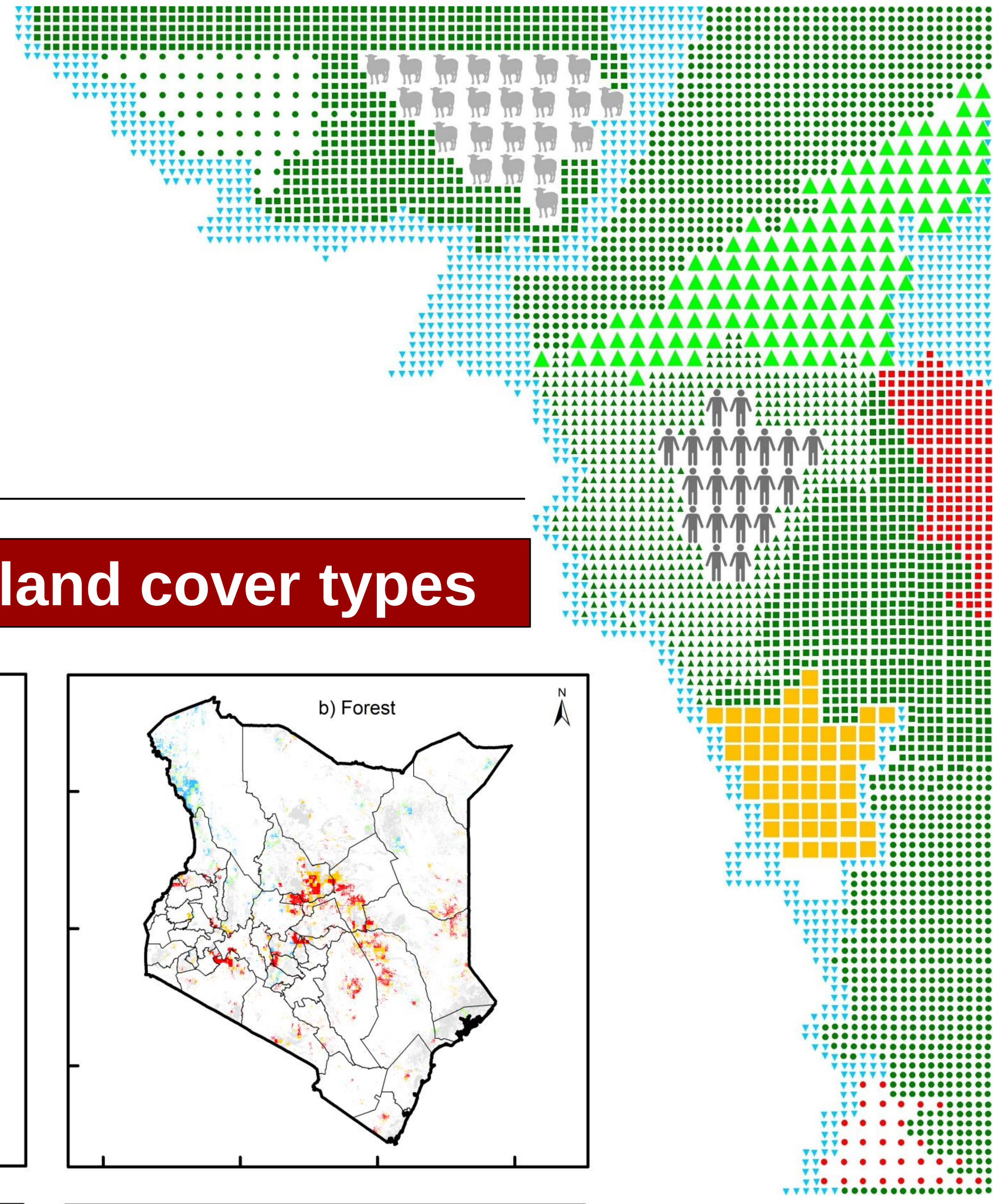
Establishing a land degradation neutrality (LDN) national baseline through trend analysis of GIMMS NDVI time series

Gichenje H[1a], Godinho S[1]

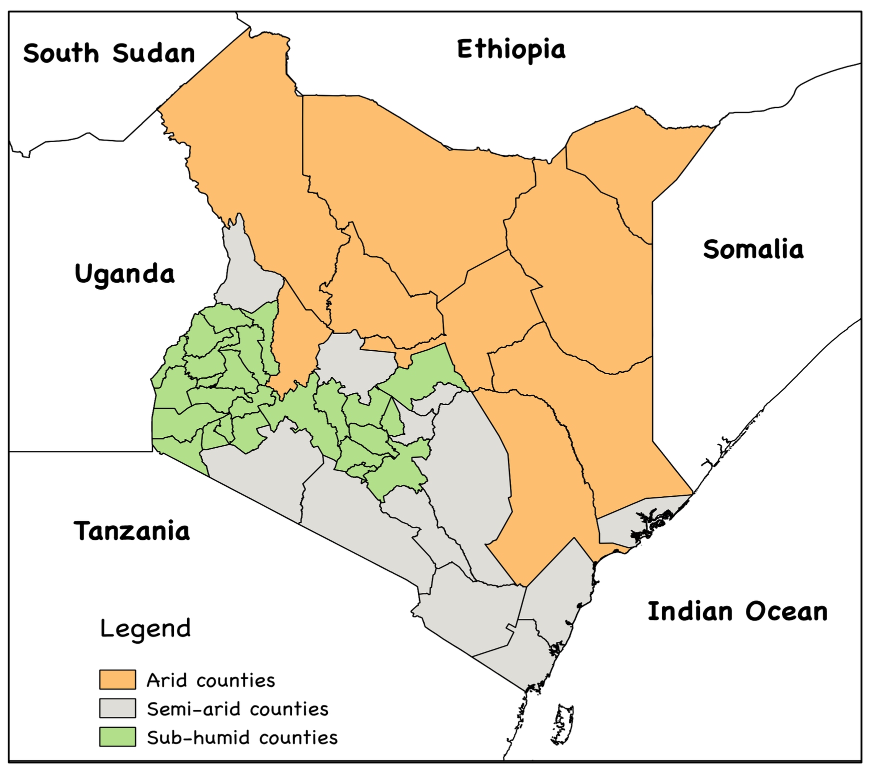
1. Instituto de Ciências Agrárias e Ambientais Mediterrânicas, Instituto de Investigação e Formação Avançada, Universidade de Évora, Pólo da Mitra, Ap. 94, 7006-554 Évora, Portugal.
a. d36637@alunos.uevora.pt



Abstract

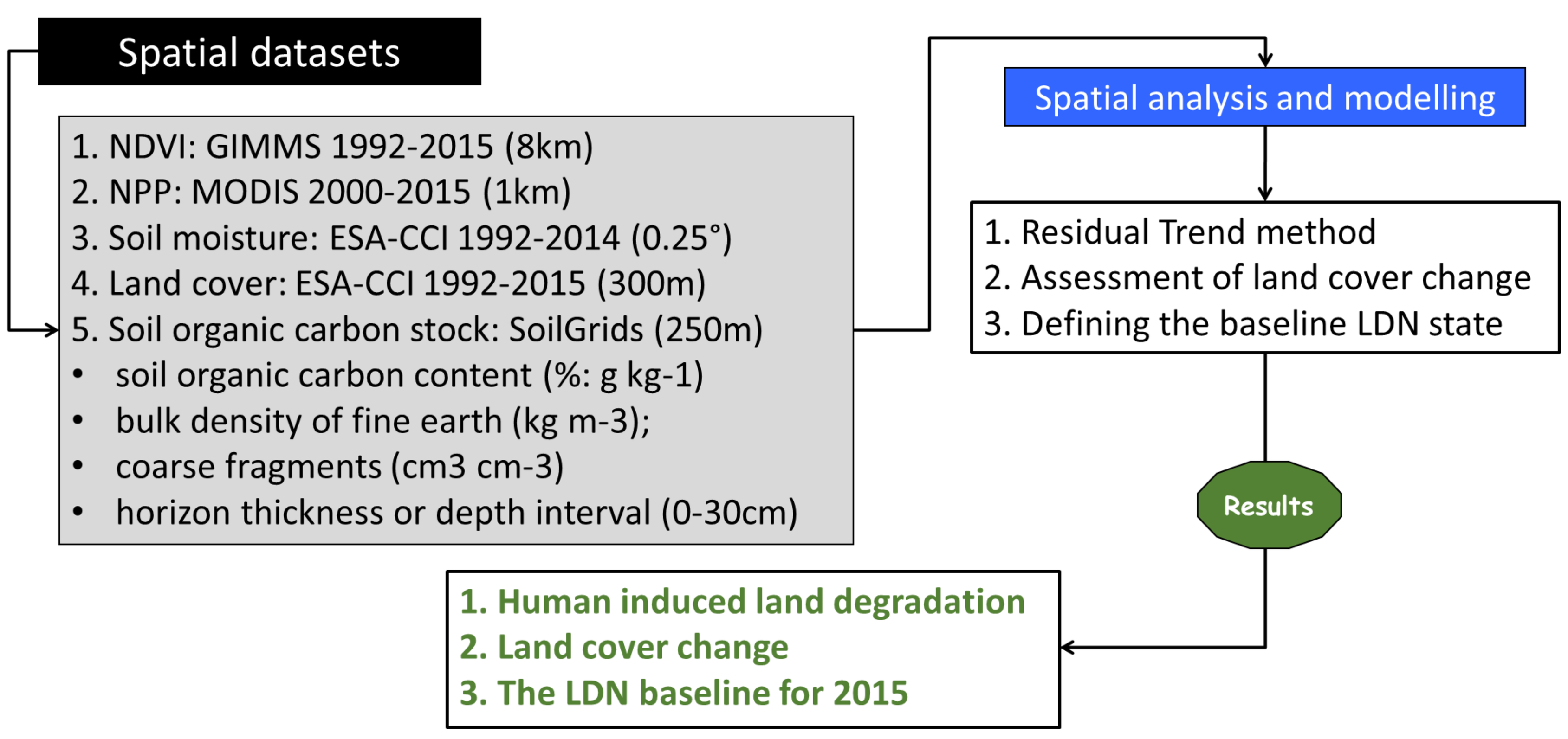
The land degradation-neutrality (LDN) national baseline for Kenya in 2015 was established in terms of the three LDN indicators (land cover, land productivity, and carbon stocks), and using trends in GIMMS NDVI and land cover datasets over the 24-year period from 1992 to 2015. Human-induced land degradation was separated from degradation driven by climate factors using soil moisture data and the residual trend method. On the basis of Kendall's tau of the NDVI residuals computed using annual mean data of the NDVI and soil moisture relationship, the country has experienced persistent negative trends (browning) over 21.6% of the country, and persistent positive trends (greening) in 8.9% of the country. The land cover change map for the period 1992–2015 showed that in 5.6% of the area there was a change from one land cover class to another. Pronounced changes in terms of land area were the increase in grasslands by 12,171 km2, the decrease of bare land by 9,877 km2, and the decrease in forests by 7,182 km2. Browning and greening trends account for 13% and 12%, respectively, of the land cover change areas.

Study area

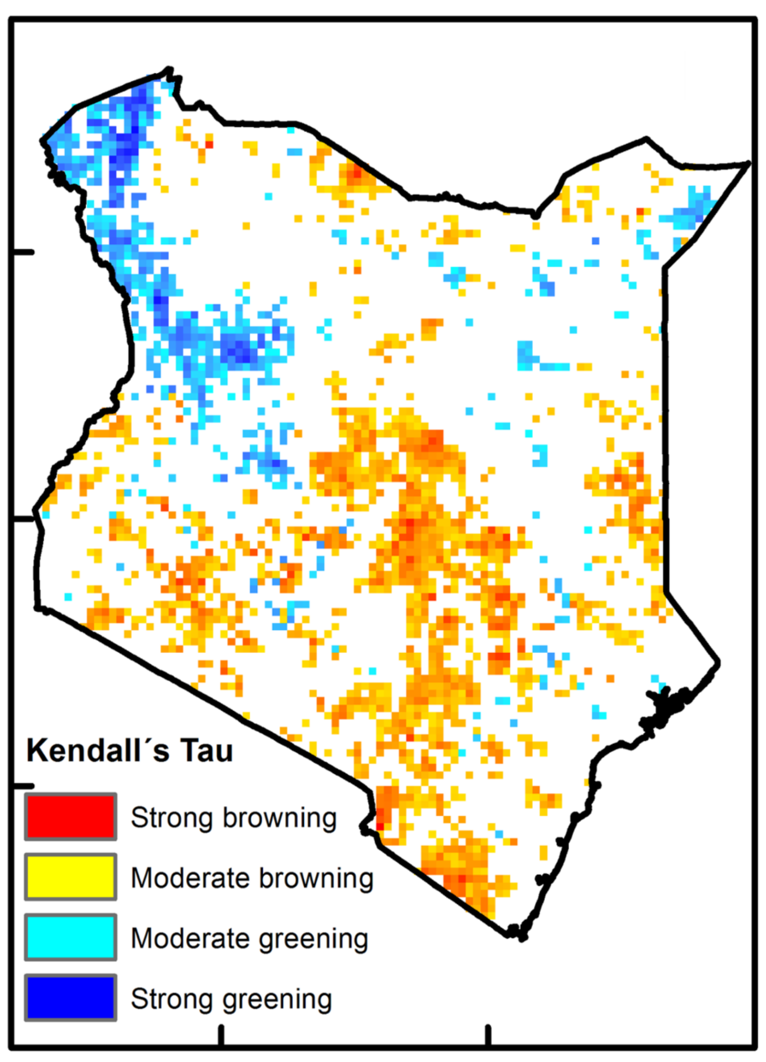


Most of the country lies within the eastern end of the Sahelian belt, a region that has been severely affected by recurrent droughts over the past decades. Kenya's average annual precipitation is typically 680mm, ranging from less than 250mm in the northern part of the country, to about 2,000 mm in the western part of the country.

Methods

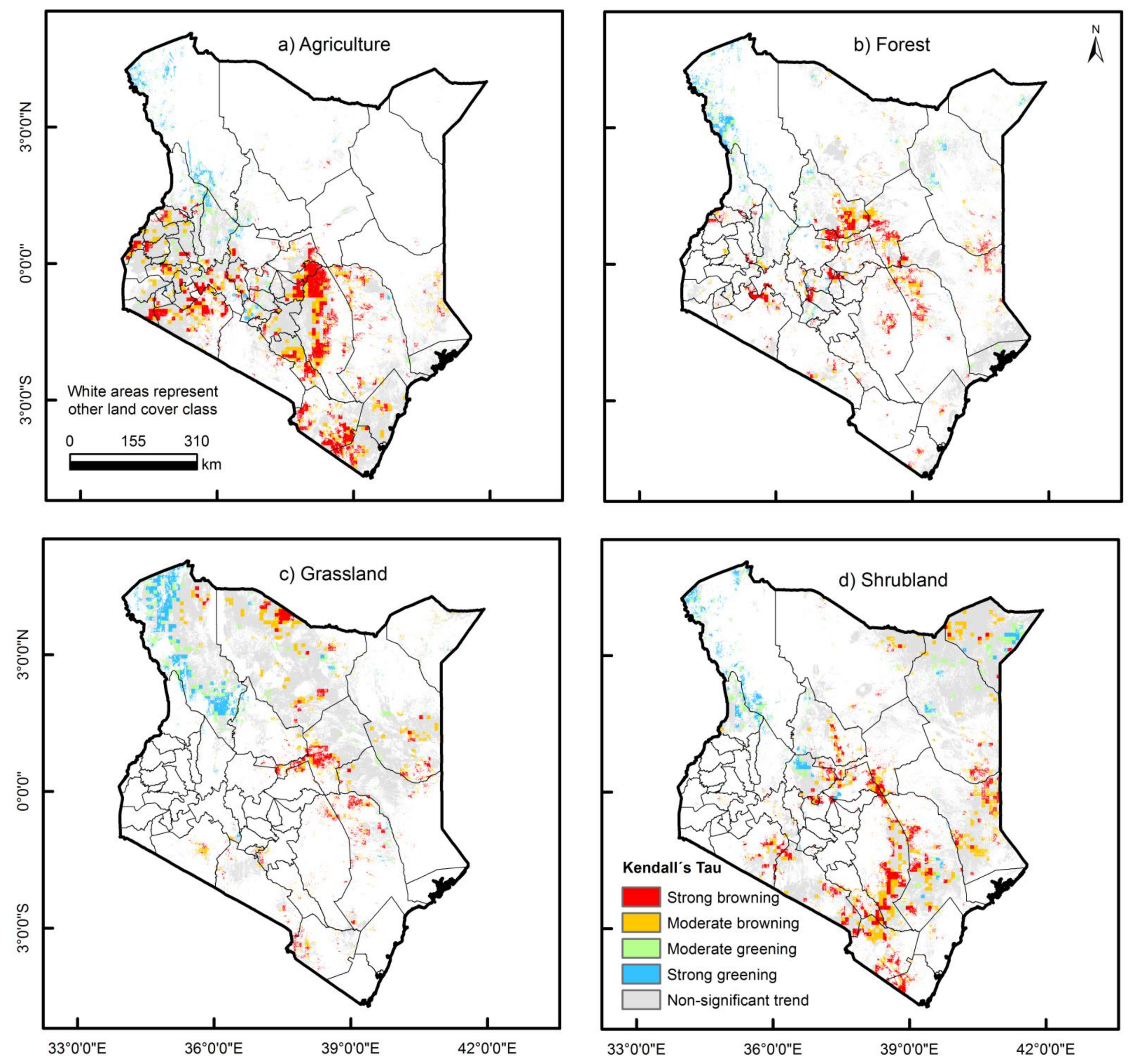


Human induced land degradation

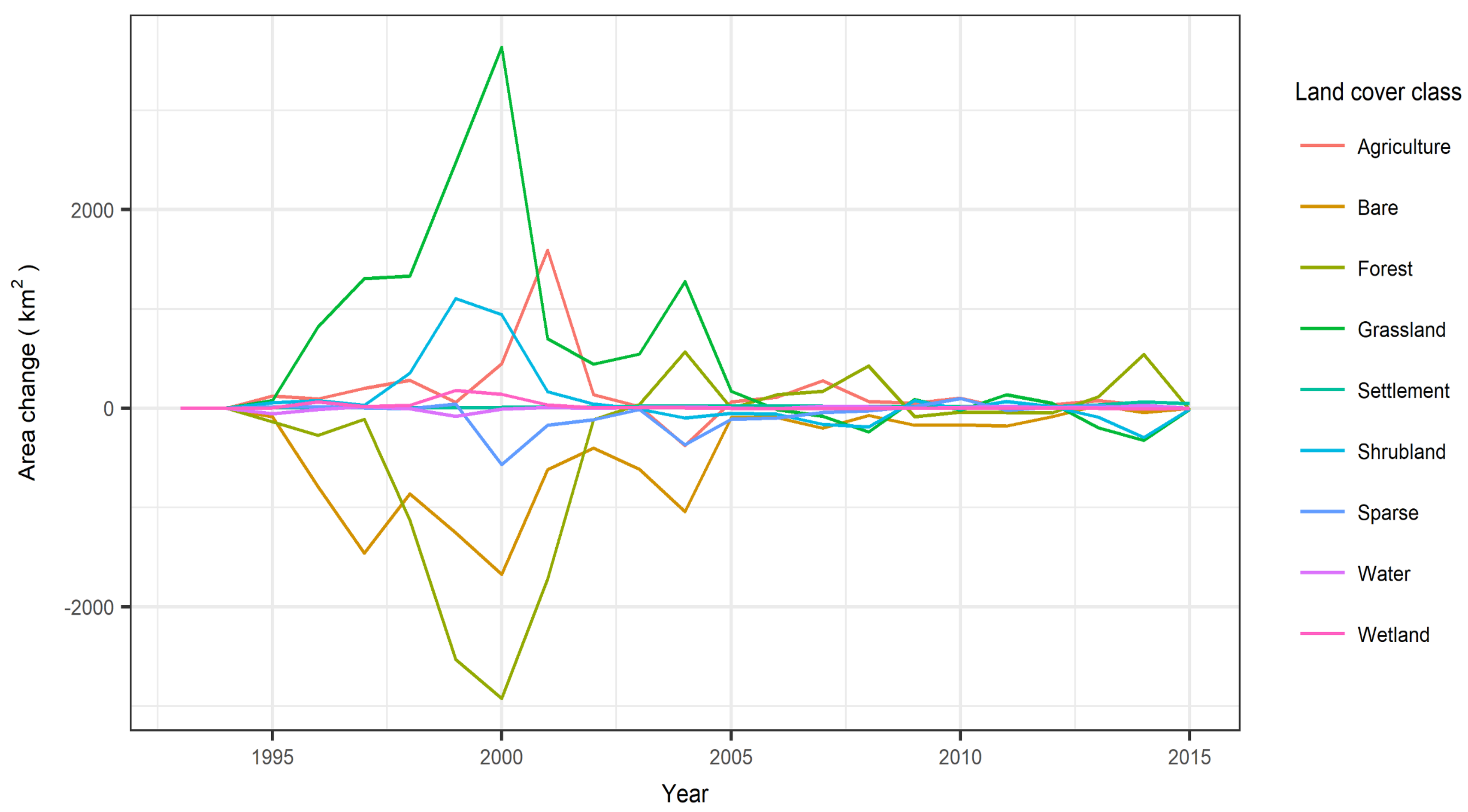


Significant (95%) trends of the NDVI residuals computed from the NDVI-soil moisture relationship over the 24-year period, indicate persistent negative trends (browning) over 21.6% of the country, and persistent positive trends (greening) in 8.9% of the country.
Strong browning has occurred in 11.8% of the country, with moderate browning occurring in 9.8% of the country.
Strong greening has occurred in 5% of the country, with moderate greening occurring in 3.9% of the country.

NDVI trends across land cover types



Land cover change



Land degradation neutrality baseline (2015)

Land cover classes	Land cover area (km^2)	MODIS NPP g C/m^2	Soil organic carbon[1] (0-30cm) (ton/ha)
Agriculture	144,324	699	65.23
Forest	86,577	497	59.81
Grassland	140,446	178	33.58
Shrubland	167,942	330	45.51
Sparse	2,796	235	30.77
Wetland	9,427	405	35.88
Settlement	461	569	67.62
Bare	18,561	131	39.51
Water	12,113	-	-

Note: 1. The mean SOC stock is for the year 2000.

Conclusion

As a first step, targeted field level assessments, alongside the collection of data for the computation of SOC stocks, should be undertaken in selected browning, greening and land cover change sites. These field studies will provide decision makers with key information on the processes and factors driving vegetation cover changes and dynamics, to inform policy development on land management broadly, and specifically on how to plan for the implementation and monitoring of LDN interventions.

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