concluded with reflections from the Ethiopian delegation, who emphasized that Ethiopia's emerging NRMS must combine strong technical tools with institutional ownership, farmer participation, and market linkages. By the end of the first day, the delegation gained both an institutional grounding and a technical appreciation of how Namibia links monitoring, governance, and markets into an actionable system. These insights established a strong foundation for the field visits to follow.

Day 2: Commercial Farm Visit and Technical Meetings on Namibia's Digital Platform for Rangeland Management

The second day of the mission took the Ethiopian delegation to Krumhuk Farm, an 8,000-hectare farm enterprise located about 25 kilometers south of Windhoek. Established in 1996, Krumhuk is managed under the principles of biodynamic agriculture, a holistic system that integrates livestock production, crop cultivation, and ecological restoration. The farm combines commercial operations with environmental stewardship, demonstrating how food production can coexist with conservation and community development.

Krumhuk Farm is recognized in Namibia as a living model of sustainable rangeland management. Through rotational grazing, bush control, and careful water management, the farm regenerates

degraded areas while sustaining livestock productivity. Wildlife such as oryx, kudu, springbok, and zebra coexist with cattle herds, illustrating how biodiversity can be preserved within productive landscapes. Beyond its agricultural role, Krumhuk plays an educational and social functions, hosting schools, training programs, and volunteer initiatives making it a hub for farmer learning and community engagement. Its guiding philosophy is that farming should not only generate food and income but also sustain ecosystems and nurture human well-being.



Figure. 10 Bird's eye view of Krumhuk Farm

For Namibia, Krumhuk represents how regenerative practices can be scaled to inform national rangeland strategies. For Ethiopia, the visit provided a first-hand opportunity to see how farm-level innovations are linked to monitoring systems and institutional frameworks, insights directly relevant for the design of a National Rangeland Monitoring System (NRMS).



Figure 11. Meeting participants posing for a group photo at Krumhuk Farm

The delegation was welcomed by Mr. Evert Strydom, CEO of Rangeland Consulting and Service, who linked the day's program to the mission's broader learning objectives. Mr. Clemens Voigts, farm manager, then introduced Krumhuk's philosophy of farming with nature and explained how the farm integrates livestock, rangeland health, and conservation into a unified management system.

The technical program began with Dr. Diego Menestrey Schwieger, who presented the NamTip Project on ecological tipping points. He explained how rangelands under stress from drought, bush encroachment, and overgrazing can cross thresholds that are difficult or impossible to reverse. Once these tipping points are passed, restoration costs rise dramatically, making prevention the only viable strategy. The project combines ecological monitoring, remote sensing, and participatory work with farmers to identify early-warning signals such as declining grass cover, soil erosion, and the spread of woody species. The Ethiopian delegation reflected that the emphasis on thresholds offered valuable lessons, and the National Rangeland Monitoring System should not only track ecological change but also alert managers before degradation becomes irreversible.



Figure 12. Dr. Diego Menestrey presenting NamTip project

This focus on prevention and preparedness is linked directly to the next presentations by Mrs. Sylvia Thompson and Mr. Albano dos Santos, introducing the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) and its Open Access Data Centre (OADC). They explained that SASSCAL operates more than 160 automatic weather stations across Namibia and neighboring countries, producing continuous datasets on rainfall, temperature, vegetation indices, and fire events. OADC, today hosts over 5,000 datasets accessible to researchers, policymakers, and farmers. The delegation was shown practical applications such as AgriWatch, which tracks vegetation and crop conditions, and the Dam and Reservoir Atlas, which monitors water storage. The Ethiopian team noted with interest SASSCAL's commitment to open access, which has helped build transparency and users' trust. Considering its relevance to Ethiopia's NRMS project, the delegation scheduled a follow-up meeting at SASSCAL's headquarters in Windhoek later in the week to discuss governance, financing, and possible collaboration.



Figure 13. SASSCAL experts, Mrs. Sylvia Thompson (left) and Mr. Albano dos Santos (right), presenting the Open Access Data Centre

Building on these institutional perspectives, the day then turned to practical farmer-facing tools. Mr. Bertus Kruger introduced the Field Photo Guide and the Fodder Flow app, both developed to make rangeland monitoring accessible to producers with minimal resources. The Photo Guide uses standardized images of rangeland at different biomass levels, enabling farmers to visually compare their pastures with reference conditions and estimate forage availability. This simple tool reduces reliance on technical measurements while still producing consistent and reliable estimates. The Fodder Flow app goes a step further, translating these estimates into stocking calculators that help farmers determine how many animals their land can carry and for how long. By linking biomass levels to herd size, the tool allows farmers to make informed decisions about destocking or supplementary feeding. The Ethiopian team reflected that such low-cost, practical methods could be especially valuable in Ethiopia's lowland pastoral systems, where technology adoption must be simple, trustworthy, and responsive to daily realities.



Figure 14. Mr. Bertus Kruger presenting Early Warning and Fodder Flow Planning (left) and Delegates reviewing the Field Photo Guide (right)

The program concluded with Mr. Evert Strydom, who presented PastureKey, a satellite-based biomass monitoring platform developed by CIBO Labs, an Australian company specializing in remote sensing for agriculture. Using Sentinel-2 imagery, PastureKey estimates total standing dry matter and differentiates between green and dry biomass. It produces paddock-level maps that allow farmers to visualize forage availability across their land and generate seasonal deciles, which place current conditions within the context of long-term historical trends. This enables farmers to assess whether their rangeland is in better, worse, or average condition compared to previous years.

Mr. Evert emphasized that the value of PastureKey lies in turning satellite data into operational advice. For example, farmers can use the maps to plan grazing rotations, adjust stocking rates, or decide when to destock before drought conditions cause market collapses. The Ethiopian delegation engaged actively on the question of validation, learning that field surveys and local observations are integrated into the platform to ensure accuracy. The key takeaway was that while satellite technology can revolutionize monitoring, its effectiveness depends on calibration with ground-level data and its packaging into user-friendly outputs that farmers can act upon.



Figure 15. Mr. Evert Strydom presenting satellite-based biomass map

Throughout the day, discussions circled back to common challenges: how to detect ecological tipping points early enough for action, how to integrate remote sensing with farmer knowledge, how to design governance systems that guarantee openness and trust, and how to secure long-term financing beyond donor cycles. Presenters acknowledged that while Namibia has made important

advances, scaling systems to communal farmers and embedding private innovations into national institutions remain ongoing tasks.

During the conclusion of the visit, the Ethiopian delegation was able to gain a comprehensive understanding of how Namibia combines advanced satellite systems, open-access data platforms, and farmer-friendly tools to build resilience in rangeland management. The crucial lesson for Ethiopia was clear: an effective NRMS must be both technically robust and socially grounded, capable of serving national planning while delivering practical, and everyday benefits to farmers.



Figure 16. Meeting participants posing for a group photo with Ethiopian and Namibian flag

Day 3: Visit to Community Rangeland and Engagement with Farmer Unions

The third day of the mission combined a field visit to Okandjira Farm, a communal settlement in the Omaheke Region, with institutional discussions involving Namibia's leading farmer organizations. This dual perspective allowed the Ethiopian delegation to see both the ecological and livelihood challenges faced at the community level, and the role of unions in shaping collective farmer representation at the national level.



Figure 17. Delegation engaging with community leaders of Okandjira Farm

At Okandjira Farm, the delegation was introduced to the settlement's history and context. The farm was officially handed over to the community in 2007 under Namibia's land reform and resettlement program, supporting communal livestock farming, promoting household food security, and improving rural livelihoods. Okandjira is home to pastoral households that depend mainly on cattle, goats, and small-scale crop production. Community leaders recalled both the opportunities and challenges since resettlement, including disputes over fencing, persistent water shortages, and limited infrastructure. Despite these constraints, households have sought to adapt through diversification strategies. These include Van Rooy sheep breeding, poultry production, irrigation for small-scale crops, and integrated livestock farming. These innovations, though modest, reflect a willingness to adapt to rangeland pressures and broaden income sources.



Figure 18. Diversification at Okandjira communal farm, poultry (left), Van Rooy sheep (middle), and irrigation (right)

From a rangeland ecology perspective, Okandjira illustrates the broader challenges of Namibia's semi-arid communal lands. Observations during the visit highlighted the widespread problem of

bush encroachment, dominated by *Acacia mellifera* and other wood species that significantly reduce grass biomass and grazing capacity. The team also noted signs of overgrazing and soil degradation, including bare patches, compaction near cattle posts, and early-stage erosion gullies. Water scarcity remains a persistent issue, with some boreholes out of service, limiting access to drinking points for livestock. Inadequate fencing has further contributed to uncontrolled livestock movement and localized grazing conflicts. Yet the delegation also observed areas where perennial grass remained, suggesting that with reduced pressure and improved management, recovery is possible.

Farmers also demonstrated their use of traceability tags at the farm level, which allow individual animals to be identified and tracked through the value chain. This practice is essential for Namibia's livestock sector, which exports beef to premium markets that demand strict quality and disease control standards. For the Ethiopian delegation, the use of traceability illustrated how even smallholder and communal systems can be linked to market requirements when supported by the right institutional and veterinary frameworks.



Figure 19. Demonstration of animal traceability tags at Okandjira for cattle (left) and sheep (right)

Discussions with community members stressed that the future of settlements such as Okandjira depends on better access to water infrastructure, stronger local institutions to regulate grazing, and support for bush control. For the Ethiopian delegation, the visit reinforced parallels with Ethiopia's lowland pastoral areas, where communal grazing, drought stress, and rangeland degradation similarly constrain productivity. The experience highlighted the importance of embedding ecological monitoring within a framework of community engagement and livelihood support, ensuring that monitoring is not an academic exercise but a tool for guiding recovery and resilience.

In the afternoon, the delegation met with representatives of Namibia's three leading farmer organizations: the Namibia Agricultural Union (NAU), the Namibia National Farmers Union (NNFU), and the Emerging Commercial Farmers Union (ECFU). Namibia's farmer unions are considered among the strongest in Southern Africa, providing a collective voice for producers across different farming systems. The NAU, founded in 1947, is the oldest union and primarily represents commercial farmers, focusing on competitiveness, sustainability, and access to export markets. The NNFU, established in 1992, represents communal and smallholder farmers, advocating for veterinary services, water development, and extension support. The ECFU, formed in 2003, provides a bridge for farmers resettled under land reform programs who are transitioning from communal to commercial production, helping them access markets and capacity-building support.



Figure 20. Meeting at the Namibian Agricultural Union

Union leaders explained their respective priorities and ongoing work. The NAU emphasized competitiveness and export markets, the NNFU highlighted communal farmers' service needs, and the ECFU shared the opportunities and difficulties of resettled farmers building viable commercial

operations. All of them emphasized the importance of strong farmer voices in national agricultural policy drafting processes.

Earlier that morning, during the field visit to the Okandjira communal area, the Ethiopian delegation observed livestock bearing official ear tags as an entry point into understanding Namibia's robust livestock traceability system, NamLITS. This system, managed by the Directorate of Veterinary Services, tracks individual animals from farm to market through unique identification numbers and a centralized digital database. It has been instrumental in maintaining Namibia's access to premium export markets by ensuring disease control, certifying animal origin, and enhancing transparency across the value chain.

During the meeting with the unions, a lively discussion unfolded how traceability works in practice and what it means for farmers. Unions acknowledged NamLITS as a powerful tool that opens access to lucrative export markets and strengthens disease management. However, they also raised concerns about its practical implications for communal farmers, particularly the costs and logistics of tagging, the need for sustained farmer training, and the risk of excluding producers who lack the resources to comply. Union representatives emphasized that for traceability to be truly equitable, farmer organizations must have an active role in managing the system, ensuring that data collected not only meets export requirements but also benefits local producers by improving market access and strengthening collective bargaining power.

The Ethiopian delegation reflected that Namibia's system of multiple farmer unions ensures diverse representation but also requires strong coordination. For Ethiopia, where pastoralists and smallholder farmers are often underrepresented in policy processes, the lesson was clear: building a future National Rangeland Monitoring System (NRMS) will require both inclusive institutional partnerships and practical, farmer-centered mechanisms for data collection and traceability. The goal should be a system that connects ecological data, livestock records, and market intelligence in ways that empower producers and inform national advocacy.

Day 3, thus, bridged the realities of communal farming on the ground with the institutional frameworks that support farmers' representation at the national level. Okandjira illustrated the ecological and socio-economic pressures of communal rangelands, while the union engagements highlighted how organized farmers' voices, supported by data systems like NamLITS, can shape policy and strengthen resilience. Key insights for day 3 include:

- The need for integrated management of communal rangelands, addressing bush encroachment, overgrazing, and water scarcity.
- The value of livelihood diversification (poultry, small ruminants, irrigation, and cattle) as a resilience strategy for communities.
- The importance of traceability systems, such as NamLITS, in linking even communal farmers to high-value markets, offering lessons for Ethiopia's livestock sector.
- The role of farmer unions and cooperatives in representing diverse constituencies and amplifying voices in policy processes.
- The recognition that community-level realities and institutional frameworks must be connected for monitoring systems to have a real impact.

Day 4: Stakeholder Meetings and Presentations

Day 4 of the learning mission was dedicated to knowledge exchange and institutional collaboration, featuring technical presentations at the Mercure Hotel and a follow-up visit to the SASSCAL Head Office. The sessions showcased Namibia's evolving ecosystem of climate services, sustainable land management practices, and innovative partnerships, offering valuable lessons for Ethiopia's planned National Rangeland Monitoring System (NRMS).

The morning began with a presentation on Namibia's Water Early Warning System, highlighting how hydrological and meteorological data are integrated to predict and manage the impacts of droughts. Rainfall, groundwater levels, and river flows are tracked using both ground-based sensors and satellite observations, with outputs processed through the Hydro-Met Database. Advisories are issued to regional authorities and farmers, supporting decisions on borehole use, livestock movement, and drought preparedness. For the Ethiopian delegation, the system demonstrated how integrating water and rangeland monitoring can improve resilience in dryland economies.



Figure 21. Presentation on Namibia's Water Early Warning System

The second presentation was given by Dr. Ndakafa Nghifindaka, President of the Emerging Commercial Farmers Union, who spoke on Cultural and Historical Perspectives of Namibian Agriculture. She traced the trajectory of Namibian agriculture from the colonial period through land dispossession to the resettlement and land reform era. Dr. Nghifindaka highlighted the resilience of emerging farmers in overcoming systemic barriers, stressing the importance of equitable access, women's leadership, and youth engagement in shaping the future of agriculture. The Ethiopian delegation drew strong parallels with Ethiopia's lowland transformation efforts, where cultural continuity and equity are also key to successful reforms.



Figure 22. Dr. Ndakafa Nghifindaka conducting a presentation on Namibia's agricultural transformation

This was followed by a presentation by Mr. David Shipingana of the Perivoli Rangeland Institute on Biochar and Carbon Credits. He explained how Namibia's bush encroachment challenge can be turned into an opportunity by converting woody biomass into biochar. Beyond soil restoration, biochar provides a new income stream through carbon credits on voluntary markets. Pilot projects already show promise in linking ecological rehabilitation with climate finance. The Ethiopian delegation noted the relevance of this approach for Ethiopia's bush management strategy, particularly in linking land restoration with carbon markets.

After the break, Mr. Colin Nott, a regenerative rangeland ecologist, made a presentation under the title "Comparative Perspectives of Ethiopian and Namibian Agricultural Systems." He highlighted ecological similarities in semi-arid zones, cyclical drought, and grazing pressures, and argued that adaptive grazing management and farmer participation are as important as technology. His remarks reinforced the mission's central theme: monitoring systems succeed only when they are paired with farmer-led stewardship.



Figure 23. Mr. David Shipingana delivering a presentation on Biochar and Carbon Credits



Figure 24. Mr. Colin Nott presenting a comparative assessment of Ethiopian and Nambian Agriculture system

The final session for the morning was delivered by Angelina Kandubarisa, lead trainer at Agra ProVision, who outlined how the organization blends commercial services with advisory support. Agra ProVision provides inputs, market facilitation, and extension services supported by digital tools and field agents. Their advisory services integrate pasture monitoring, seasonal forecasts, and livestock market data, enabling farmers to make evidence-based decisions. The Ethiopian

delegation reflected that Ethiopia could benefit from similar public–private partnerships, ensuring that NRMS data are not confined to government institutions but reach farmers through service providers.



Figure 25. Mrs Angelina Kanduvarisa presenting Agra ProVision's service model

Ethiopian Delegation Visit to SASSCAL

In the afternoon, the delegation visited the Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL) headquarters, continuing the collaboration initiated earlier at Krumhuk Farm. SASSCAL was founded in 2012 by Namibia, Angola, Botswana, South Africa, Zambia, and Germany to provide regional science services on climate and land management. The organization is funded primarily by the German Federal Ministry of Research and Technology, while member states contribute to operational costs. National nodes operate in each member state, with the regional secretariat based in Windhoek, Namibia.

At SASSCAL, the Ethiopian delegation was introduced to the Open Access Data Centre (OADC), which consolidates data from more than 150 automatic weather stations, satellite imagery, and ecological research projects across Southern Africa. OADC offers a user-friendly interface that allows farmers, policymakers, and researchers to access real-time information on rainfall, vegetation condition, and drought risk. The delegation noted that SASSCAL's open-data

philosophy was particularly important, as it builds trust, encourages transparency, and ensures that data are broadly applied.

Beyond the data center, SASSCAL staff highlighted the institution's broad service portfolio:

- **Research and Development:** Conducting climate and land-use research to inform biodiversity conservation, food and water security, and adaptive management.
- **Capacity Building:** Offering workshops, internships, and fellowships for young professionals across the region.
- **Data Collection and Management:** Operating extensive monitoring networks and databases that track climate, hydrology, and ecological change.
- **Collaboration and Partnerships:** Working with governments, academic institutions, and communities to ensure research is relevant and applicable.
- **Policy Support:** Providing evidence-based advice for climate adaptation strategies and sustainable land use.
- **Technology Transfer and Climate Services:** Demonstrating pilot projects, offering localized forecasts, and developing tools for land managers and communities.
- **Public Awareness:** Engaging stakeholders through outreach programs and ensuring local voices inform climate action.

The Ethiopian delegation engaged actively with SASSCAL staff, asking questions about governance, long-term financing, and regional collaboration. SASSCAL acknowledged that while its research outputs are robust, ensuring sustainable funding and embedding its services within member states remain ongoing challenges.

For Ethiopia, the visit provided several key lessons:

- Open-access systems foster transparency and trust, making monitoring outputs more usable.
- Regional cooperation can pool resources and expertise that no single country can achieve alone.
- Capacity building is as important as technology, since trained professionals sustain systems over time.
- Climate services must combine data with communication, ensuring information is accessible to communities, not only to policymakers.

The Ethiopian delegation expressed strong interest in pursuing joint research, capacity-building initiatives, and technical cooperation with SASSCAL, particularly in areas related to climate resilience, sustainable rangeland management, and data-driven decision-making. They emphasized the importance of knowledge exchange, collaborative pilot projects, and training programs that could enhance both institutional and technical capacities in Ethiopia, while fostering stronger regional partnerships.



Figure 26. The Ethiopian delegation with SASSCAL staff at headquarters in Windhoek

By the end of Day 4, the Ethiopian delegation gained a multi-dimensional perspective on Namibia's climate and rangeland institutions. From water and biochar innovations to farmer-driven unions, private-sector models, and regional science services, the day reinforced the fact that sustainable systems emerge when technology, institutions, and people work together.

The Ethiopian team also presented the status of NRMS development in Ethiopia, sharing lessons from pilot sites and discussing challenges in data management and institutional integration. The meeting concluded with discussions on areas of potential collaboration, including data-sharing frameworks and capacity-building exchanges.

Day 5: Biomass and Visit to Research Centers

Day 5 of the Ethiopia-Namibia learning mission centered on innovation in biomass utilization, sustainable rangeland management, and applied agricultural research. The day began with a visit to the Namibia Biomass Industry Group (N-BiG), followed by a field engagement at the University of Namibia's Neudamm Campus. Together, these sessions provided valuable insights into how Namibia is transforming environmental challenges, particularly bush encroachment, into economic and ecological opportunities through science, enterprise, and institutional collaboration.

The morning session began with a meeting at Namibia Biomass Industry Group headquarters, where the delegation was welcomed by Mr. Daniel Shahama, Operations Manager, and his technical team. The meeting provided a comprehensive overview of Namibia's growing biomass sector and its pivotal role in restoring degraded rangelands.

N-BiG was established in 2015 under the Bush Control and Biomass Utilization Project, a collaboration between the Government of Namibia and the German Development Cooperation (GIZ). Conceived as a multi-stakeholder platform, the organization brings together farmers, private companies, researchers, and policymakers to advance the sustainable use of biomass resources. Its core mission is to turn bush encroachment, which affects over 45 million hectares of Namibia's rangelands, into a viable engine for economic growth and climate resilience.



Figure 27. The Ethiopian delegation at the Namibia Biomass Industry Group headquarters

An objective statement for Ethiopia was delivered by Mr. Dagnachew Lule, Senior Director of Ethiopia's Agricultural Transformation Institute (ATI), who spoke on "Biomass Perspectives from Ethiopia." He outlined Ethiopia's experience and challenges in managing dryland resources and developing renewable energy solutions, emphasizing opportunities to transform woody encroachment and agricultural residues into productive assets. His opening remark set the tone for a South-South dialogue on how biomass can underpin both climate adaptation and economic transformation.

Following this, a detailed presentation was delivered on "Biomass Opportunities from Bush Encroachment." Mr. Daniel began by highlighting the ecological scale of bush encroachment, which has dramatically reduced Namibia's livestock carrying capacity and biodiversity. Yet, through coordinated industry action and research partnerships, this challenge is being recast as a national opportunity.

N-BiG is facilitating a biomass-based circular economy by connecting producers, processors, and markets. Its work spans several fronts:

- Developing Biomass Industrial Parks (BIPs) as regional processing hubs for bush-to-feed, biochar, charcoal, and renewable energy products.
- Promoting sustainability and certification schemes, including FSC and SURE standards, to access international markets.
- Introducing digital biomass quantification tools that combine field data, drone imagery, and remote sensing to map harvestable resources.
- Providing training and technical support for SMEs and cooperatives engaged in bush harvesting and processing.
- Supporting policy and market development to anchor the biomass sector within Namibia's green economy strategy.



Figure 28. Presentation on N-BiG's biomass innovation model

Through these efforts, N-BiG has created one of Africa's most dynamic biomass value chains, generating thousands of jobs, promoting rural enterprise, and contributing over N\$1.3 billion annually through charcoal and biochar exports. The organization's model demonstrates how environmental rehabilitation, economic diversification, and climate mitigation can reinforce each other.

During the discussion, the Ethiopian delegation engaged actively with N-BiG's leadership on potential areas of collaboration, including joint research on bush-to-feed conversion, carbon credit certification, and technology exchange on biomass mapping and monitoring. The two sides agreed on the importance of a structured partnership between N-BiG and ATI, recognizing that both institutions share a mandate to promote sustainable resource use through innovation and market systems.

Following the discussion, the delegation joined a short briefing circle showcasing biomass products such as biochar, animal feed pellets, and briquettes made from encroacher bush. The team explained how these innovations add value to degraded landscapes, while supporting renewable energy, soil health, and rural employment.



Figure 29. Product showcase and group photo at N-BiG

After the N-BiG engagement, the delegation traveled east to the University of Namibia's Neudamm Campus, a center of excellence in agricultural education and research. Located about 30 kilometers from Windhoek, Neudamm integrates classroom learning, laboratory research, and hands-on training in livestock production, rangeland management, and agricultural innovation.

The delegation was warmly welcomed by Prof. Simon Angombe, who delivered an introductory presentation on Rangelands and Commercial Livestock Production Research at Neudamm. He explained how the University's programs link academic research with practical field applications, addressing challenges such as forage scarcity, bush encroachment, and drought resilience. The presentation showcased the Rangeland Mapping Project, which uses ground surveys and satellite imagery to assess carrying capacity and guide sustainable grazing management. He also

highlighted collaboration areas with Ethiopia, specifically on the projects implemented by ATI, such as 8028 hotline for advisory service and other digital initiatives.

The Ethiopian delegation also delivered a concise briefing on the ongoing projects at ATI, highlighting key initiatives and opening a discussion on potential areas for collaboration in response to the interest expressed by the Neudamm team.



Figure 30. Meeting at UNAM on rangeland research initiatives

The next session was led by Mr. E. Beukes, who made a presentation on “Commercial Livestock Production at Neudamm.” He described how the campus operates diverse livestock units, cattle, sheep, goats, pigs, and poultry that serve both research and teaching purposes. Students and researchers conduct joint trials on feed formulation, breeding, and animal health, ensuring that scientific knowledge directly informs farm management practices.

Mr. Beukes highlighted that Neudamm’s model bridges academia and industry, producing graduates who are both technically skilled and commercially aware. The Ethiopian team noted that this integration of research, training, and extension closely aligns with Ethiopia’s Agricultural Commercialization Cluster (ACC) approach.

Following the presentations, the delegation toured the Neudamm research facilities and demonstration farms. The walk-through included visits to the cattle feedlot, dairy unit, and pasture research fields. Faculty members explained how ongoing experiments in feed optimization, pasture recovery, and bush thinning contribute to Namibia's National Rangeland Monitoring System. The experiential learning provided practical insights into how universities can anchor innovation and policy linkages in agriculture.



Figure 31 Touring livestock research and demonstration facilities at Neudamm Campus

The combined engagements at N-BiG and UNAM revealed how Namibia was able to build a coherent ecosystem, connecting science, enterprise, and governance around sustainable land management. For the Ethiopian delegation, several key lessons emerged including:

- **Transformative thinking:** Namibia's approach demonstrates how an ecological crisis like bush encroachment can evolve into a vibrant economic sector supporting livelihoods and climate goals.
- **Institutional integration:** Strong coordination among government, academia, and the private sector ensures that research outputs translate into practical, and market-ready solutions.
- **Technology and data:** Digital tools from biomass quantification to rangeland mapping.
- **Knowledge partnerships:** Cross-country collaboration accelerates innovation and mutual learning, especially in areas such as biomass utilization, digital agriculture, and capacity building.

By the end of Day 5, the Ethiopian delegation was able to gain a nuanced understanding of how Namibia's biomass and research institutions drive sustainability through innovation and partnership. The day reinforced a central theme of the learning mission that resilient agricultural systems emerge when technology, enterprise, and stewardship work in tandem to turn environmental challenges into opportunities thereby ultimately ensuring transformation.



Figure 32. Group photo of the Ethiopian delegation with UNAM representatives

Day 6: Reflection, Synthesis, and Way Forward

The final day was dedicated to reflecting on the week-long learning experiences and identifying key lessons relevant to Ethiopia's rangeland monitoring system. The Ethiopian delegation held a joint session with stakeholders to summarize major insights and discuss possible areas of collaboration in the evening of 6 September 2025 at Mercure Hotel. Key lessons highlighted the importance of institutional ownership, consistent data flow, and regular capacity building to sustain the rangeland monitoring and early warning system. Participants emphasized that sustained government commitment and clear coordination mandates are critical for operationalizing Ethiopia's NRMS. The session also explored potential collaboration of areas, including experience sharing, technical training, and integration of satellite data platforms. The learning visit concluded with closing remarks from both countries, underscoring the value of South–South knowledge sharing in building resilient and data-driven rangeland management systems.

3. Summary of Key Insights and Lessons

The learning visit provided valuable insights into Namibia's rangeland monitoring and early warning systems, which can inform Ethiopia's ongoing NRMS development. Key lessons are summarized as follows:

System Development and Technical Insights

- Early Warning Systems (EWS) must integrate multiple data sources: satellite imagery (NDVI, VCI), rainfall networks, automatic weather stations, and community-level observations.
- GIS tools enhance rangeland monitoring by mapping land-use patterns, vegetation dynamics, and bush encroachment trends.
- Open-access platforms such as SASSCAL's Data Centre show how science can be translated into user-friendly dashboards for policymakers, researchers, and farmers.
- Linking ecological monitoring with market signals (destocking advisories, price information) makes early warnings actionable rather than theoretical.
- Lesson for Ethiopia: The NRMS should not only be a data warehouse but a decision-making support tool that connects ecological monitoring with practical farmer and policy decisions.

Governance and Institutional Insights

- Namibia's experience shows the value of multi-actor governance: government (MAWLR), farmer organizations (NAU, NNFU, ECFU), NGOs, and private sector actors - all play complementary roles.
- Sustained operation requires embedding systems into permanent national institutions rather than short-term projects.
- Farmer representation through unions ensures feedback loops between monitoring outputs and farmer realities.
- Lesson for Ethiopia: Ethiopia's NRMS must have clear custodianship (who owns and manages it for the long-term) and mechanisms for inclusive governance that bring pastoralists, cooperatives, and unions into decision-making process.

Funding and Financial Sustainability

- Namibia's EWS was initially donor-driven (EU, Agribank), but long-term sustainability remains a challenge due to limited domestic financing
- Innovations such as biochar-carbon credit projects demonstrate ways to link ecological restoration with climate finance
- Private advisory services like Agra ProVision illustrate how market-based models can support sustainability while serving farmers
- Lesson for Ethiopia: A sustainable NRMS must combine public funding, donor support, and explore climate finance and private-sector models to reduce dependence on external grants

Capacity Building and Human Resources

- Universities such as UNAM Neudamm Campus are central to training the next generation of rangeland experts
- SASSCAL offers internships, fellowships, and workshops to build skills in climate science, data management, and adaptive land management
- Farmer capacity is built through participatory validation of monitoring data (e.g., communities' ground-truthing satellite outputs)
- Lesson for Ethiopia: Alongside technical systems, Ethiopia must invest in human capacity, both institutional experts and community-level users who can interpret and apply monitoring information

Community Engagement and Trust

- Namibia's EWS builds farmer trust by combining local knowledge with scientific data and disseminating advisories in accessible formats
- Pilot projects in areas like Kunene show that community training in hazard detection improves uptake of advisories
- Traceability initiatives at farms (livestock tagging) enhance disease control and market compliance, linking monitoring to livelihoods
- Lesson for Ethiopia: Trust and adoption depend on inclusive engagement; communities must be partners in monitoring, not just recipients of data

Policy and Strategic Alignment

- Namibia integrates different systems into national drought policies, livestock marketing strategies, and food security frameworks, making the system part of decision-making, not an isolated tool
- Farmer unions use monitoring data to influence land reform debates, water allocation, and veterinary services, ensuring data informs policy advocacy
- Lesson for Ethiopia: The NRMS must be aligned with Ethiopia's broader policy frameworks (climate adaptation, livestock development, and land reform) and provide credible evidence for both government action and farmer advocacy

Innovation, Entrepreneurship, and Partnerships

- N-BiG (Namibia Business Innovation Centre) shows how innovation hubs can incubate agri-tech solutions and youth-led enterprises linked to rangeland monitoring.
- Public-private partnerships (e.g., Agra ProVision) strengthen extension delivery and data services.
- Regional institutions like SASSCAL illustrate the power of cross-country collaboration, pooling knowledge and resources.
- Lesson for Ethiopia: Ethiopia's NRMS should link with innovation ecosystems (start-ups, private sector, research networks) and pursue regional partnerships to scale up knowledge and tools.

4. Key Next Steps

Based on the insights gained from the learning visit, the Ethiopian delegation identified the following key next steps to advance the implementation of the National Rangeland Monitoring System (NRMS).

Enrich the National Rangeland Monitoring System (NRMS)

- Strengthen the design and implementation of Ethiopia's NRMS by integrating Namibia's best practices in data-driven rangeland monitoring, institutional coordination, and the use of digital tools for early warning and decision support.

Collaboration on livestock traceability and export readiness

- Explore partnerships with Namibia's Directorate of Veterinary Services and the Namibian Agricultural Union to adapt lessons from the NamLITS system. This includes approaches to animal identification, data governance, and integration of smallholders into formal markets.

Joint learning on bush control and value addition

- Engage with Namibian experts and private sector actors involved in bush-thinning and biomass utilization to explore scalable models for Ethiopia. Collaborative initiatives could focus on transforming invasive bush species into value-added products such as animal feed, charcoal briquettes, and industrial biomass, creating both ecological restoration and rural livelihood benefits.

Strengthening farmer representation and institutional linkages

- Foster dialogue among Ethiopian cooperatives, unions, and Namibian farmer organizations (NAU, NNFU, and ECFU) to enhance inclusive governance and advocacy. Learning exchanges could focus on mechanisms for policy engagement, service delivery, and integrating farmers' voices into national monitoring and decision-making processes

Establishing a technical partnership framework

- Develop a Memorandum of Understanding (MoU) between ATI and key Namibian counterparts, MAWLR, UNAM, and the agricultural unions to formalize cooperation.

This framework could guide knowledge sharing, staff exchanges, joint research, and pilot projects aligned with both countries' agricultural transformation priorities

5. Appendices

APPENDIX 1. LIST OF PARTICIPANTS

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11	Seid Omer	Lowland Livelihood Resilience Project	National Project Coordinator
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APPENDIX 3. LEARNING VISIT AGENDA

Date	Activity	Location
Monday, 1 September		
Morning	Opening program and courtesy meeting at Mercure Hotel	Mercure Hotel, Windhoek
Afternoon	Technical discussion on Namibia’s Early Warning System	
Tuesday, 2 September		
Whole day	- Field visit to a commercial farm, Krumhuk Farm - Technical meeting on Rangeland Monitoring Systems - NamTip Project, Sasscal and Early Warning Systems, Cibo Labs - Grass Biomass System and Photo Guide	Willemshof, Windhoek
Wednesday, 3 September		
Morning	Field visits to a communal farm, Okandjira Community - Communal farm management - Meeting with the local council	Okandjira Settlement
Afternoon	Meeting with Farmer Union - Namibian Agricultural Union - Namibian Emerging Commercial Farmers Union - Namibian National Farmers Union	Robert Mugabe Av, Windhoek
Thursday, 4 September		
Morning	Stakeholder meetings and presentations - Water Early Warning System - Cultural and Historical Perspectives on Namibian Agriculture - Biochar Carbon Credits - Perspectives of Ethiopian and Namibian Agricultural Systems - Agra ProVision	Mercure Hotel, Windhoek

<i>Date</i>	<i>Activity</i>	<i>Location</i>
<i>Afternoon</i>	Meeting at Sasscal, an organization working on an integrated climate change and adaptive land management service	Robert Mugabe Av, Windhoek
<i>Friday, 5 September</i>		
<i>Morning</i>	Meeting at Namibia Biomass Industry Group (NBIG) Biomass opportunities from bush encroachment	Von Braun St, Windhoek West
<i>Afternoon</i>	Visit the University of Namibia, Neudamm Campus - Presentations on development projects - Visit the compus and livestock production	B6 to Gobabis, Windhoek Rural

APPENDIX 4. PHOTO GALLERY

Ethiopian Delegation Presenting Token Gift to the Namibian counterparts



