Dynamic Water Value Map

Jeremiah K. Kiptala, Pieter van der Zaag *et al.*

A holistic tool for monitoring and assessing the economic, social and ecological status of African landscapes

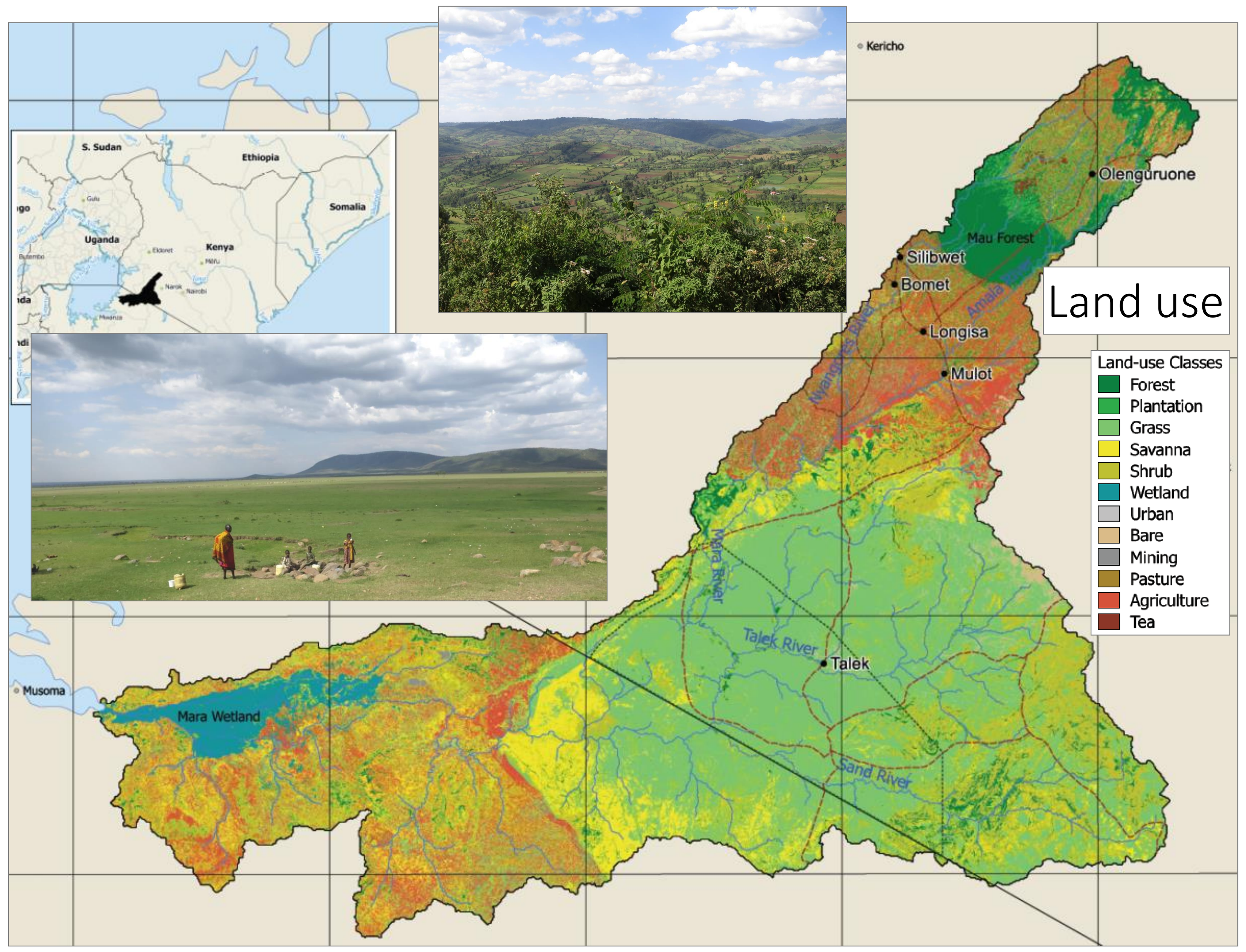
Problem statement

Changes in African landscapes due to human interventions and climate forcing are not holistically monitored and assessed. Different landscape elements add value in different ways and at different scales [1,2]. Landscape elements are linked to each other through water flows, sediment flows, natural movements of species, and through human intervention, among others. Resulting changes in land use / land cover modify the value added of each landscape element and those linked to it.

However, the value added cannot always be appropriately quantified along one and the same metric – some value added can be measured directly in economic terms, but others are difficult to measure despite being important socially (e.g. more resilient livelihoods) or ecologically (e.g. enhanced biodiversity) [3].

The central value addition in catchments considered here is biomass production, which can be estimated through remotely sensed images. The main process underlying biomass production, transpiration, can also be estimated through RS. Thus also the amount of biomass produced per unit of water consumed in each landscape element, and the economic [4], social and/or ecological value added, resulting in a holistic water value map.

Coupling the water value map to a hydrological model makes it dynamic [5], as it can show how alternative interventions change not only the economic but also the social and ecological water values. Policy makers can assign different weights to the three value metrics so that (economic, social and ecological) tradeoffs become clear and decision-making is better informed.



Source: MaMaSe, 2015; see: MaMaSe GeoNode: http://maps.mamase.org

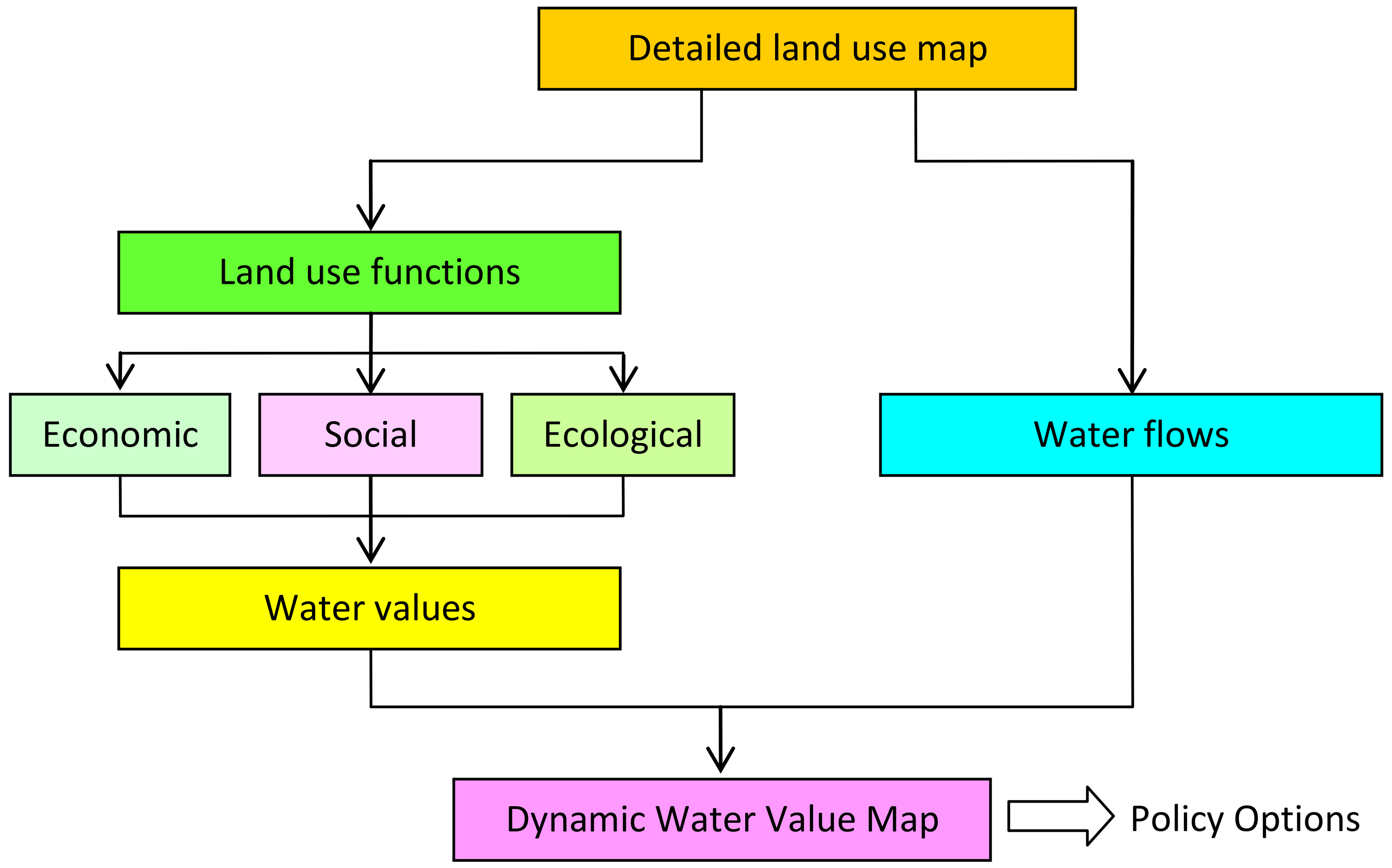
Innovation

The Dynamic Water Value Map can significantly improve the insights into the economic, social and ecological tradeoffs and synergies of alternative (water and land use) development scenarios in African landscapes, and thus lead to better informed decision-making.

The problem of data scarcity in such landscapes is partially mitigated by new RS products, although the water value map is also based on precise information on land use and its (economic, social, ecological) functions.

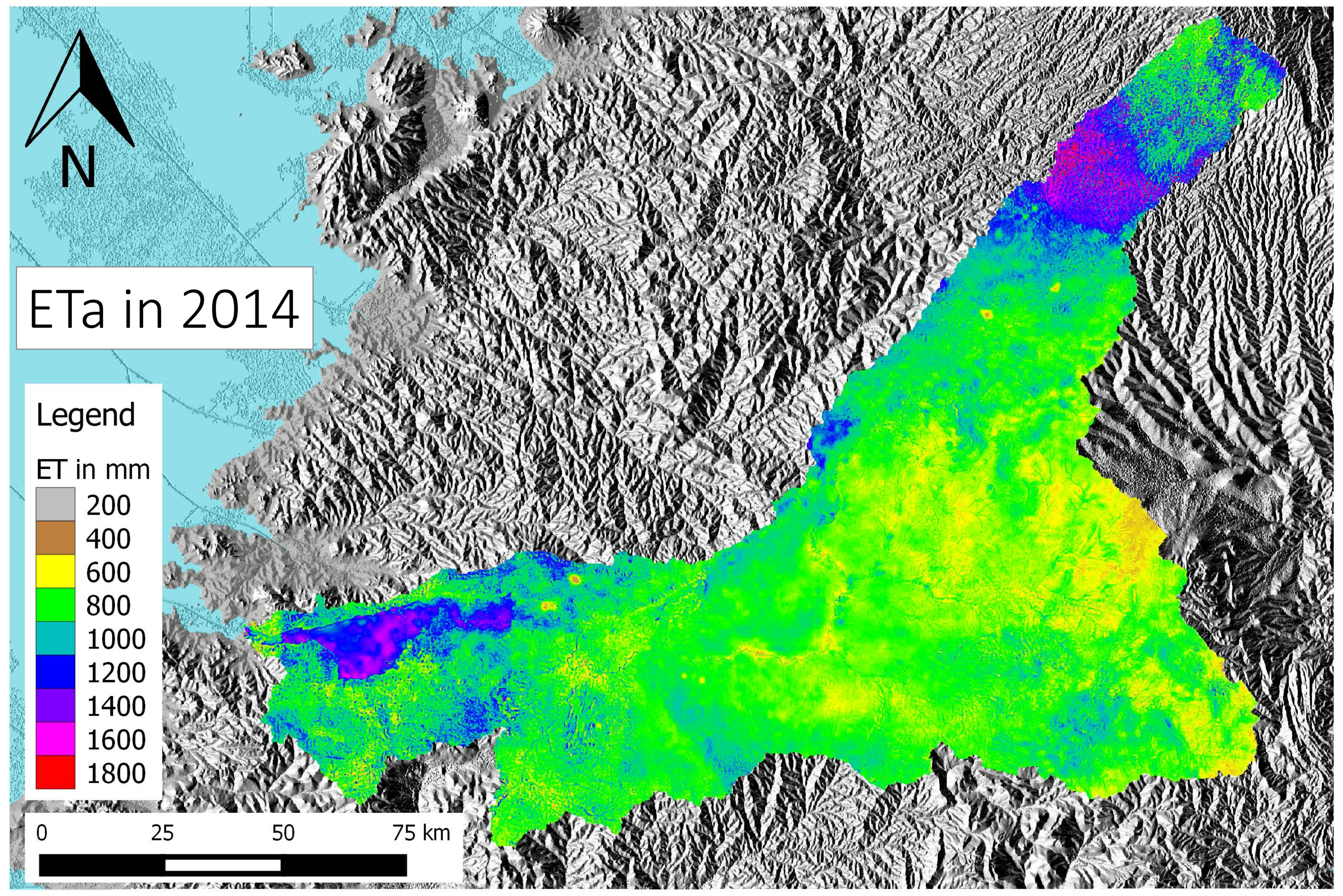
Basin managers can report on a routine basis to policy makers the current water values in a basin, how these have changed compared to the previous reporting period, and how these could evolve in future given planned interventions and new policies.

Approach



Proof of concept: Mara river basin, Kenya

The proof of concept will be developed for the Mara river basin in Kenya (8,800 km^2), where we work closely together with the Water Resources Management Authority (WRMA) – Mara Sondu Catchment, as well as with many of the 27 Water Resources Users Associations (WRUAs), in the context of the Mau-Mara-Serengeti Sustainable Water Initiative.



Source: Wim Bastiaanssen & Tim Hessels, Water Accounting+, 2016

Resources

Apart from ESA Tiger, activities will be funded by the WA+ programme of UNESCO-IHE (www.wateraccounting.org), and the Mau-Mara -Serengeti Sustainable Water Initiative MaMaSe (www.mamase.org) that is implemented by a consortium of African and European partners led by UNESCO-IHE.

We intend to use data derived from Sentinel-2, initially for one entire year (July 2015 - June 2016). The fine temporal resolution of Sentinel-2 (16 days) improves chances to identify non-cloudy images during the rainy seasons. The spatial detail (20mx20m or better) is at least twice as good compared to Landsat, which allows us to improve the existing land use map of the Mara.

Team	JKUAT	UNESCO-IHE
	Eng. Jeremiah K. Kiptala	Prof. Dr. Pieter van der Zaag
	Prof. Eng. Bancy M. Mati	Prof. Dr. Wim Bastiaanssen
	Ms. Jackline A. Ndiiri	Mr. Tim Hessels, MSc
	Dr. Clifford C. Obiero	Dr. Yong Jiang
	Dr. John K. Mwangi	Prof. Dr. Michael McClain
	Dr. Charles C. Kiproech	Dr. John Conallin
	Dr. Njenga Mburu	

References

[1] Hermans, L.M., G.E. van Halsema and H.F. Mahoo, 2006. Building a mosaic of values to support local water resources management. *Water Policy* 8: 415–434

[2] Jiang, Y., Swallow, S.K., 2014. Providing an ecologically sound community landscape at the urban-rural fringe: a conceptual, integrated model. *Journal of Land Use Science* 10(3), 323-341.

[3] Bateman, I.J. et al., 2010. Economic analysis for ecosystem service assessments. *Env Resource Econ* 48, 177-218.

[4] Hellegers, P.J.G.J., R. Soppe, C.Perry and W.G.M. Bastiaanssen, 2010. Remote Sensing and Economic Indicators for Supporting Water Resources Management Decisions. *Water Resour Manag* 24:2419–2436.

[5] Kiptala, J.K., Mul, M.L., Mohamed, Y., Van der Zaag, P., 2014. Modelling stream flow and quantifying blue water using modified STREAM model in the Upper Pangani River Basin, Eastern Africa, *Hydrol Earth Syst Sc* 18, 2287-2303.