Identifying and describing the impact of gully erosion in the livelihoods and properties of traditional Himba communities in Kaokoland (Namibia) as a driver of regional migration

Miguel Vallejo Orti[1], Bernhard Höfle[2], Olaf Bubenzer[1], and Kaleb Negussie[3]

[1]Heidelberg University
[2]3DGeo Research Group, Institute of Geography, Heidelberg University, Germany
[3]Namibia University of Science and Technology

November 21, 2022

Abstract

Gully erosion is an accelerator of land degradation and one of the most critical agents threatening the environment in Namibia's north-western region. Large gullies dominating alluvial valleys expand each year during the short but intense rains, leading to a reduction of arable land and grazing areas, destruction of roads, cattle paths, agricultural facilities, and houses, prompting territorial fragmentation and the geographical isolation of local communities. In contrast, gullies can also act as a linear oasis while providing several benefits to their inhabitants. This research aims to describe the mutual influences between a large gully and the local communities in a valley extended towards the south from Opuwo, inhabited by the same native Himba families for several generations. In-situ surveys show that the gully is a general concern in the area due to the insecurity and direct physical risk it poses to humans and their domestic animals. The second factor of distress is the accelerating land degradation in the valley, leading to the disappearance of grazing areas, forcing local shepherds to travel further in their transhumance. Ortho-imagery and spatial analysis show that 10% of the houses, 25% of the Kraals, and 50% of the gardens are less than 50 meters away from the gully border, and therefore they are in current or potential risk of abandonment, forcing eventual re-settlements and migrations. Moreover, indigenous knowledge arises that the gully also offers a few advantages, like its ability to store water during the dry season. These benefits are frequently seen as a trap or an associated risk for the animals and children getting in the gully. To this end, it is noticeable that as the gully affects the communities and its livelihoods, it also acts as a driver of development for the gully through its agricultural and livestock practices. This is evident by the appearance of the gully heads on paths, ditches, and domestic animals' routes, along with endemic overgrazing for decades. In summary, this research identified these prevalent human-nature dynamics and attempted to provide recommendations that can reverse accelerated degradation in the long term while describing the present and potential future of the Himba people inhabiting these fragile lands in Kaokoland.

Identifying and describing the impact of gully erosion in the livelihoods and properties of traditional Himba communities in Kaokoland, Namibia

Miguel Vallejo-Orti, Kaleb Negussie, Olaf Bubenzer and Bernhard Höfle

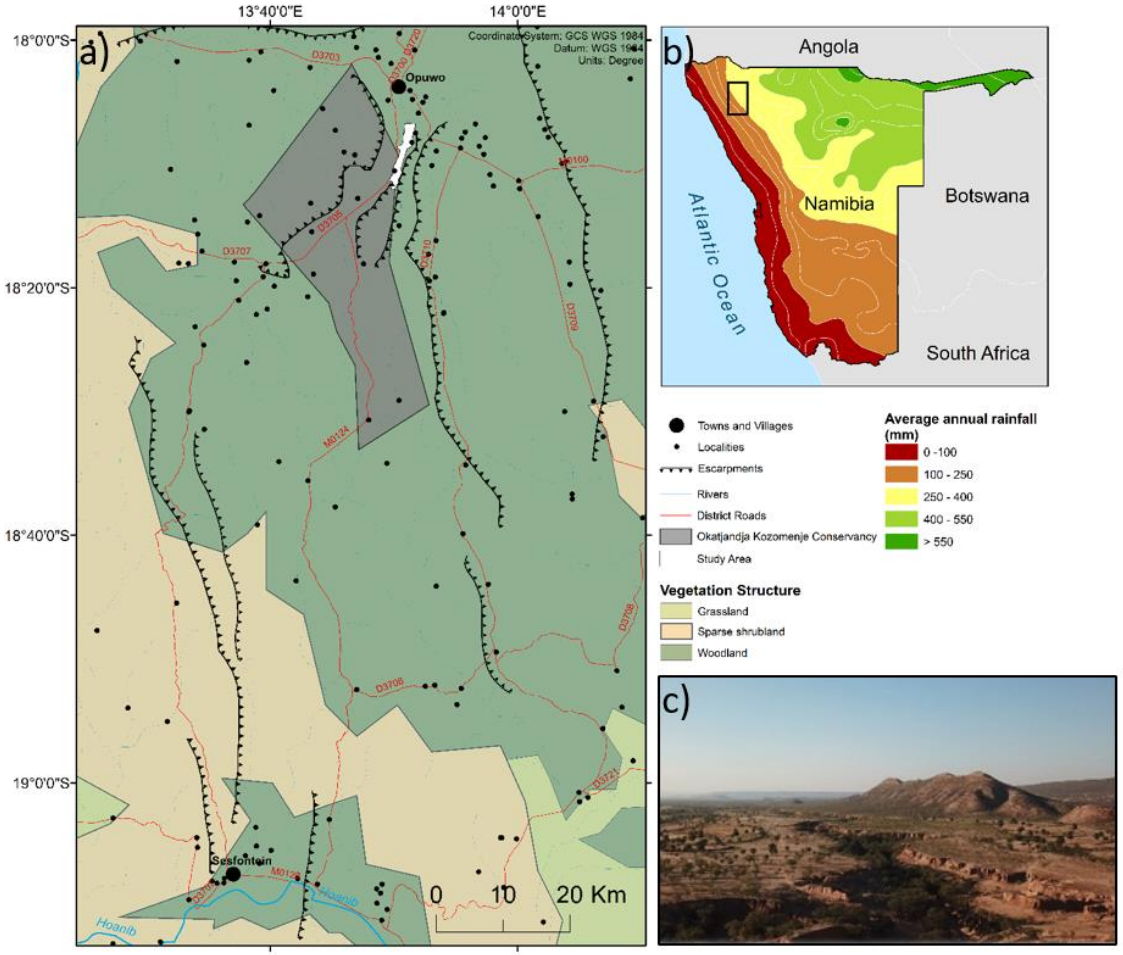
AGU FALL MEETING
New Orleans, LA & Online Everywhere
13–17 December 2021

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

3DGEO HEIDELBERG

Introduction

- Gully erosion is a **form of soil erosion caused by flowing surface water which consists of open, unstable channels** that have been cut more than 30 cm deep into the ground. (https://www.environment.nsw.gov.au/).
- Gullies lead to a **decrease in soil moisture in the inter-gully areas** (Frankl et al., 2013).
- Gully development enhance drainage and **accelerate aridification processes** in the semi-arid zones, which leads to a **loss of crop yields** and available land (Valentin et al., 2005)
- It is possibly the **most critical overlooked environmental problem in Namibia** (Pringle et al., 2011).



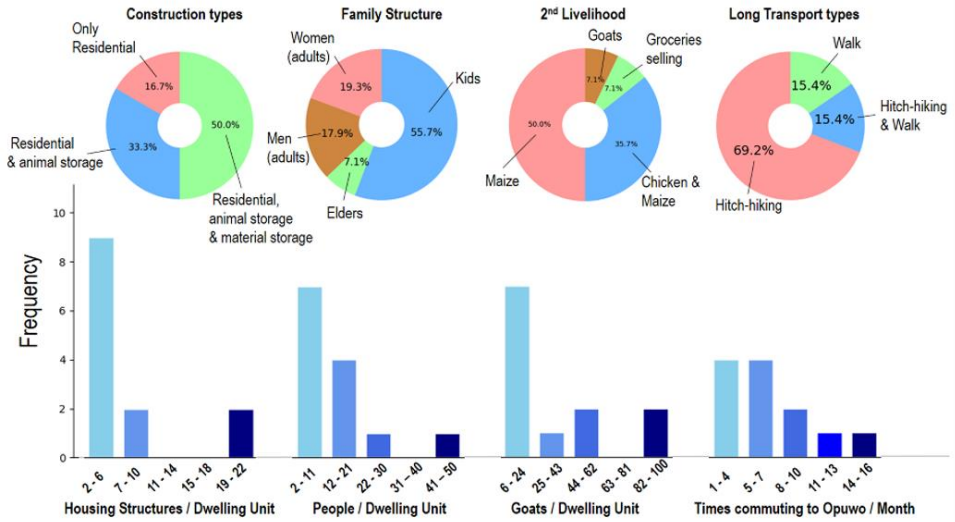
- The Himba Land use is based on the joint management of the natural resources pasture and water.
- 1970-80 -> New boreholes system.
- 2004/5→ stability not there anymore in Himba communal management (Bubenzer, Bolten and Darius, (2007))

The Omaipanga valley

3DGEO HEIDELBERG

NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

a)

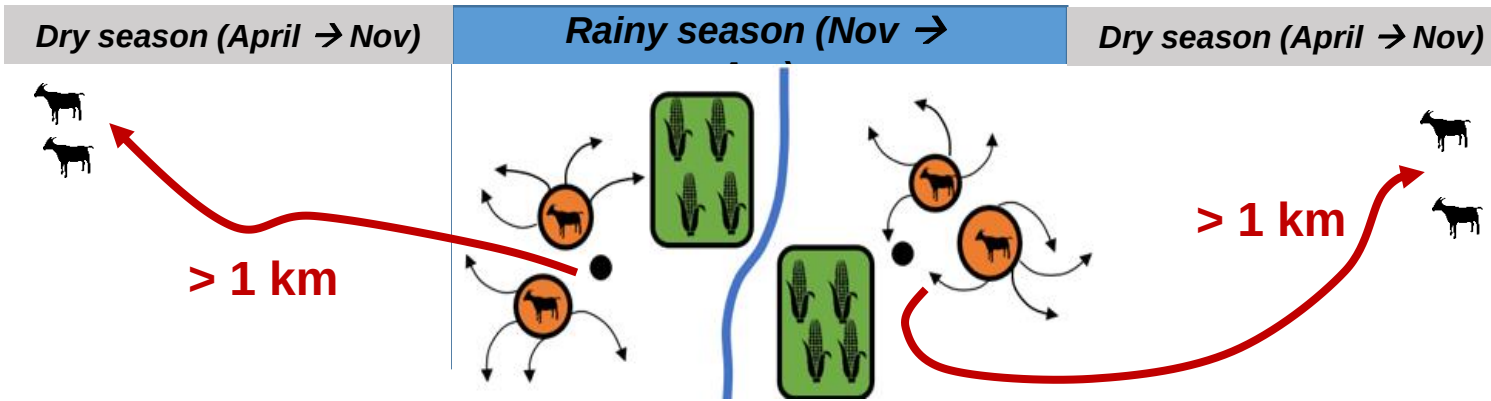


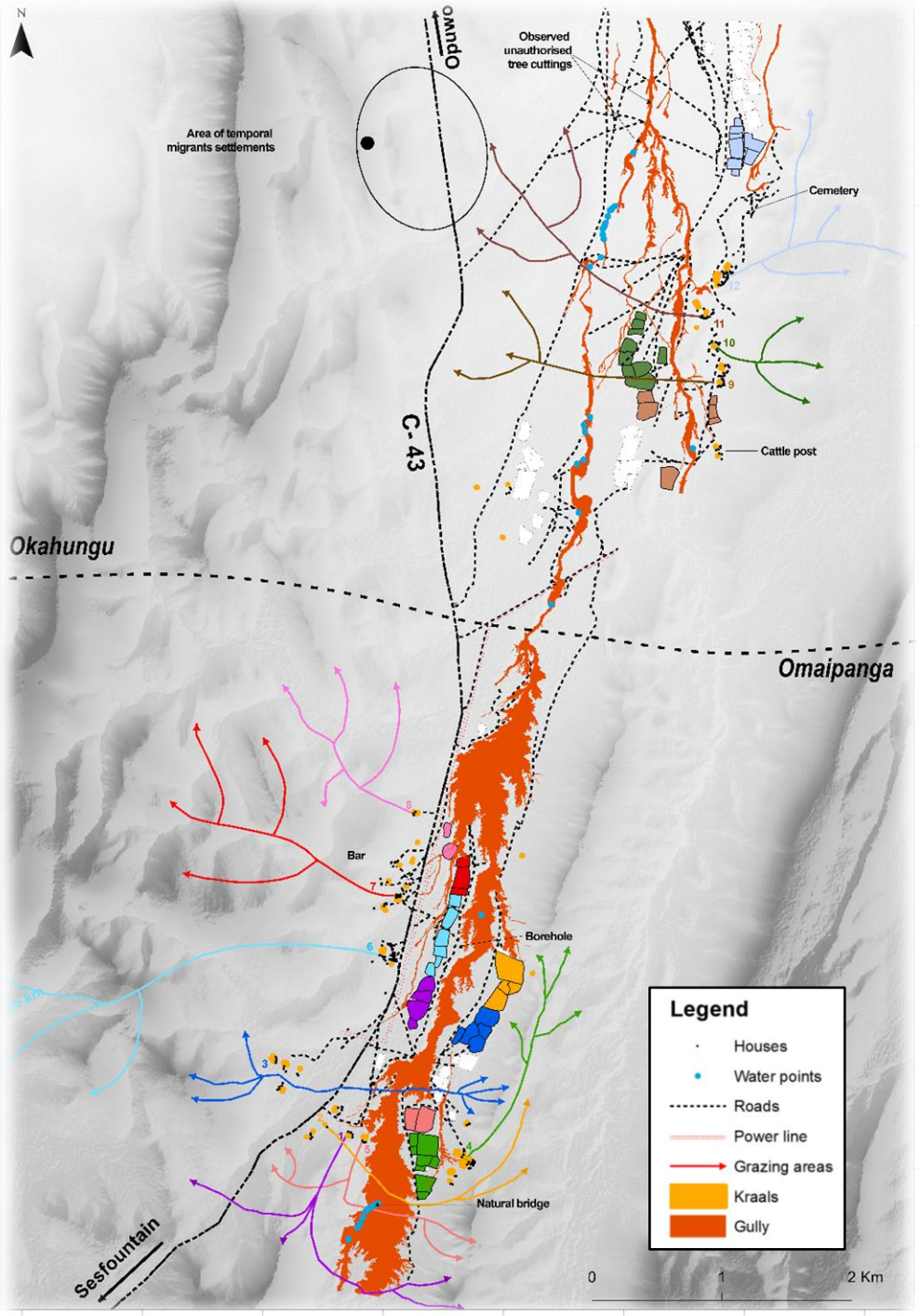
b)

c)

d)

e)

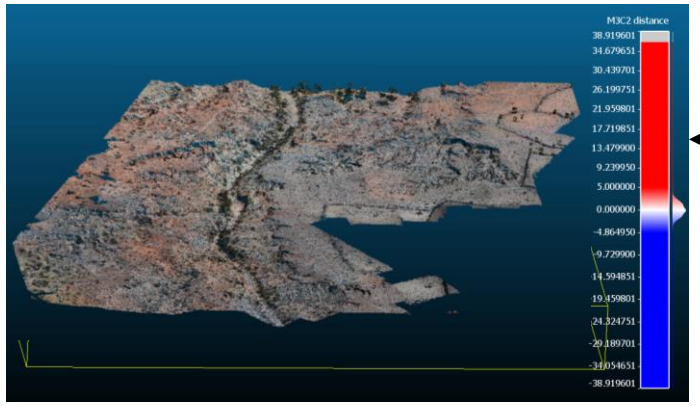


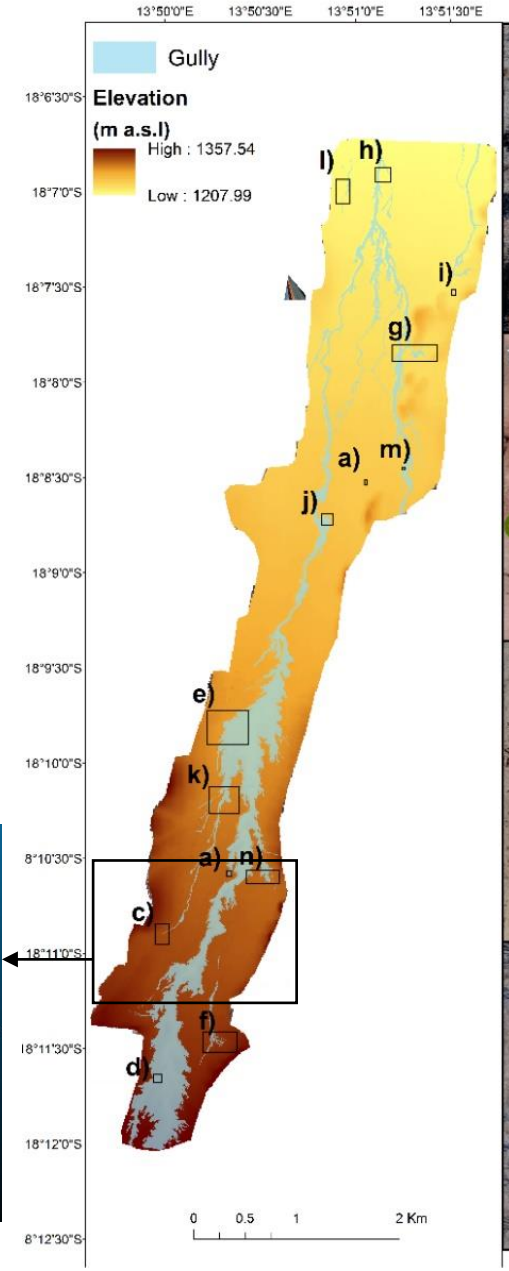


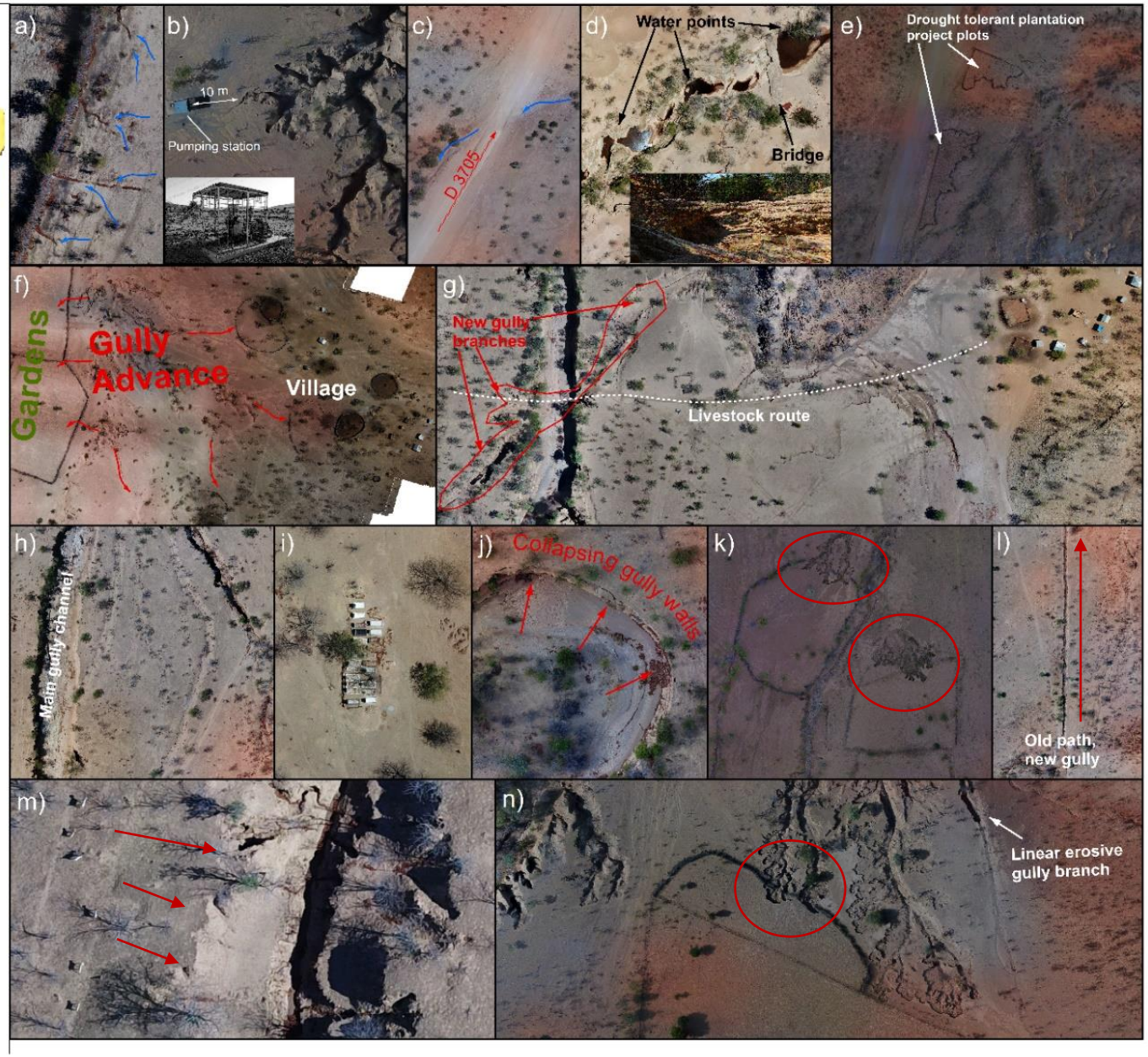
Gully-human connections

Drone Based 4D Analysis

- Multiple UAV Flights
- SfM
- 3D Point Clouds
- ICP Co-registrations
- M3C2 Distance

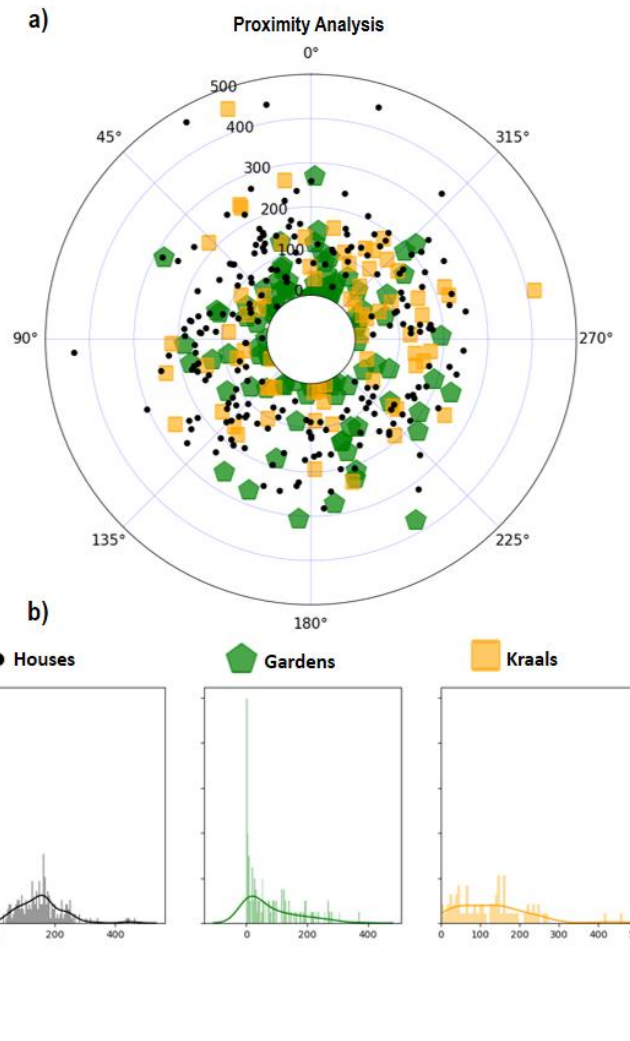


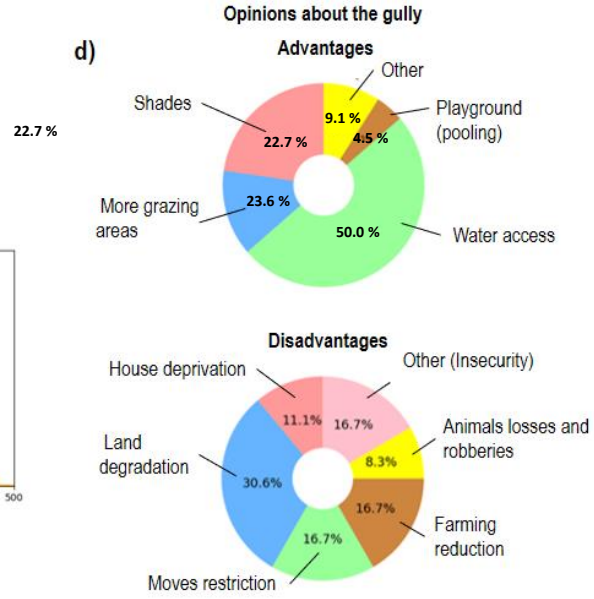




Results

Item	Total	In Danger (<50m)	Description
Gardens	110	57	Reduction of area for crops Abandonments of areas which serve as water and runoff barrier Gully opens for goats Conflicts with new migrants
Kraals	70	17	Economic impact to rebuild them Less protection of domestic animals against predators Temporal migration to safer areas Reduction of number of animals
Houses	60	23	Economic impact as need to rebuild Permanent migration Loss of ancestral identities and accentors connections. Family fragmentations
Power Line (sections)	-	15	Isolation of main logistic village with school Public investment
Roads and paths (sections)	-	45	Territorial isolation School deprivation Health deprivation Moves restrictions for animals Cattle farming not possible Development of new roads, increase of degradation.
Bombing station	1	1	Water deprivation

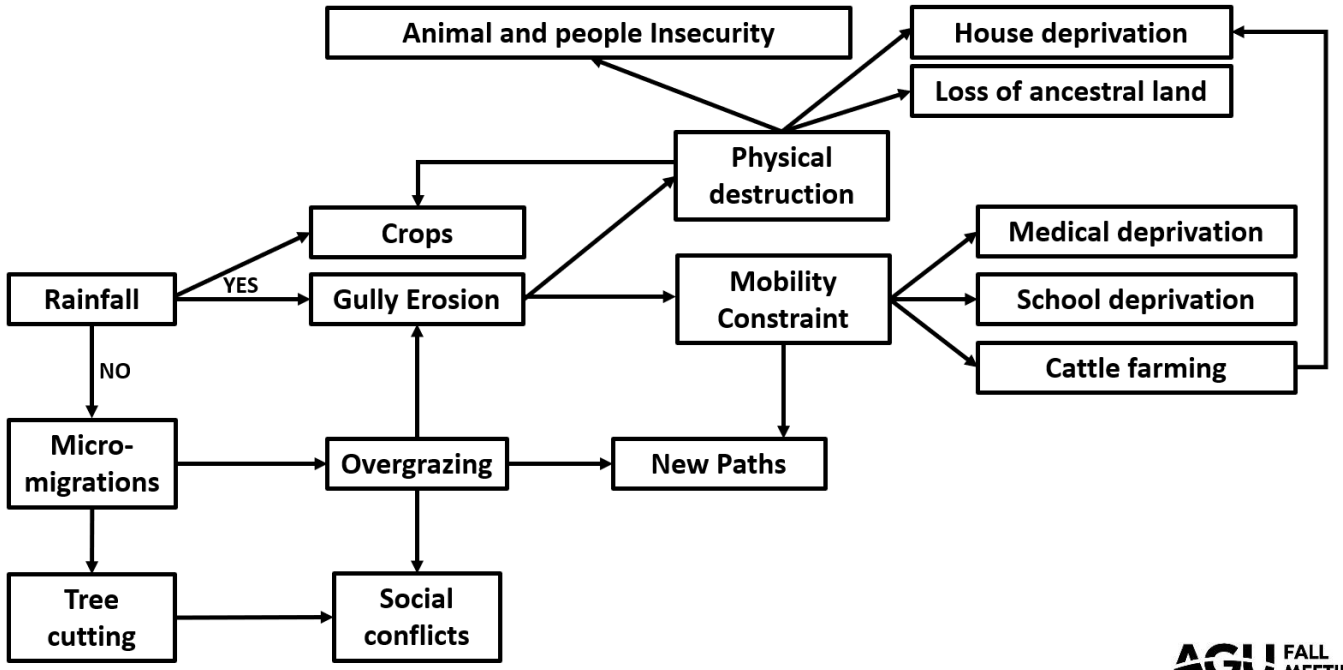




- Most affected elements are the gardens.
- General land degradation and security for animals and humans is reported as the main concern,
- Permanent access to water is reported as the main benefit of the gully.

Conclusions

- The main livelihoods in the study area are **goat herding** and **maize crop farming**.
- **Diversity** of the **family and settlements** spatial arrangements, as well as in the **type of construction structures**.
- The **potential rainy season pasture is disappearing**, and the pressure is transferred to potential dry season pasture.
- As the gully offers continuous resources it is an attractive **migration spot in the rainy season**.
- **Mobility patterns** and **agricultural practices** affect the development of existing gullies and favour the creation of new gullies.
- As the **gully increases in size**, it becomes **more difficult to keep cows**.
- On of the main problem associated with gully is **safety for animals and people**.
- Large scale gully monitoring (Satellite based) is required.



References

- Bubenzer, Olaf & Bolten, Andreas & Darius, Frank. (2007). Atlas of Cultural and Environmental Change in Arid Africa.
- Pringle, H. et al. (2013). Landscape incision processes favour bush encroachment over open grasslands in the two extremes of soil moisture balance in arid zones across southern Africa and Australia. Agricola
- Nyssen, J. et al. (2002). Impact of road building on gully erosion risk: A case study from the Northern Ethiopian Highlands. Earth Surface Processes and Landforms, 27(12), pp. 1267–1283. doi:10.1002/esp.404.
- C. Valentin, J. Poesen, Yong Li (2005). Gully erosion: Impacts, factors and contro. CATENA, Volume 63, Issues 2–3, https://doi.org/10.1016/j.catena.2005.06.001.
- Bollig, M. (1997) Risk and risk minimisation among Himba pastoralists in north-western namibia, Risk and Uncertainty in Pastoral Societies.