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POLICY BRIEF

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The status of ravines problem in Angola: Causes, Consequences, and solutions

Vasco Chiteculo[1], Carlos Ferreira[2], Anacleto Diogo[1], Chipilica Barbosa[1]
[1]Southern African Science Service Centre for Climate Change and Land Adaptive Management
[2]National Centre for Scientific Research

"The problem of ravines management in Angola is more of social challenges than the physical or technological problem".

KEY MESSAGES AND RECOMMENDATIONS

- **Problem:**
- The problem of ravines negatively affects the development of people's lives, infrastructure, access roads, and arable land. The Ravines in Angola became a national security problem putting at risk buildings, connections of provinces and municipalities, schools, hospitals, residences, water supply systems, electrical installation even silting up rivers. Large, cultivated areas can become unproductive, without access roads and economically viable infrastructure for the development of society, if there is no adequate strategic planning, that considers the particularities of the physical and biological environment, the social and economic conditions of the development trends of the region and erosion is not controlled at tolerable levels so that the soils and biodiversity are healthy.
  - **Recommendation 1:** Intervention using mechanical and biological methods supported by the local population.
  - **Recommendation 2:** Create vulnerability maps in the entire province and develop a resident guide for restoring and protecting ravines

INTRODUCTION

Angola has currently over 800 ravines according to last year's data records. Ravine's erosions are threatening to destroy roads, districts, and houses in many provinces of Angola. This process mainly consists of the detachment and dragging of soil particles, caused by the action of water and wind.

This policy brief aims to explore a new approach to ravine management which is based on a residence guide for the restoration of ravines. The need to seek housing, new living conditions, best places to work or relax forced people to construct houses or commercial buildings in places with a high probability of floods and landslides (Figure 1). The problem is that many cities (8 provinces of Angola) are endangered

by ravines and need urgent intervention. However, the cost of containing a ravine in the advanced stage is estimated at one million USD dollars. The center east and east parts of Angola are the most vulnerable regions due to their geological features. In this policy brief, we targeted the Luena Province as one of the most affected regions in the country. The origins of ravines in Angola are diverse, they can be due to natural phenomena, resulting from the combination of three factors such as climate, relief, and types of soil, combined with anthropogenic action, such as the execution of low-quality construction works, obstruction of the micro and macro drainage systems, exploitation of aggregates, agricultural activities and burning, which makes the phenomenon more active, often requiring immediate, profound and concise interventions.

Previous and ongoing projects have applied different techniques to contain the expansion of ravines and mitigate the impact of soil erosion. However, it turns out that there is no single erosion control measure that can be used to resolve the problem. Ground assessment is necessary to identify the best way to address each erosion problem (see Figure 2). Using the wrong erosion control technique for certain ravines can have negative impacts. Solutions and methods are frequently prescribed which have little bearing on the problems felt by the local population. The government's efforts to curb ravines must obey the participatory and codesign method approach with increased responsibilities for the communities experiencing the impact of the ravines. In essence, this is no longer a physical, technical, and economic problem, rather, it is a social challenge that requires collective and urgent action.

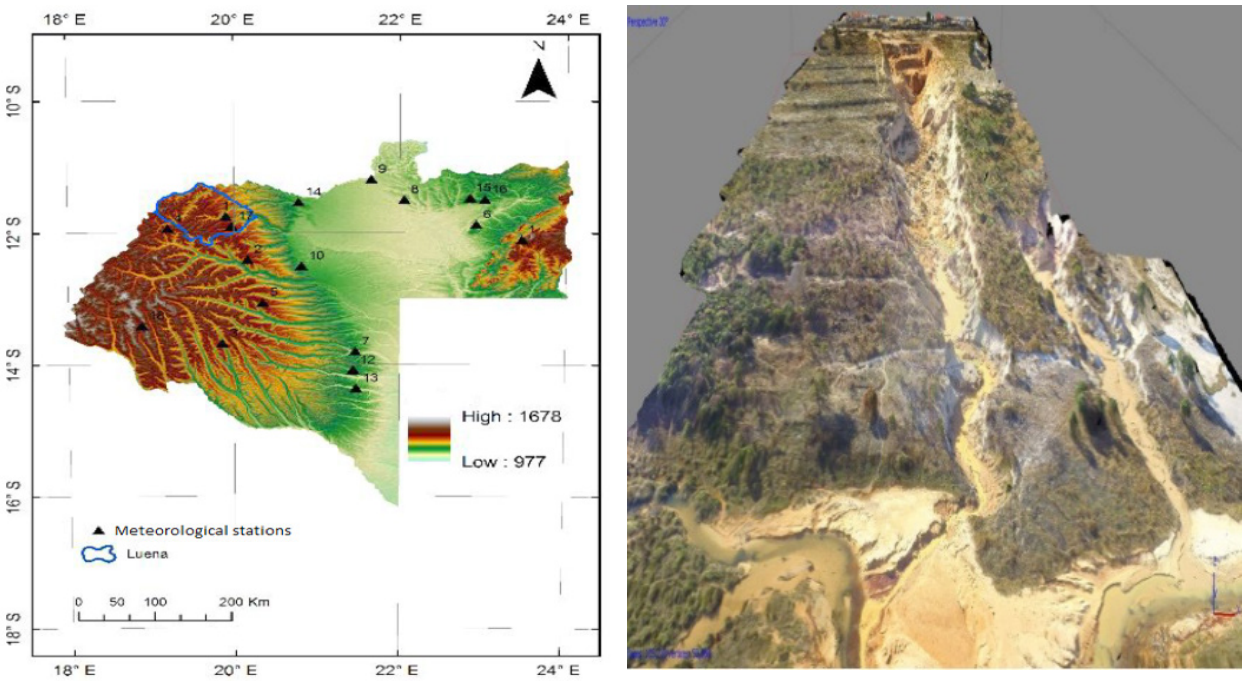

Figure 2. Digital elevation model of the study area. The higher the terrain, the more susceptive it is to water erosion.

ABOUT THE PROJECT

The project was labeled as TASK 173, funded by the German Ministry of Education and Research (BNBF) and supported by the Ministry of Higher Education, Science, Technology, and Innovation (MESCTI) which aimed to mitigate the effect of soil erosion in Luena using a biological and mechanical method. The studies consisted of collecting and gathering basic information diagnosing the causes of ravines in Luena and assessing the impact of erosion on the surrounding population and infrastructure.

The mechanic method included the construction of earth slopes, ditches, and canals while the biological method focussed on best agriculture practices such as agroforestry systems. It is possible to see that if the intervention was done correctly, the ravine will not expand and can remain stable (Figure 3). The project targeted about 8 ravines and the interventions using both methods were successfully achieved in Luena.

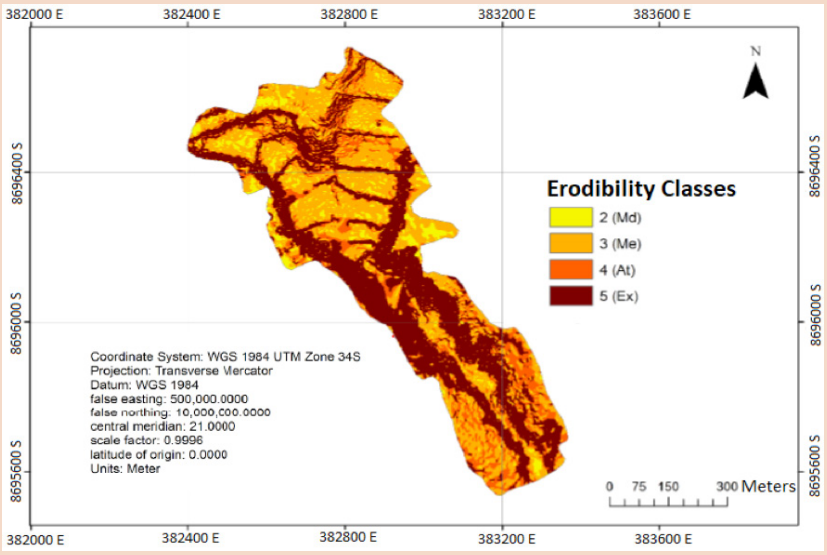

Figure 4. Erodibility of the main ravine in Luena. This ravine has about 40% of extreme erodibility which means the soil lost its absorption capacity.

KEY FINDINGS AND RECOMMENDATIONS

The project has successfully tested 9 plant species which can be used to contain the ravines depending on the stage of the ravine and method chosen. Erodibility and susceptibility maps of the main ravines in Luena were developed and suggested the best method to mitigate the expansion. The main results of the project are summarised as follow:

- From satellite images, it is evident that ravines are rapidly increasing in large scale in the entire city. The erosion processes are very active in the region, and it is more likely to cause environmental, social, and economic damages in very short time (Figure 4).

- The use of mechanical method enabled earthworks and construction of earth slopes, ditches, and canals (about 410,000 m3 of sand in 130 m with and 3,5 m deep were moved) to divert the course of rainwater and improve runoff, as well as contour planting of various plant species among which stands out the Australian Acacia (Acacia mangiun), Muchivi (Guibourtia coleosperma) and Red Acacia (Delonix regia) see figure 2.

- The project delivered a completed study (Master thesis) in application of Geographic Information System produce risk maps for the main ravines in Luena.

Recommendation 1: Intervention using mechanical and biological methods supported by local population.

- The combination of mechanical and biological approach shall be guaranteed by the government in all other ongoing projects and integration of community living closer the ravine shall be supported and encouraged. Among the solutions to mitigate water erosion, we have mechanics (which consists of earthworks and the construction of earth slopes - landfill and micro and macro-drainage systems - ditches, channels and sewage networks, to concentrate the course of rainwater, improving drainage and diverting rainwater, reducing erosion and its impact on socioeconomic infrastructure, the archaeological and cultural heritage), biological (which consists of planting various plant species, diversifying agricultural practices, which helps in the macro - capillary drainage, fertility recovery and soil stabilization, attenuating the direct impact of the drop of water on the soil, absorbing part of the precipitation through the roots and reducing surface and sub-surface runoff). These measures help protect socio-economic infrastructure, such as roads, buildings, and industries, which are subject to erosion, ensuring the safety of populations.

Recommendation 2: Create vulnerability maps in the entire province and develop a resident guide for restoring and protecting ravines.

- The problems can be avoided with an early, detailed, and efficient diagnosis of areas with a probability of erosion, using techniques for monitoring and controlling ravines, which enables the registration and knowledge of the behaviour of erosion processes that provide advances in these aspects and their relationships with affected areas, since the purpose of the cadastre is to highlight the dynamics and phenomenology of erosion and the effective and successful recovery of these areas. Funds shall be made available to create vulnerability maps for population in radio of 20 km of ravines and develop a detailed resident guide to combat the ravine around them.

A RESIDENT GUIDE FOR LUENA CITY

The project encourages the resident to inspect their ravines regularly and to take appropriate steps to preserve the stability of these features. The main objective of the guide is to prevent extensive erosion which can lead to property damage adjacent to ravines and in a radius of 20 km from the resident areas.

1. Background

For extensive, efficient, profound, and successful prevention of erosion processes, we must first insert and provide knowledge to community members in the area affected by the phenomenon, the essential tools for mitigating erosion. These tools are embodied in primary elements such as origin; erosion processes; basic prevention strategies and principles. Within the basic principles of prevention, there is the planning, use, and occupation of the soil according to the topographic characteristics of the terrain, micro and macro-drainage, reduction of fires, and preservation of the natural flora and fauna.

Within the strategic plan is the erosion prevention and control plan; the basic elements of planning, Consultation of Master Plans, Provincial, Municipal, Communal, and Neighbourhood; Elaboration of control measures, management and licensing, inspections, and maintenance of works; registration and consultation of climate and soil databases and respective publication and surveys.

2. Ravine location

The location refers to the micro and macro location from the origin and progress of the ravine up to the inventory phase to estimate the necessary and available resources inside and outside the community for its mitigation.

3. Erosion process

Erosion is the process of wear, transport, and sedimentation of soil, subsoil, and rocks by the action of water, wind, and living beings.

4. Erosion Control Techniques

Among the erosion control techniques are:

Intercept and direct runoff of surface and subsurface water, retain soil particles carried by stormwater and reduce flow velocity.

Controlling earth movements, with slope stabilization measures through duly designed engineering solutions. Construction of retention basins; surface and sub-surface drainage systems; Control and Dimensioning of stormwater discharges, Hydrology, affluent hydraulic flow.

5. Restoring ravine

Before restoring the ravine, it is necessary to know the embryonic stage and the origin and cause to prepare the cadastre and inventory of the ravine, to prevent progress and solve it at the local level with local resources. Restoration using the biological method (consists of planting various plant species, diversifying agricultural practices, which helps with capillary macro-drainage, fertility recovery and soil stabilization, attenuating the direct impact of the drop of water on the soil, absorbing part of the precipitation through the roots and reducing surface and sub-surface runoff), which leads to the harmonious development of people's lives, infrastructures, with access roads and quality arable soils, with large productive areas and economically viable infrastructures for the well-being of ecosystems.

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