Mapping vital ecosystem services by integrating local knowledge and remote sensing data

Case study in the Barotse Floodplain, Zambia

1. Background and Research Objective

- Wetlands support high levels of biodiversity and provide vital ecosystem services to society.
- Wetlands are facing increased pressures from land degradation and agricultural expansion.
- The Barotse region, located in the western province in Zambia, experiences a four to five month "hungry" season with limited food access.
- Growing interest on: **How land use configuration leads to providing the goods and services upon which human well-being is dependent?** (TEEB 2015).

This study aims to integrate of local and scientific knowledge by developing a land type map which is associated with vital ecosystem services for a dynamic landscape

Figure 3. The understanding of the local classification and management of the land type units from the Barotse region associated to their provision of goods and services is the cornerstone of this study.

2. Methodology

- The study area corresponded to the Barotse floodplain and surroundings, located in the western province in Zambia *(Figure 1)*.
- **Using the local land type characterization based in local knowledge *(Figure 2)*, this land type map was created using information from land types locations and management of farm plots and natural areas** collected through interviews to smallholder farmers distributed in the region, participatory activities and fieldwork done in 2014 *(Figure 3)*.

Figure 1. The location of the study area in Zambia (37.5 thousand km^2). The white square shows the location of the study area.

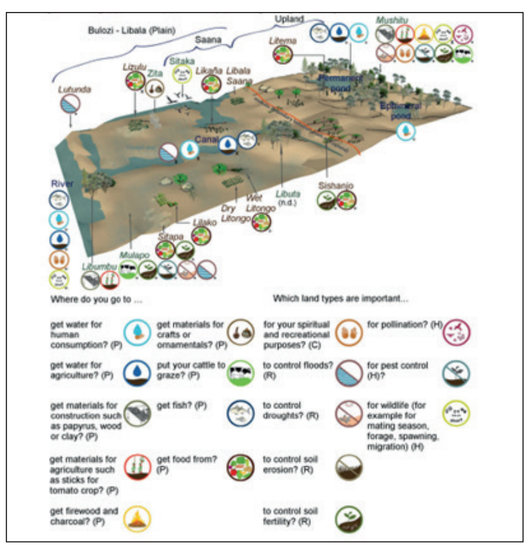

Figure 2. Schematic map of the Barotse floodplain with approximate land types location and description linked to the ecosystem services provided (Estrada-Carmona et al., 2016, submitted).

- **Combining categorized water and vegetation categorized rasters,** we used the previously collected field measurements and the land types characteristics of water content and vegetation cover **to identify and map 11 classes corresponding to main previously identified land types.**
- Additional ground truthing data (91 plots of 100 m^2 and 70 waypoints) was used for the accuracy assessment *(Figure 4)*.

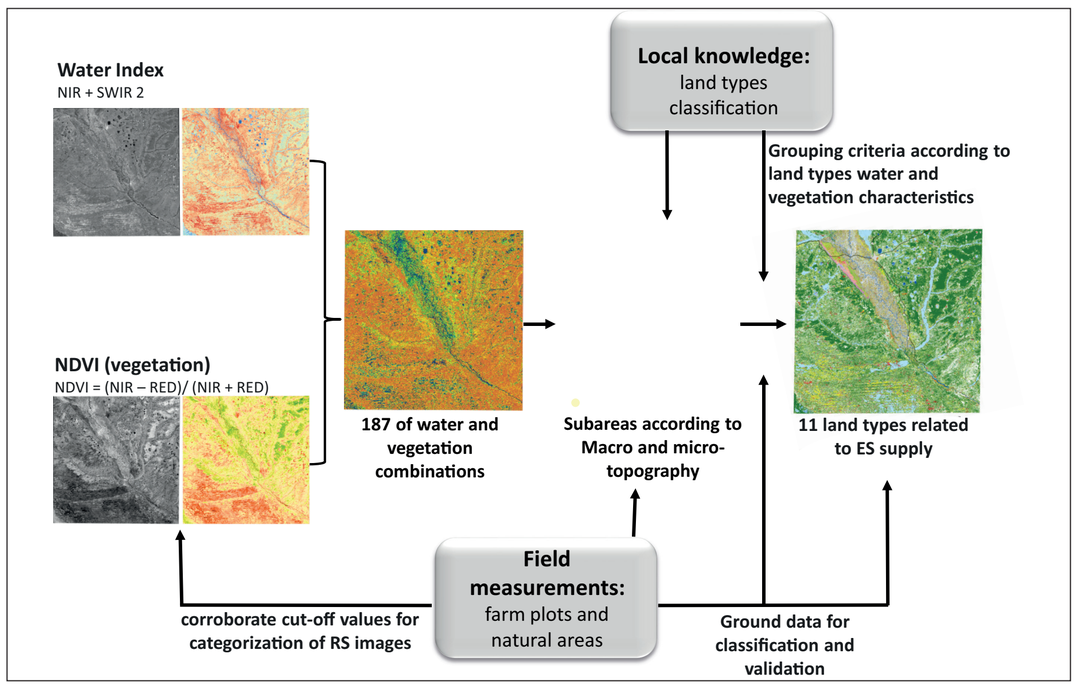

Figure 4. Diagram showing the followed steps for the creation of the land type map integrating local and scientific knowledge. The input images used were Landsat 8 Enhanced Thematic Mapper (TM) images from March 24th and July 14th, 2014 for the analysis (path 175, row 71).

3. Results

- **The integration of local and scientific knowledge with remote sensing resulted in a map that displays the distribution of land units which are relevant to their users** (the Barotse inhabitants) *(Figure 5)*.
- Understanding the local use of different land units in agricultural landscapes is essential to support effective decision making and is vital to **untangle the complex interactions between people, nature and agricultural landscapes.**
- Ground truthing measured the land type map's overall accuracy and a Kappa value of 82.1 and 78% respectively.
- Soil fertility and the seasonal risk of flooding or droughts are the main land type factors that determine the what, where and when of crop selection and management. Therefore, this land type map represents a useful guide that supports decisions for sustainable development in rural areas *(Figure 6)*.

Mapping vital ecosystem services in dynamic floodplains considering the local knowledge is a promising tool that supports effective decision and planning for food and nutritional security

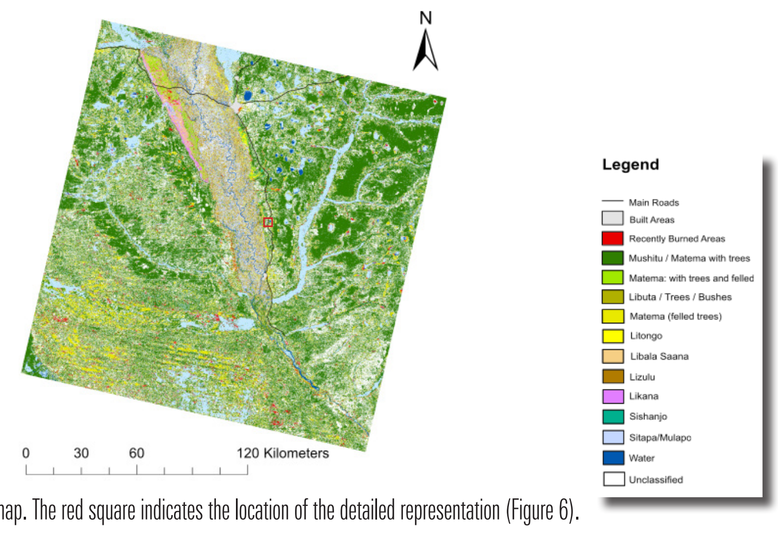

Figure 5. Land type classification map. The red square indicates the location of the detailed representation (Figure 6).

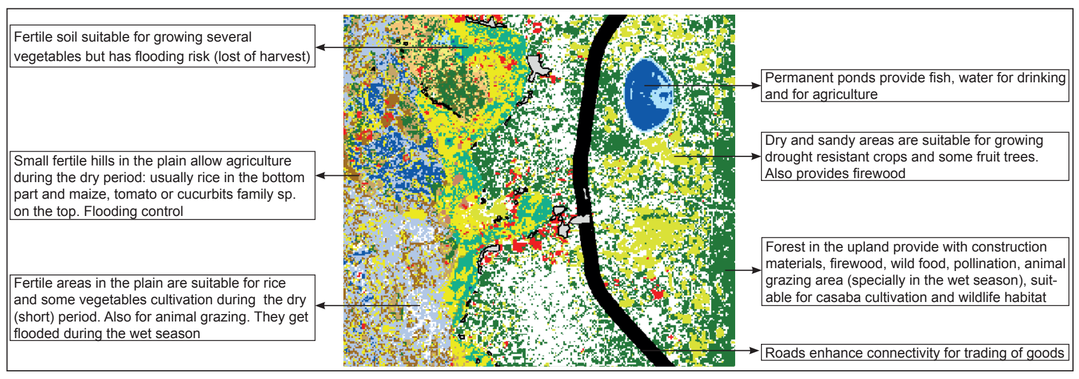

Figure 6. Detailed representation of a 5 x 3 km subset of the study area showing examples of land type units associated through the understanding of the local classification to ecosystem services provision.

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References

Estrada-Carmona, N., Attwood, S., Cole, S.M., Remans, R., DeClerck,F. 2016 (submitted). "Ecosystem services framework to guide crop diversification for nutrition and ecosystem health in Barotse Floodplain." Ecology and Society.
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