RESEARCH PROGRAM ON Water, Land and Ecosystems

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Photo: Fishing in a small reservoir in Burkina Faso.
Credit: Carsten ten Brink.

Characterization of small reservoirs in Burkina Faso

Technical report

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Introduction

Small reservoirs (SRs) are used for multiple purposes in Burkina Faso and West African agroecological landscapes (Venot et al. 2012). These SRs are used for domestic (drinking, bathing and washing) and agricultural (crop, livestock and fishery) purposes, among others (McCartney et al. 2012). However, natural processes and human-induced activities in the surrounding landscapes can be a threat to the water quality and sustainable use of SRs. In order to reduce negative effects, several projects have been designed to study different aspects of how SRs are used and impacted by natural and human-induced activities. But the number of SRs in Burkina Faso (about 1,450) (Cecchi et al. 2009) makes it practically impossible to study every single one of them. A possible solution to this is to categorize the SRs into groups in terms of their responses to the aforementioned natural and anthropogenic influences. Such categorization can provide the basis for site selection in subsequent research programs and further permit generalization (upscaling) of results obtained for selected SRs (at local scale) to many other SRs (at national scale).

The objective of this analysis was, therefore, to model different areas within which SRs respond similarly to natural and anthropogenic influences. The output is intended to aid in selecting a representative sample of SRs for studies/research and enable a reasonable upscaling of results to the whole country (and beyond). The analysis was conducted by combining two spatial layers: one representing natural conditions (hereinafter referred to as 'natural factor') and the other representing human-induced activities (hereinafter referred to as 'anthropogenic factor'). The resulting layer was reclassified into different impact zones.

Key messages

- The analysis revealed 1,033 small reservoirs in 2014 with a surface area of 1 hectare (ha) or more, distributed across low- to high-impact zones across Burkina Faso.
- Most reservoirs were found in moderate- and high-impact zones, with the Nakambe sub-basin recording the highest number (603) of highly impacted SRs.
- The findings highlight the threats of natural and anthropogenic influences on SRs and indicate the need for urgent actions toward the sustainability of SRs in Burkina Faso.

Research context and method

The influences considered in characterizing the SRs in Burkina Faso are both natural and anthropogenic in nature. The natural factor was derived by implementing the Revised Universal Soil Loss Equation (RUSLE) (Wischmeier and Smith 1978; Renard et al. 1997). RUSLE is determined as a factor of many parameters: rainfall–runoff erosive index; soil erodibility or susceptibility of soil to erosion; topographic factors such as slope length and slope steepness; vegetation cover and management, or the effect of vegetation and other land covers on soil erosion; and conservation practices with respect to reduction in erosion. A spatial layer was developed for each factor, using secondary spatial datasets freely available online. Spatial layers representing the RUSLE parameters were combined in a standard GIS 9Geographical Information System) and reclassified. The anthropogenic factor was included via a population map that was developed and reclassified based on the distribution of pixel values. A characterization map was developed by combining the reclassified layers of the natural (RUSLE) and anthropogenic (population) factors, using the matrix presented in Table 1, which assumes four classes.

Table 1: Matrix for characterizing small reservoirs

Anthropogenic factors		Natural factors	
		LOW	HIGH
	LOW	Low impact	Slight impact
	HIGH	Moderate impact	High impact

Characterization and distribution of small reservoirs in Burkina Faso

Characterization of small reservoirs

Figure 1 shows the combined spatial layers of natural and anthropogenic factors using the matrix in Table 1. Low-impact zones were mostly areas along stream channels, and the severity of impact increased away from those areas. Moreover, majority of the high-impact areas were areas with high population.

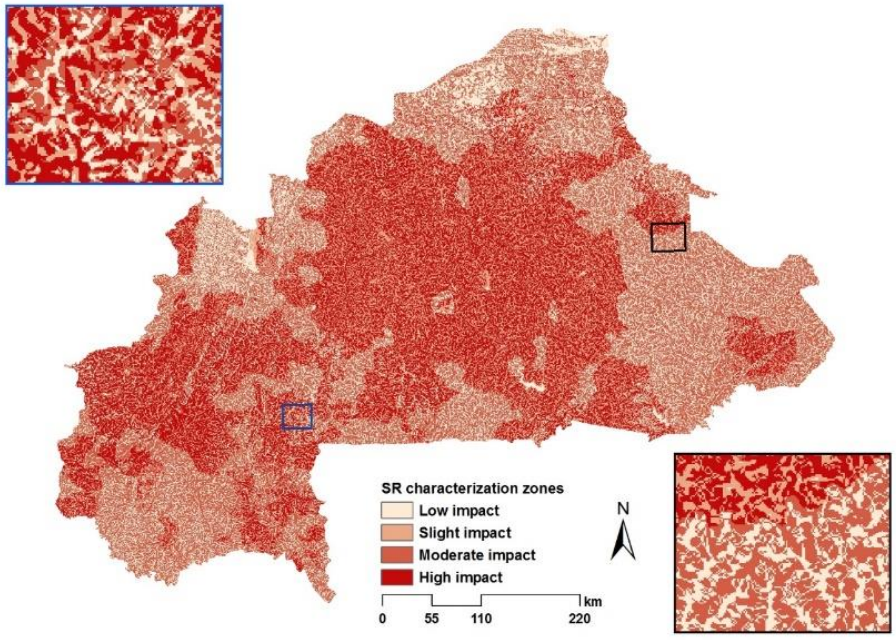

Figure 1: Small reservoirs characterization map of Burkina Faso

More detailed descriptions of the four classes are given as follows:

- ***Low-impact zones*** are areas that have low susceptibility to erosion and low population pressure. They represent areas in which SRs will be least affected by natural or anthropogenic influences.
- ***Slight-impact zones*** experience small anthropogenic influences, but are highly susceptible to soil erosion. It is assumed that the water quality and sustainability of SRs is more affected by anthropogenic influences than by natural effects. These zones are therefore second to low-impact zones, in terms of severity.
- ***Moderate-impact zones*** are deemed to be more impacted than slight-impact zones due to high anthropogenic influence factor and low susceptibility to erosion.

- ***High-impact zones*** are the most impacted in terms of both natural and anthropogenic influences.

Spatial distribution of small reservoirs

Whereas, Figure 1 characterizes the total number of SRs in Burkina Faso using 2014 Landsat images, Figure 2 shows the spatial distribution and classification of the small reservoirs. In total, 1,033 small reservoirs with a surface area of 1 ha or more were identified as of December 2014. The majority of these (512) are within high-impact zones, with high natural and anthropogenic influences, followed by those (273) in moderate-impact zones. The low- and slight-impact zones have 124 SRs each. The distribution of SRs across the country shows that the Nakambe sub-basin has the highest number of highly impacted SRs (603), while Comoe has the lowest number (15) of highly impacted SRs. The Mouhoun and Nakambe sub-basins jointly have the lowest percentage of reservoirs in low-impact zones (~8%), whereas the Niger sub-basin has the highest (33%).

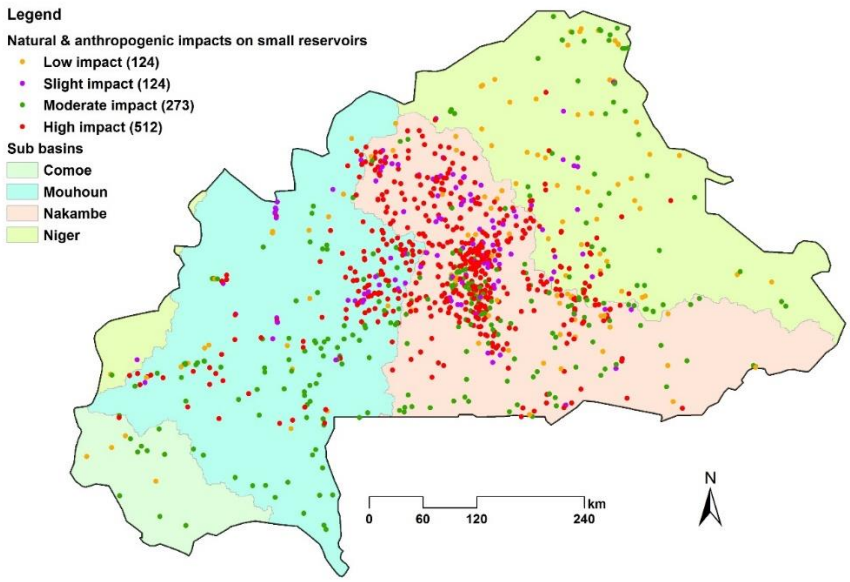

Figure 2: Spatial distribution of small reservoirs in Burkina Faso.

Additionally, 41 SRs studied under the WLE in Africa project were characterized in terms of natural and anthropogenic influences. Figure 3 shows their distribution. Most of the selected reservoirs are located within high-impact (15) and moderate-impact (15) zones. The remaining SRs are distributed in the low-impact (8) and slight-impact (3) zones of Burkina Faso.

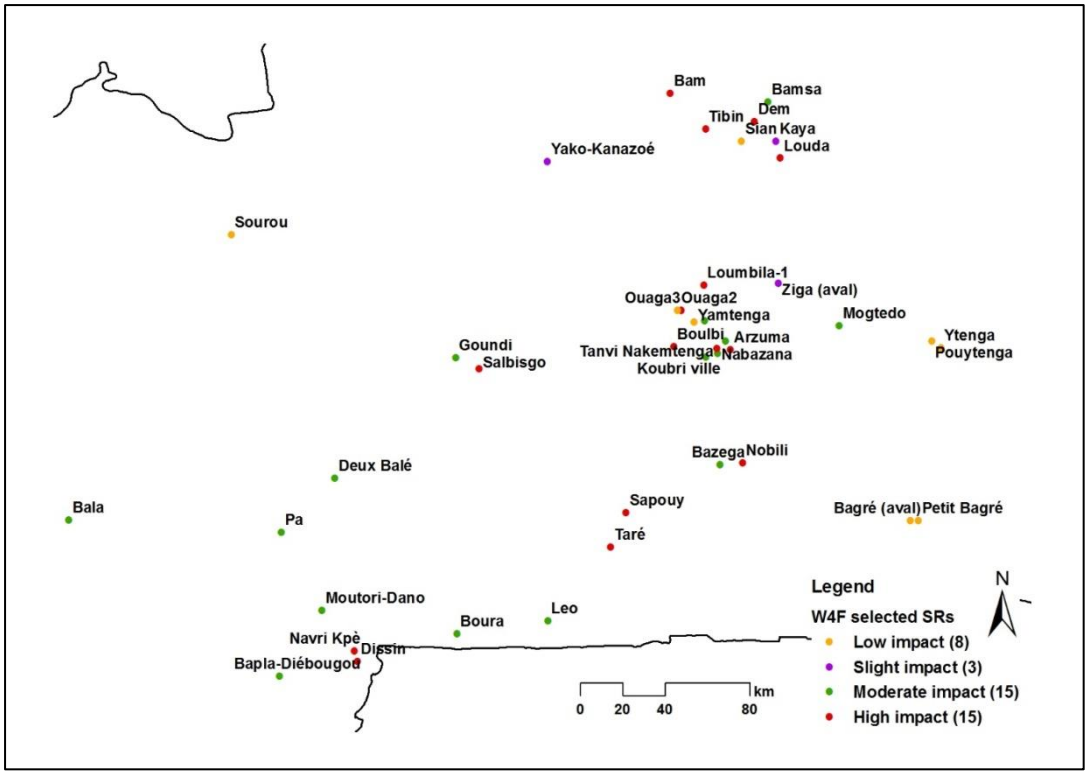

Figure 3: Spatial distribution of 41 small reservoirs studied under the Water for Food project in Burkina Faso

Lessons learned and implications

- The study has characterized small reservoirs in Burkina Faso considering natural and anthropogenic influences. Based on the final map produced from combining the factors, a total of 1,033 SRs were characterized according to four impact classes.

- Most of the SRs were found to be located in the high- (512) and moderate-impact (273) zones, resulting from natural and anthropogenic influences, signaling a greater concern for the use and sustainability of SRs in Burkina Faso.

- The study also analyzed 41 SRs studied under the Water for Food project to understand their distribution and their characterization. Thirty of these reservoirs were found to be moderately or highly impacted by both natural and anthropogenic factors. This confirms the above pattern and the need to take urgent measures to protect SRs and minimize natural and anthropogenic influences on them.

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Further reading

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Data sources

Remotely sensed data were obtained from various sources: Landsat satellite images were downloaded from the global visualization viewer (GLOVIS); gridded population databases were from worldpop (www.worldpop.org.uk); a soil map of Africa at 1 kilometer resolution was downloaded from the World Soil Information website (http://www.isric.org/content/soilgrids1km); rainfall data from worldclim (http://www.worldclim.org/); DEM data from Shuttle Radar Topographic Mission (SRTM) was downloaded from the CSI (consortium for spatial information) website (http://srtm.csi.cgiar.org/); NDVI data (MOD13Q1) was downloaded from the USGS website (https://mrtweb.cr.usgs.gov/); and land use and land cover data derived from MODIS data (MCD12Q1) were from the LP DAAC website.

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