Do community-conserved areas in Tanzania achieve conservation goals?

Evaluating the environmental impact of a major conservation initiative in a stochastic dryland environment

Anthony Dancer, Imperial College London (anthony.dancer09@imperial.ac.uk)

Intro: Community-based natural resource management (CBNRM) & Tanzania's Wildlife Management Areas

CBNRM has been advocated as a means to balance the needs of conservation and rural populations. In theory, by enabling local communities to decide on and benefit from natural resources, they may be incentivised to manage those resources sustainably[1].

Evidence for the success of CBNRM initiatives is mixed, partly due to trade-offs between ecosystem and poverty alleviation outcomes, but also **limited use of rigorous impact evaluation**.

Tanzania's Wildlife Management Areas (WMAs; fig 1.), community-managed zones outside of core protected areas, are a case in point. **Villages within WMAs set aside land for conservation**, and in return are granted user-rights to wildlife, but at present their **ecological effects are poorly understood**.

Aim:

Undertake the **first initiative-wide assessment of the environmental impact of WMAs**, drawing on **satellite imagery** and **quasi-experimental matching methods**, to **compare change in habitat attributes** within WMAs to change in similar, unprotected areas.

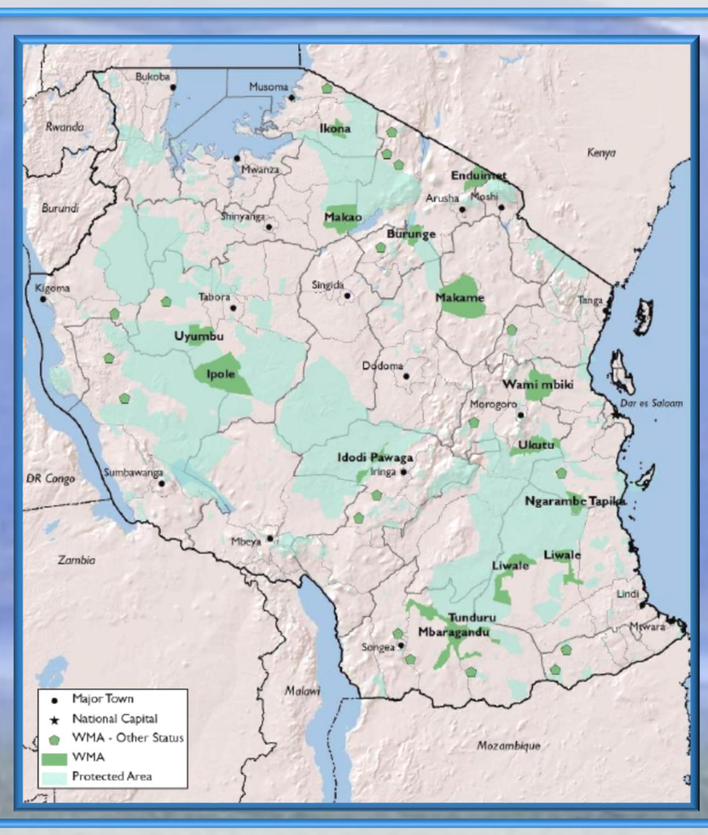

Figure 1: WMAs and PAs of Tanzania (USAID 2013)

Problem: Paucity of techniques for remote detection of fine-scale degradation

Methods for detection of absolute conversion of land-cover type (e.g. large-scale deforestation for agriculture) are commonplace, but **techniques for identification of fine-scale, smallholder-induced habitat degradation remain elusive**[2].

Traditional methods quantify changes in land-cover over short time series (2-5 images), but within-type change may go undetected[3].

More problematically, **in highly stochastic environments before-after comparisons can produce misleading results** as observed change between time points likely reflects background variation, not degradation[4].

In East African drylands **vegetation vigour fluctuates widely** according to irregular seasonal, interannual and multiannual variation in natural factors, predominantly rainfall[5], **masking fine-scale anthropogenic disturbance**.

Solution: High temporal resolution imagery and mixed-effects models

Long-term, high temporal resolution satellite imagery captured by the MODIS satellite sensor provide the opportunity for sophisticated statistical analysis of continuous, noisy data, making use of full-resolution time series to fit linear mixed-effects models with temporal and spatial autocorrelation structures.

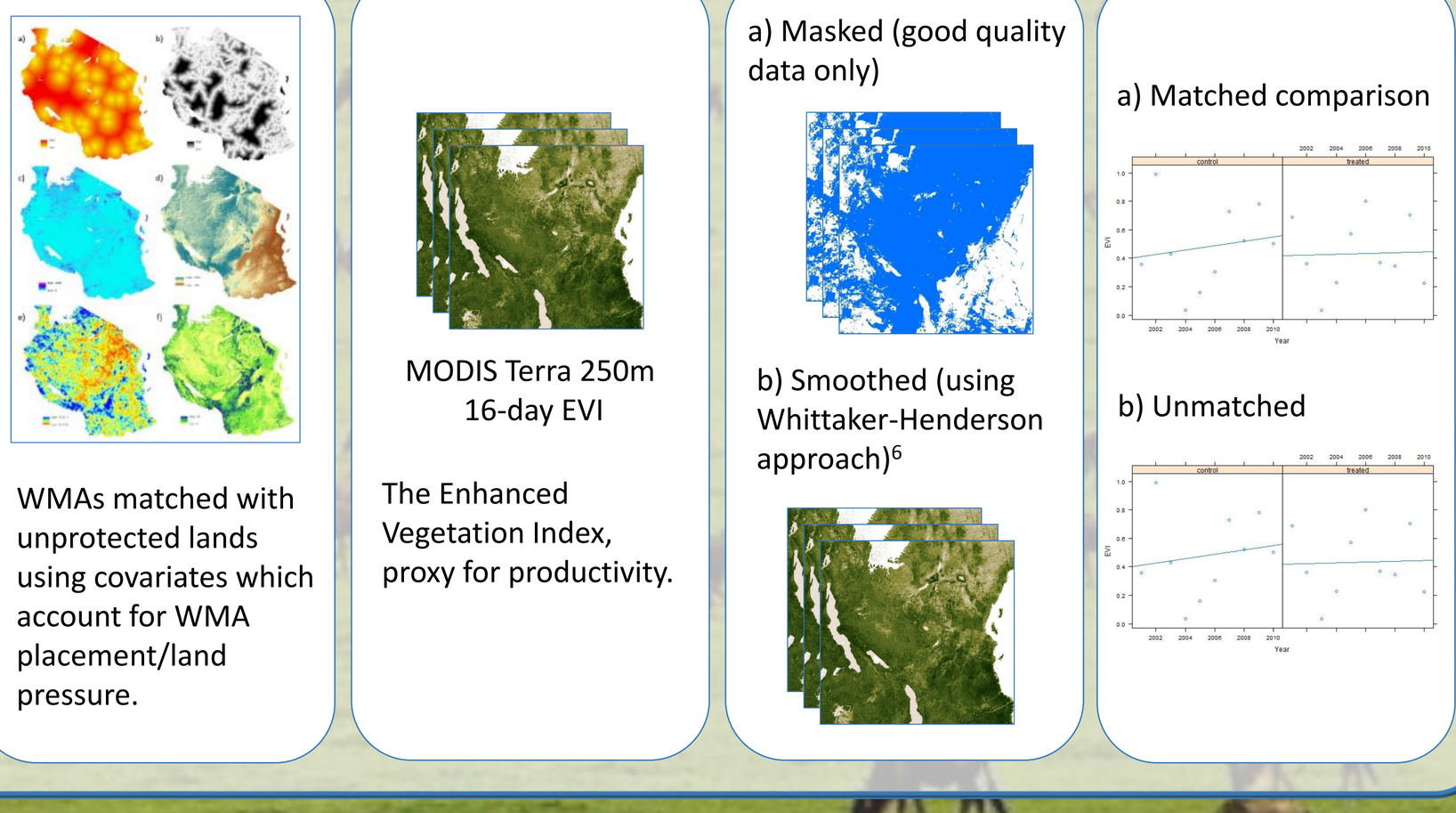

Figure 2: Data analysis process. To isolate the impact of WMAs on habitat degradation we will statistically match WMA lands with similar, unprotected areas, according to observable covariates which account for biases in WMA placement and degree of land pressure (1).

Post-matching, we will detect and compare trends in degradation by fitting linear models (4) to a continuous habitat attribute, productivity, using 'greenness' or photosynthetic activity as a proxy (calculated using the Enhanced Vegetation Index (EVI)).

Imperial College London

References
1. Roe et al. **2009**, IIED.
2. Coppin et al. **2004**, *Int. J. Remote Sens.*, 25(9), 1565–1596.
3. Lambin. **1999**, *Global Ecol. Biogeogr.*, 8(3-4), 191-198.
4. de Beurs & Henebry. **2005**, *Int. J. Remote Sens.*, 26(8), 1551–1573.
5. Nicholson et al. **1990**, *Climatic Change*, 17(2-3), 209-241.
6. Vuolo et al. **2012**, *Proc. SPIE*, 8538.

NERC SCIENCE OF THE ENVIRONMENT
espa ecosystem services for poverty alleviation