The Integrated Land Management Institute is a centre of the Faculty of Natural Resources and Spatial Sciences (FNRS) at the Namibia University of Science and Technology (NUST) committed to develop reputable and multidisciplinary research and public outreach activities in the field of land, administration, property, architecture and spatial planning.

The Land, Livelihoods and Housing Programme 2015-18 aims at deepening and expanding the focus on these three key issues in Namibia. The programme was developed to guide ILMI’s activities by organising it in four aspects: institutional, environmental, fiscal and spatial processes.

Gully-affected areas in the Kunene region: looking for suitable locations for future citizen-science project

Summary

Land degradation in Namibia is currently threatening livelihoods from several regions of the country. One of the major causes of land degradation in Namibia is soil erosion, which produces very critical ecological, landscape and economic damage when it manifests in the form of gullies. The development of standardized methods to detect and monitor the evolution of gully-affected areas is crucial to plan prevention and remediation strategies. Previous research supported by Integrated Land Management Institute (ILMI) and German Aerospace Center (DLR) was focused on the development of methods to detect gullies automatically from satellite remote sensing data (Vallejo et al, forthcoming). Although the results are valid for carrying out a preliminary large-scale spatial mapping, the satellite images are not usable for a detailed modelling in time and space. For this reason, new methodologies are proposed to address the problem from a different perspective, this time using the local inhabitants as a citizen scientist in a crowdsourcing approach. To set the foundation of this project, planned for 2019, it is necessary to identify several pilot areas where there are gullies of different types and where the local inhabitants are interested in collaborating. Therefore, this working paper intends to document a field work campaign carried out with this aim.

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**Introduction**

The idea behind this project is to find suitable locations to focus in subsequent gully-related studies. Kunene region is one of the most severely affected areas by land degradation and gullies due to several reason derived from climate change and inappropriate land uses (i.e. overgrazing). Different projects (i.e. SASSCAL Task 41 (SASSCAL, 2017), EU Stabilizing Eroded Areas by planting drought tolerant fodder shrubs) are implemented here with the intention of addressing the problem, trying to stop gully advancement, and minimize their effects. Different solutions in place are applied on different types of gullies, therefore this area is of special interest to researchers. Since the final goal is to test measuring techniques for gullies at different spatio-temporal scales, it is critical to find gullies of different typology in terms of size and shape.

**Objectives**

Our main objective was to find and georeference three suitable gully affected areas, document graphically their characteristics as well as create contacts with local communities and authorities mandated with land management issues. The main criteria to decide on the selection of gullies were:

- **Size and shape:** the measuring technology must be tested for gullies of different sizes (in terms of width, depth) ranging from 2-3 meters to gullies as large as 200 m width. It was also important to identify gullies with different shapes (i.e. U-Shape, V-Shape, etc.)

- **Accessibility:** finding locations easily accessible by car was also a selection criterion, as measuring equipment (i.e. GPS, LiDAR, Photogrammetry equipment) must be transported in subsequent visits.

- **Feasibility of joint work with locals:** Since the final goal is to develop a collaborative mapping concept, it is fundamental to have the commitment of local people to do basic field measurements and with the possibility to send the collected data periodically to NUST (i.e. access to internet, email, WhatsApp).

**Study Area**

The study area is located in the northern part of Kunene region (Namibia), covering different sites near Opuwo. Figure 1 illustrates the different gully locations and the road connections from Opuwo.

**Figure 1.** Location map of the study sites visited in August 2018.
Results

After several visits to different locations, the following gullies were selected and described for future studies:

Gully 1

This gully is classified as a small gully (< 5 m width and 1 m depth) which has been treated in the past during SASSCAL TASK 41. It is especially interesting to test the capabilities of measuring techniques to monitor gully dynamics in detail i.e. how is the bush filters efficiency and effectiveness through the years. Our contact person in Erora, where Gully 1 is located, is Mr. Nelson, who has been collaborating with SASSCAL TASK 41 in the past.

![Figure 2. Photos of Gully 1 in Erora. Left image shows remediation works carried out between 2013 and 2017 as part of SASSCAL.](image)

Gully 2

This gully is classified as a medium gully (5 – 15 m width and 1 -3 m depth) and has not been treated in the past. As it can be seen in the figure 3, this gully is very active (visible roofs) and it is surrounded by woody vegetation in the ledges, which is a factor to be considered while measuring the gully morphology (i.e. through Terrestrial LiDAR Scan (TLS) and close-range photogrammetry). Our contact person for this gully is also Mr. Nelson, who has been collaborating with SASSCAL in the past.

![Figure 3. Photos of Gully 2 in Erora. Image showing the gully dimensions (top left), gully V-Shape (top right) and the recent erosive activity (down).](image)
Gully 3

This is typically classified as a large gully (50 – 200 m width and 10 -30 m depth). It was treated as part of an EU project to stabilize the soil in the margins of the gully though plantations of different local species: omungambú, amukarabize, omukeka and otxipembati. As it can be seen in figure 4, some parts of the gully are very active, and the erosive impact is catastrophic in terms of soil loss. The dehydration effect on the surrounding landscape is evident and very detrimental/harmful for several Himba communities living nearby and subsisting from different types of farming (i.e. goats, cattle, etc). Our contact person is Mr. Tjakazapi Mbunguha, who has been collaborating with EU projects in the past. This gully has a specially scientific interest due to the geomorphological processes associated, as evidenced by the existing publications on it (Brunotte and Sander 2000 ; Brunotte et al. 2009).

![Photo of Gully 3, 14 km south to Opuwo. Left and right top images show the advancement of gully branches while the image below presents a general view the gully.](image-url)
Further steps

The three gullies have been selected. Currently the authors are looking for funding to implement a crowdsourcing and citizen science project. This concept would include different kinds of technology managed by NUST Staff, NUST Students and local citizens. The proposed methods for this study are to acquire datasets through mobile application and involvement of citizen science crowdsourcing to complement existing remotely sensed databases. This process will involve farmers and extension officers to record and update field data (i.e. gully perimeter, size and shape) on regular basis using low cost technologies (i.e. GPS, Smartphone camera and drones). Following the completion of the data collection, spatiotemporal data analysis and reporting will be performed. Finally gully information sheets with statistics about their evolution will be produced and disseminated via digital platforms. The concept note of the proposed approach is presented in the following illustration (Figure 5):

**Figure 5.** General concept of project implementation for a citizen based VGI project in Namibia to measure and monitor gully evolution.
References


