



Variations of ecosystem service values as a response to land use and land cover dynamics in Central Malawi

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Introduction

☀ Ecosystems offer several services that are crucial to the well-being and survival of humankind

☀ The analysis and quantification of changes in Ecosystem Services Values (ESVs) is an essential tool to:

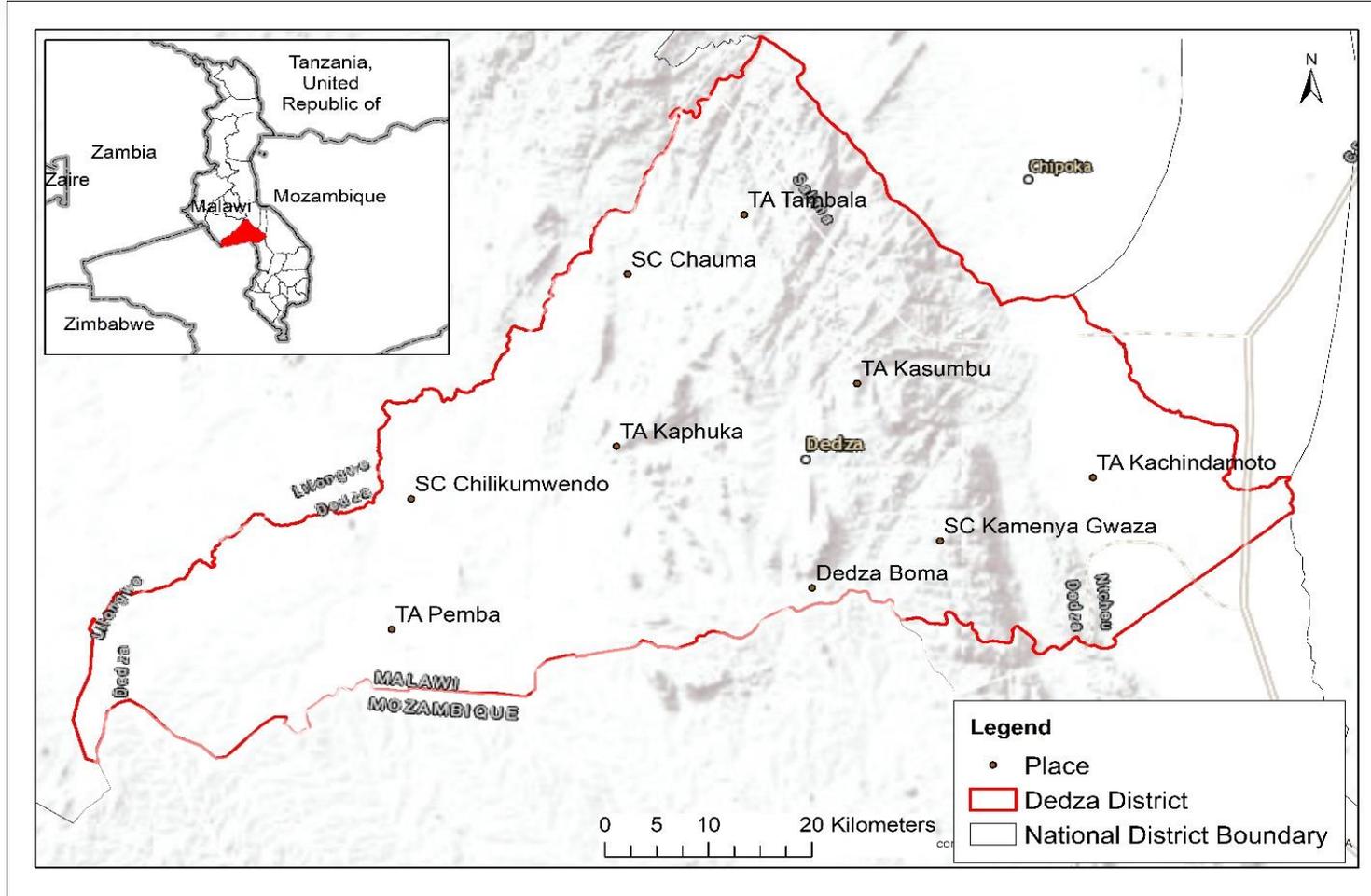
- inform policy formulation
- development of sustainable land use or biodiversity conservation plans.

☀ Study aimed at

Estimating the variations in ESV as a result of LULC changes which occurred between 1991 and 2015, and project these changes during the period 2015 and 2035 and examining the implications of LULC changes on ES functions

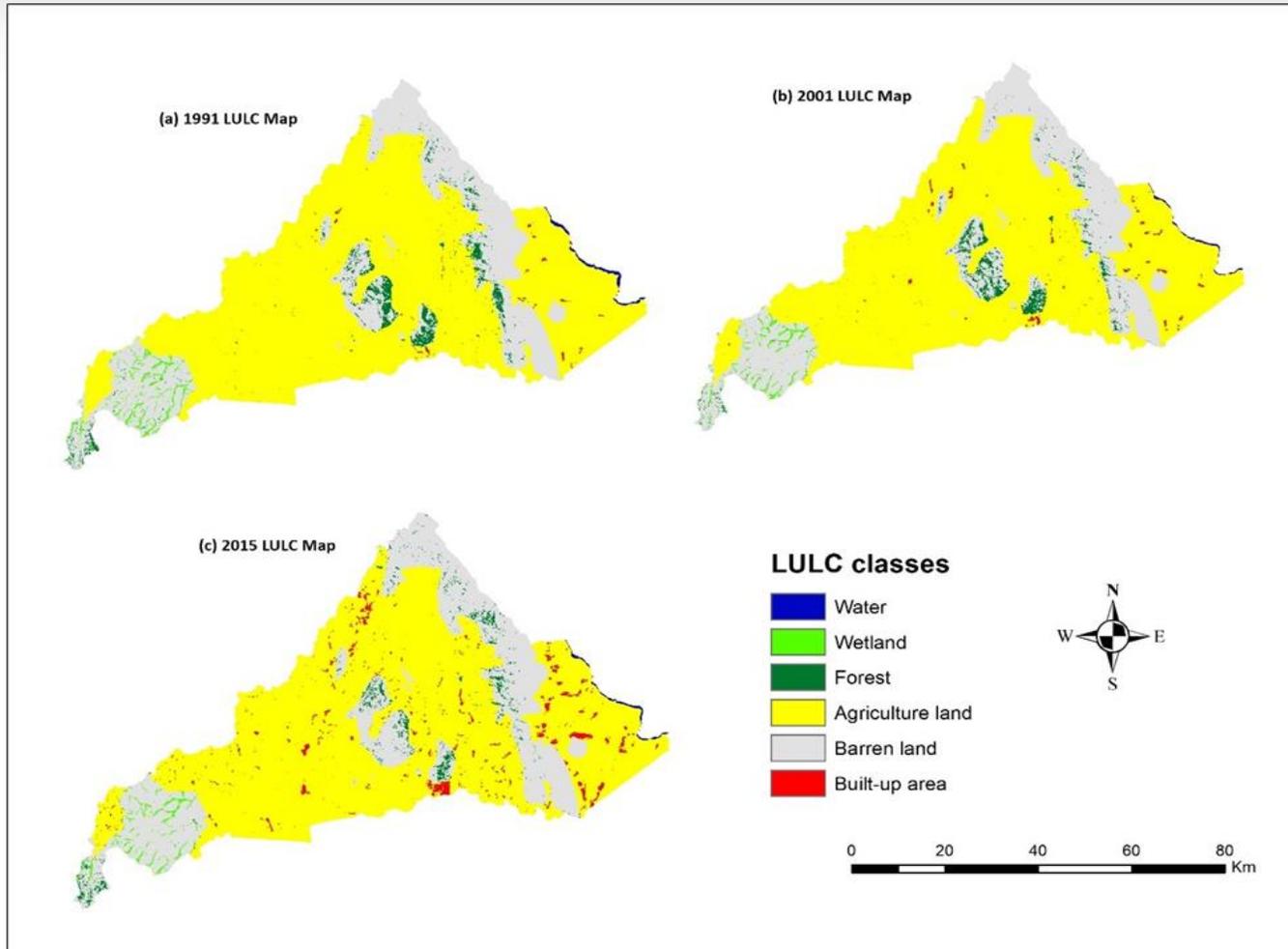
Study area

Map of Dedza district



- ☀ Study was conducted over the Dedza district situated in the central part of Malawi
- ☀ The district covers an estimated area of about 3,624km²
- ☀ In 2018, the total population of the district was 830,312 of which 799,584 was the rural population **representing 96%**.

Data used



Land use and land cover data (1991-2015)

- Three cloud-free Landsat 5 (TM), Landsat 7 (ETM+) and Landsat 8 (OLI) satellite data were used in this study and the images were selected based on their availability and quality.

Hybrid LULC classification technique that combines unsupervised and maximum likelihood supervised methods. The classified maps were categorized into six classes :

- barren land, water bodies, forest, wetlands, built-up areas, and agricultural land

Classification and estimation ESVs

Classification of Ecosystem services

Classified based on Millennium Ecosystem Assessment (MEA). The services were grouped into:

- Provisioning ES; Regulating ES; Cultural ES and Supporting ES

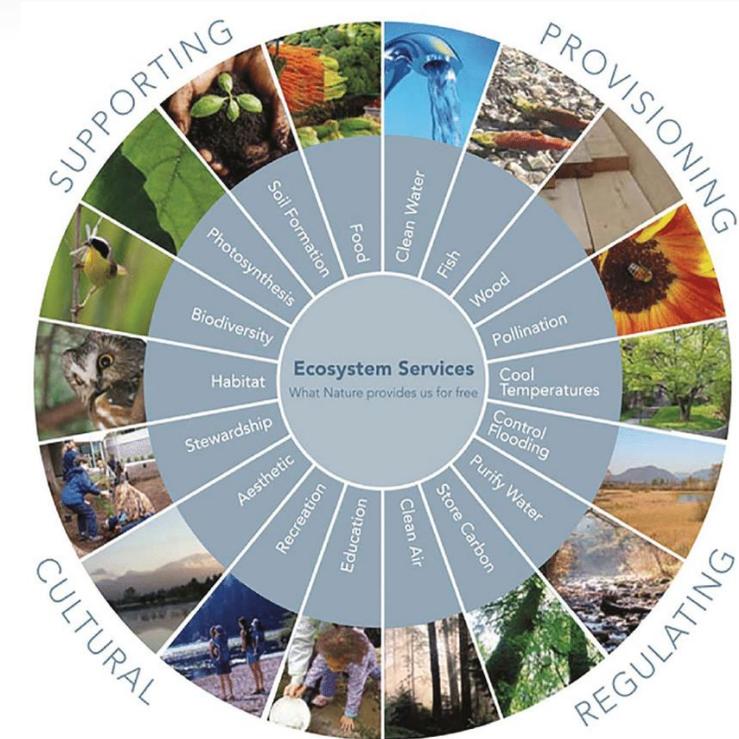
Estimation of ESV:

- The ESV of the six (6) LULC classes as classified from Landsat images of 1991, 2001, 2001 and 2015 were compared with biomes

LULC classes, the equivalent biomes and ecosystem service value of coefficients.

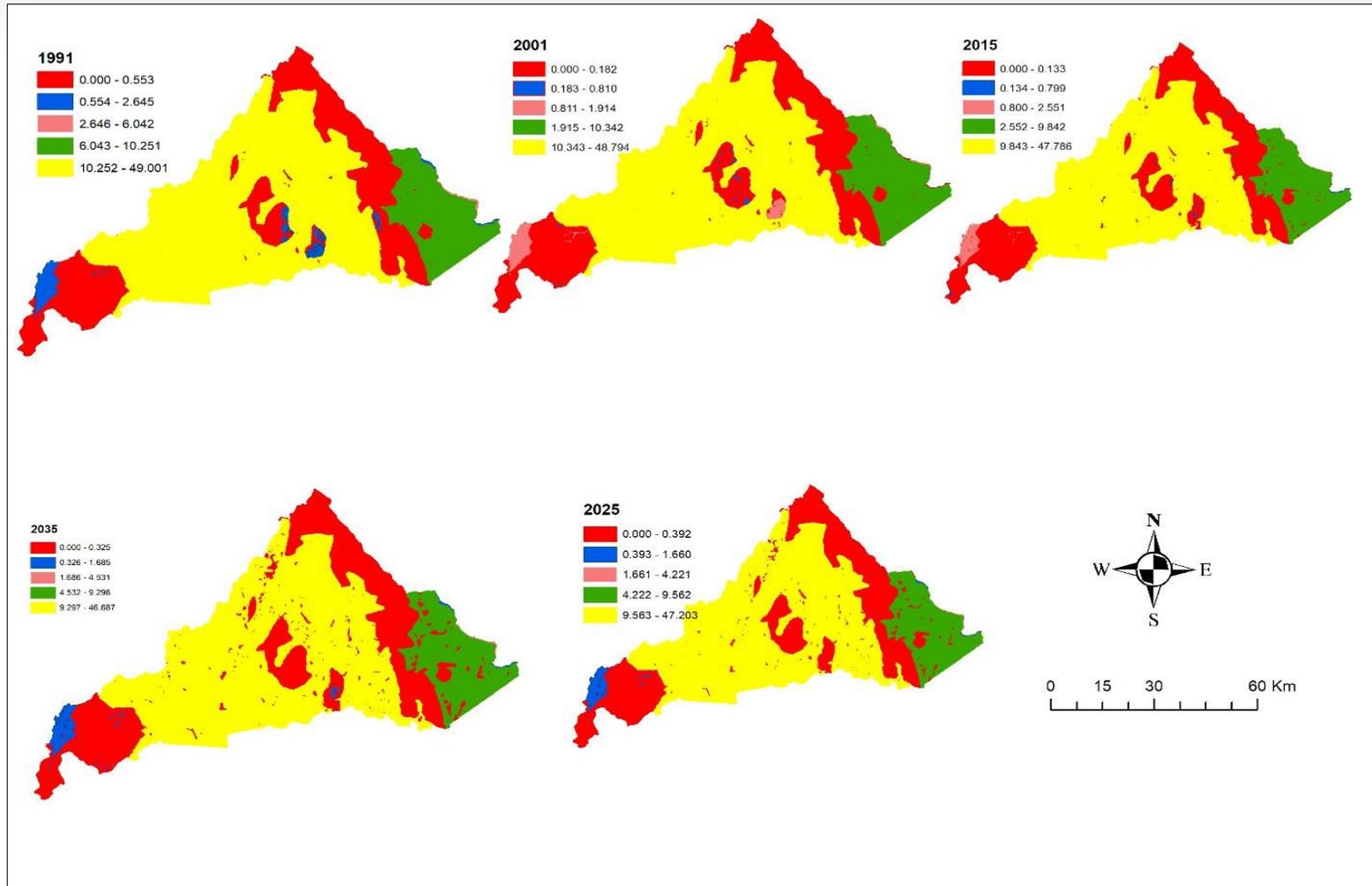
LULC Class	Equivalent Biome	ES value of coefficient (US\$ ha ⁻¹ yr ⁻¹)
Water bodies	Lakes/ivers	8,103.5
Wetland	Wetlands	1,992.4
Forest	Tropical forest	986.69
Agriculture	Cropland	225.56
Barren	Desert	0
Built-up	Urban	0

Source: Computed from Kindu et al., (2016) and Temesgen et al., (2018)



Spatial distribution of estimated ecosystem services values

Spatial distribution of ecosystem services values for Dedza district from 1991 to 2035



☀ The total ESVs of the whole area were as follows:

☀ 1991: US\$88.7

☀ 2001: US\$80.9

☀ 2015: US\$77.6

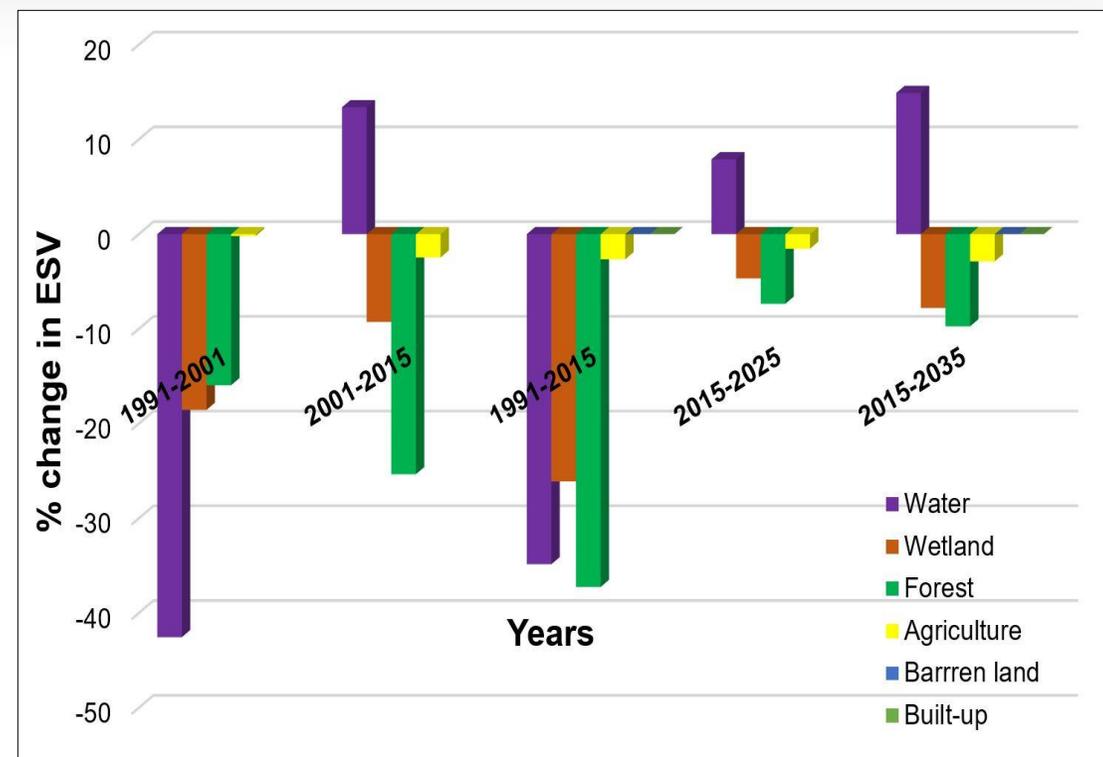
☀ 2025: US\$76.6

☀ 2035 US\$76.0

Estimated changes in ecosystem services values

Estimated total ecosystem services values for each LULC class & corresponding changes 1991 to 2035

LULC Class	ESV (US\$ million)					ESV change (US\$ million)	
	1991	2001	2015	2025	2035	1991-2015	2015-2035
Water bodies	11.2	6.4	7.3	7.9	8.4	-3.9	1.1
Wetland	7.2	5.9	5.3	5.1	4.9	-1.9	-0.4
Forest	9.8	8.2	6.2	5.7	5.6	-3.7	-0.6
Agriculture	60.4	60.3	58.8	57.9	57.2	-1.6	-1.7
Barren land	0	0	0	0	0	0	0
Built-up	0	0	0	0	0	0	0
Total	88.7	80.9	77.6	76.6	76.0	-11.1	-1.6



Conclusion

- 🌅 Findings have revealed that ESVs declined between 1991 and 2015 due to a loss of forest cover and a decline in wetlands, water bodies and agricultural lands.
- 🌅 The continuing decrease in ESVs found in this study presents a significant threat to both natural resources and people.
- 🌅 The reduction in the value of ESV in the study region represents an ecological deterioration of natural resources.
- 🌅 Our estimation of ESV changes using LULC data is vital for steering policy formulation and designing appropriate intervention strategies for sustainable management of natural resources and providing guidance for the allocation of limited resources among competing users.
- 🌅 It also helps to prioritize and conserve ecosystems that provide the highest-valued services.



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