Land Degradation Assessment in the Zambezi Region, Namibia

Figure 1 Community member engagement

Figure 2 DeltaQuad #Pro drone assembly

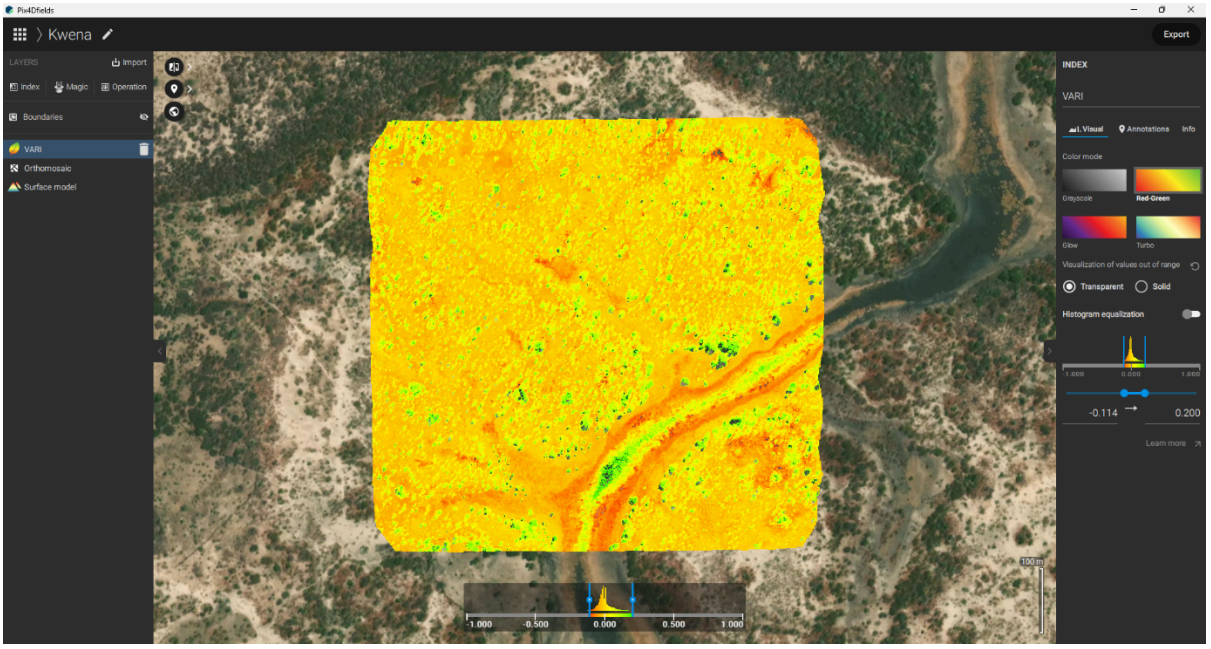

Figure 3 Kwena area Visible Atmospherically Resistant Index (VARI) vegetation index map

OVERVIEW	
Flying Labs	Namibia Flying Labs
Geographic area	Zambezi Region, Namibia
Date range	April - May 2024
Sector program	Climate Action
Main SDGs	GOAL 1: No Poverty GOAL 13: Climate Action GOAL 15: Life on Land

SCOPE	
Project stakeholders	1. Flying Labs Namibia (FLN) 2. Ministry of Environment Forestry and Tourism (MEFT) 3. Namibia Civil Aviation Authority (NCAA) 4. Namibia Integrated Landscape Approach for Enhancing Livelihoods and Environmental Governance to Eradicate Poverty project (NILALEG), Multilateral Environmental Agreement Monitoring Unit (MEA MU) 5. University of Namibia (UNAM) 6. Zambezi Regional Council (ZRC)
People impacted	Zambezi region community.
Number of people impacted	Approximately 142,000 people.
Problem statement	The primary challenge addressed by this project is the urgent need for integrated management of Namibia's rural landscapes; in the absence of which, the more densely settled northern regions of the country face the looming threats of increased poverty and inequality. These challenges are compounded by the continuous decline in forest cover, leading to the loss of biodiversity, soil fertility, and carbon sequestration.
Project objectives	1. To conduct a comprehensive land degradation assessment; that would validate the United Nations Convention to Combat Desertification (UNCCD) land degradation assessment platform: Trends.Earth. 2. To reverse environmental degradation while maximising sustainable livelihoods rooted in nature.
Scope	DeltaQuad #Pro and DJI Mavic 2 Pro drones were used to collect data, with the subsequent processing conducted using the PIX4Dfieldssoftware. The UNAM team then meticulously analysed and uploaded resulting data to the Trends.Earth platform. Trends.Earth, is an open-source platform that served as a valuable resource for understanding land change dynamics, and provided a holistic view of ground-level changes, towards facilitating informed decision-making.
Outcome	The resulting information was used to assess land degradation using three sub-indicators, as follows: 1. Land cover 2. Soil organic carbon 3. Vegetation productivity
Impact	The data gathered will be utilised to inform the development of an action plan aimed at effectively managing Namibia's rural landscapes and promoting sustainable livelihoods.
Challenges	1. A DeltaQuad #Pro drone crashed while mapping the Mubiza area, and could not be used any further, thus the

	rest of the missions were conducted using the DJI Mavic 2 Pro drone. 2. Operations near a military base posed a security threat, hence effective communication with the pertinent officials was imperative. 3. Very strong magnetic interference around Nukwa rendered the mapping of the area impossible.
Next steps	The development of a long-term action plan for managing Namibia's rural landscapes.

COMMUNITY ENGAGEMENT AND STAKEHOLDER SUPPORT	
Consent for data acquisition	The authorisation to acquire the data was sought and obtained from the following: 1. Ministry of Environment, Forestry and Tourism (MEFT) 2. Zambezi Regional Council (ZRC)
Community engagement activities	Informal meetings with community members at each of the following villages, where drone flight operations were conducted: 1. Bukalo 2. Kwena 3. Lisikili 4. Luhonono 5. Masokotwane 6. Mubiza 7. Nukwa 8. Zilitene
Community groups engaged with	1. Local residents 2. Regional government officials
Community attendance	No official community meetings were conducted, as consent to acquire data had already been given by the relevant stakeholders.
Community feedback	Addressed community members had no objection to the initiative.
Stakeholder support	Not relevant, as the entire project team consisted of actors in academia, as well as industry specific professionals; who could manipulate and interpret the output data, with ease.

DATA ACQUISITION	
Size of area	Individual area sizes: 25 - 30 ha (250m^2 - 300m^2) Estimated total area: 220 ha (2.2km^2)
Drone	1. DJI Mavic 2 Pro 2. DeltaQuad #Pro
Sensor(s)	1. Flir Duo Pro R (Radiometric Thermal + RGB Camera). 2. Hasselblad RBG Camera

Flight plan software	1. DroneDeploy 2. QGroundControl
Flight height	Maximum of 121.92m above ground level
GSD (Accuracy)	2.3 cm/px 7.5 cm/px
Number of images acquired	7676
Number of flights	8
Time invested in data acquisition	Total project duration: 18 days. ● Mapping: 8 days ● Data processing and analysis: 8 days ● Travelling between sites: 2 days
Georeferencing	Onboard GPS

DATA PROCESSING & ANALYSIS	
Processing software	Pix4Dfields
Processing time	≈ 6 hours
Data products	1. Orthomosaics 2. Vegetation Index maps
Analysis tools	1. ArcGIS Pro 2. PIX4Dfields 3. QGIS
Analysis outputs	1. Normalised excess green index (NExG) 2. Normalised green-red difference index (NGRDI) 3. Triangular Greenness Index (TGI) 4. Visible Atmospheric Resistant Index (VARI)
Final outputs shared with stakeholders	1. Raw data 2. Flight logs 3. Processing reports 4. Orthomosaics 5. Vegetation Index maps
Data sharing	1. Google Drive 2. Secure Digital (SD) card storage
