Organização das Nações Unidas para a Alimentação e a Agricultura

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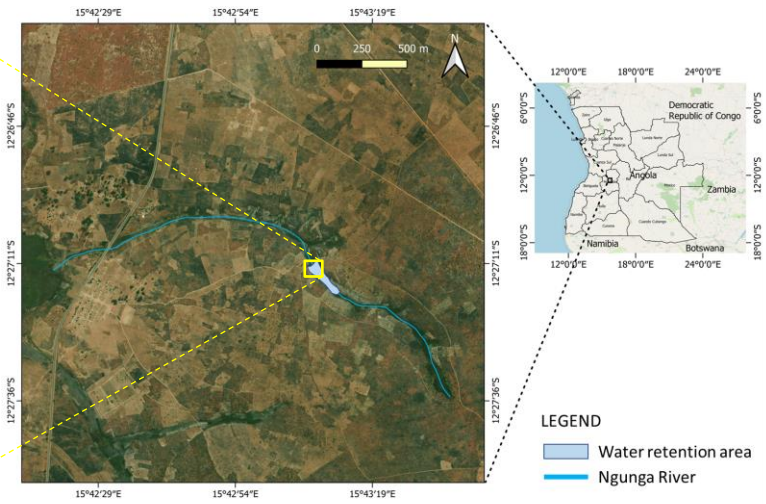
A community-driven agroecological restoration of a dam through GIS and Remote Sensing integration

Introduction

In Ngunga sector, within the Chipipa commune (in Huambo province, Angola), a colonial-era dam remained in a state of ruin for decades. Aiming at leveraging the water potential and existing resources in this region, the ZAEC project, implemented by FAO in conjunction with Angola's Ministry of the Environment, focused on revitalizing the Ngunga dam through a remarkable convergence of community-driven efforts and agroecological principles, coupled with innovative integration of GIS and Remote Sensing technologies.

Water course before dam restoration

Location of Ngunga dam



Source: Map data ©2023 Google (left). OpenStreetMap contributors, CC-BY-SA (right). Modified by José Caela.

Methods

The determination to restore the dam stemmed directly from the comprehensive insights gained through the application of the LADA methodology (Land Degradation Assessment in Dryland Areas) applied in Ngunga sector. The LADA methodology involved an evaluation of current land degradation, its underlying causes, and impacts, while also identifying sustainable agricultural approaches and training needs in agroecological practices within areas of intervention.

Application of LADA methodology

As an integral part of the methodology, the use of a drone was instrumental in meticulously mapping land cover and terrain, providing critical insights for the evaluation process by allowing flood simulations and accurate estimation of storage capacity, aiding in further decisions.

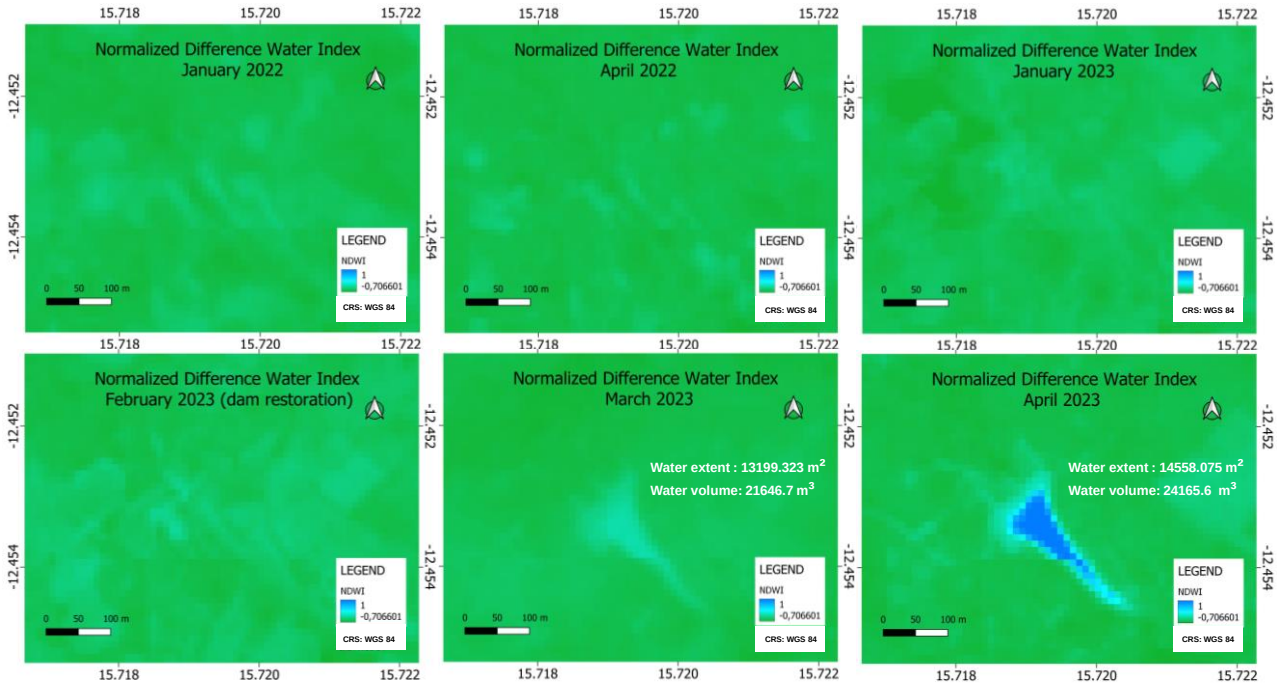
Following the restoration efforts, the dam successfully retained water originating from rainfall as well as the Ngunga spring. The community excavated two channels on each side of the dam to facilitate the conveyance of water from the retention area to agricultural fields situated downstream of the dam.

Water retention area and irrigation channels

Results

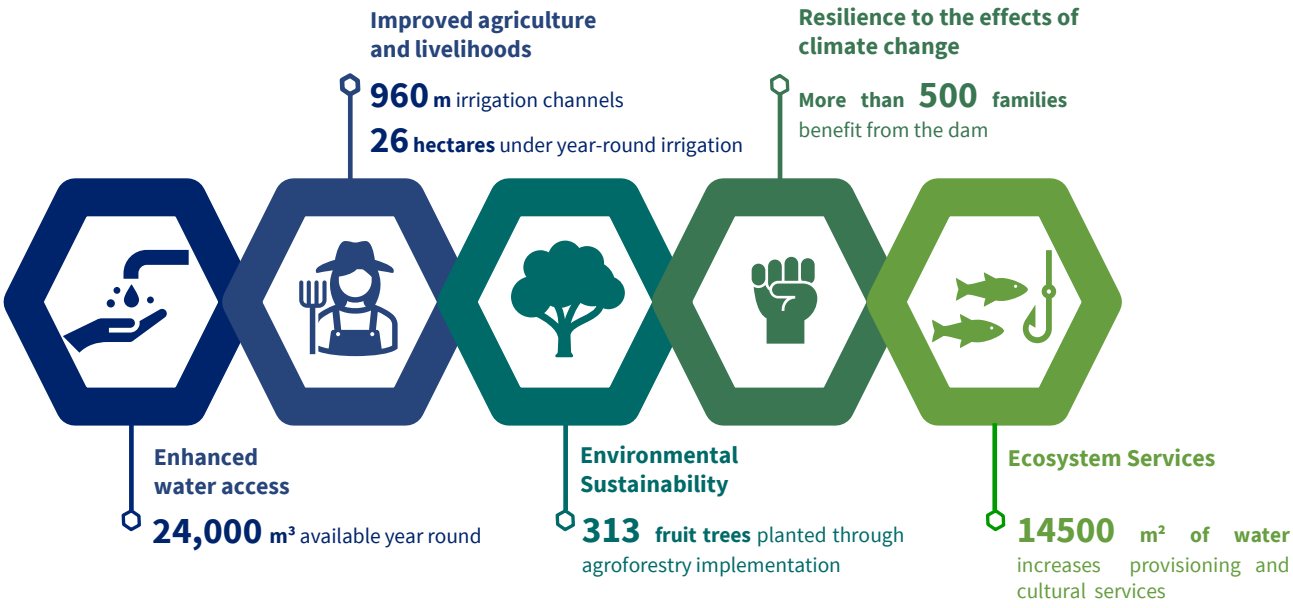
Employing Remote Sensing and Geographic Information Systems (GIS) facilitated the monitoring of water extent and volume, and irrigation channel lengths. The determination of water boundaries utilized the canny edge detection technique on Normalized Difference Water Index maps (NDWI, where values close to 1 indicate the presence of water) from NICFI PLANET images. Water volume estimation relied on specialized software, calculating the volume beneath the water boundaries outlined by the elevation model derived from drone data. Channel lengths were derived from GPS tracking.

NDWI before and after dam restoration during the raining season



Source: Image © 2023 Planet Labs PBC. Modified by José Caela.

Benefits of dam revitalization



Enhanced water access

With **24,000 m³ of water** available, the dam ensured reliable and consistent water supply for agricultural activities, livestock, and domestic use. Farmers can benefit from irrigation services, allowing a greater number of families rely on agricultural activity as a source of subsistence and income.

Environmental Sustainability

Restructuring the dam promoted the community's utilization of water for agroforestry **313 fruit trees** were planted, fostering a more sustainable and diverse ecosystem, maintaining ecological balance, and potentially restoring habitats.

Dam and water retention area

Water from the dam used for irrigation in agroforestry

Improved agriculture and livelihoods

The two irrigation channels with **442** and **521 meters** of length respectively provided better irrigation systems, supporting increased crop yields and diversified agricultural production, thereby contributing to food security in the region, boosting incomes and livelihoods. Currently, **twenty-six hectares** of cultivated land enjoy year-round irrigation through micro-irrigation systems stemming from the two primary channels.

Irrigation channel, micro-channel and agriculture production

Resilience to the effects of climate change

With an adequate water reserve, more than **500 families** will be better prepared to face periods of drought or irregular rainfall, ensuring the continuity of agricultural production even in the face of these adversities.

Ecosystem services

An expanse of **14,500 m² of open water** has transformed the area into a fishing hub. The scenic beauty of the reservoir has emerged as a potential focal point for tourism offering leisure opportunities. Furthermore, the dam has become an integral part of the community's identity, symbolizing progress and economic development.

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