**Supplementary methods**

**Landsat tiles used in satellite analysis:**

LandSat tiles used for tree cover:

169/64, 170/64, 168/65, 169/65, 170/65, 169/66

Dates: 169 = 5th June 2015, 170 = 28 June 2015, 168 = 14th June 2015.

Landsat tiles used for water availability:

Wet: 170/64 = 20/2/2015, 1st Feb 2014; 170/65 = 1/2/14, 5/3/14, 169/64 = 18/4/15, 13/2/15; 169/65 = 13/2/15, 28/3/13; 169/66 = 13/2/15, 28/3/13; 168/65 = 21/4/13; 3/2/14

Dry: 170/64 = 13/9/14, 15/8/15; 170/64 = 29/9/14, 15/8/15; 169/64 = 22/9/14, 18/8/13; 169/65 = 9/9/15, 21/8/14; 169/66 = 9/9/15, 21/8/14; 168/65 = 28/9/13, 1/8/15.

**Estimating woody vegetation cover:**

Woody vegetation cover was estimated at 30 m resolution from cloud-free LandSat8 images made at the end of the wet season in 2015 that cover the Ruaha-Rungwa ecosystem. Around 80% of the ecosystem fell within one tile, and in this primary area we calculated scaled NDVI [(Zeng et al. 2000)](https://paperpile.com/c/8Q3zgD/OyeB) and used this to stratify a random selection of 4,000 pixels with estimated scaled NDVI scores within 0-25, 25-50, 50-75 and 75-100. In each of the remaining tiles with partial coverage within the survey boundary, 100 further pixels in each tile were sampled at random, delivering a total of 4,500 pixels from across the landscape. Overlaying these pixel boundaries on Google Earth high resolution images [(DigitalGlobe 2012)](https://paperpile.com/c/8Q3zgD/xVPM), we estimated by eye the tree cover within all 4,500 30 m pixels using images from June, when trees are green and most grass already dry. From this dataset, we sampled 80% of the pixels and used Artificial Neural Networks (ANNs) to model the percent cover using bands 2 - 7 of the original LandSat8 images after correcting with dark object subtraction (DOS1: [(Chavez 1989)](https://paperpile.com/c/8Q3zgD/7U8R)) and conversion for top of atmosphere reflectance and temperature brightness [(Song et al. 2001/2)](https://paperpile.com/c/8Q3zgD/8v99). Following [(Atkinson & Tatnall 1997)](https://paperpile.com/c/8Q3zgD/Y9Mv), we fitted 10 ANNs using internal cross validation to select network architecture and recommended fitting parameters for tree cover analysis. We used the mean prediction of the 10 models as estimates of tree cover, which we validated externally with the remaining 20% of data. R2 for external validation of data at 30 m resolution was 0.60. We aggregated these data to 500 m resolution using the maximum value, to ensure narrow riverine areas with high cover were correctly identified.

**Supplementary Literature cited:**

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[DigitalGlobe. 2012. Google Earth. Available from](http://paperpile.com/b/8Q3zgD/xVPM)<http://www.earth.google.com> [(accessed August 14, 2014).](http://paperpile.com/b/8Q3zgD/xVPM)

[Song C, Woodcock CE, Seto KC, Lenney MP, Macomber SA. 2001/2. Classification and Change Detection Using Landsat TM Data: When and How to Correct Atmospheric Effects? Remote sensing of environment **75**:230–244.](http://paperpile.com/b/8Q3zgD/8v99)

[Zeng X, Dickinson RE, Walker A, Shaikh M, DeFries RS, Qi J. 2000. Derivation and Evaluation of Global 1-km Fractional Vegetation Cover Data for Land Modeling. Journal of Applied Meteorology **39**:826–839.](http://paperpile.com/b/8Q3zgD/OyeB)