

A new approach to quantify grazing pressure under Mediterranean pastoral systems using GIS and Remote Sensing

Introduction

Pastoral systems based on grazing itineraries, very common along the Mediterranean region, provides an opportunity to search feeding resources at landscape scale under a silvopastoral system called by San Miguel (2004) as “Mosaic of different land uses within one management unit”. However daily and seasonal movements of flocks bring on different Grazing Pressure (GP) over the landscape. The GP in a given location depends on the distance from the stable to the parish border, the distance to the stable, the heads of livestock and their preferences for land use and land cover (LULC).

Objectives

The objective is to design an approach for grazing pressure modelling, in pastoral systems in Mediterranean areas, using the northeast of Portugal (Fig. 1) as a case of study, by the integration of multispectral data from Sentinel-2 and geoprocessing.

Results

Shrublands were the more abundant LULC class (188,315 ha, 28.5% of total area) with the remaining land uses being: permanent crops (161,724 ha, 24.5 %), grassland (135,277 ha, 20.5 %), ungrazed forest (69,781 ha, 10.6 %), annual crops (49,814 ha, 7.5 %), grazed forest (41,626 ha, 6.3 %), urban (8,221 ha, 1.2 %), water bodies (5,242 ha, 0.8 %) (Fig. 2).

The most common GP class is 0-0.25 sheep.ha⁻¹(Fig. 3, Fig. 4). Seeing the GP per LULC, it was found mean values of 1.84 sheep.ha⁻¹ in permanent crops, 1.73 in annual crops, 1.25 in grassland, 0.88 in the grazed forest and 0.84 in shrublands (Fig.5).

Land uses related to the agrarian matrix have a GP compatible with the conservation of a mosaic landscape. The land uses related to the forest matrix showed a lower GP value, not compatible with a fire resistant landscape.

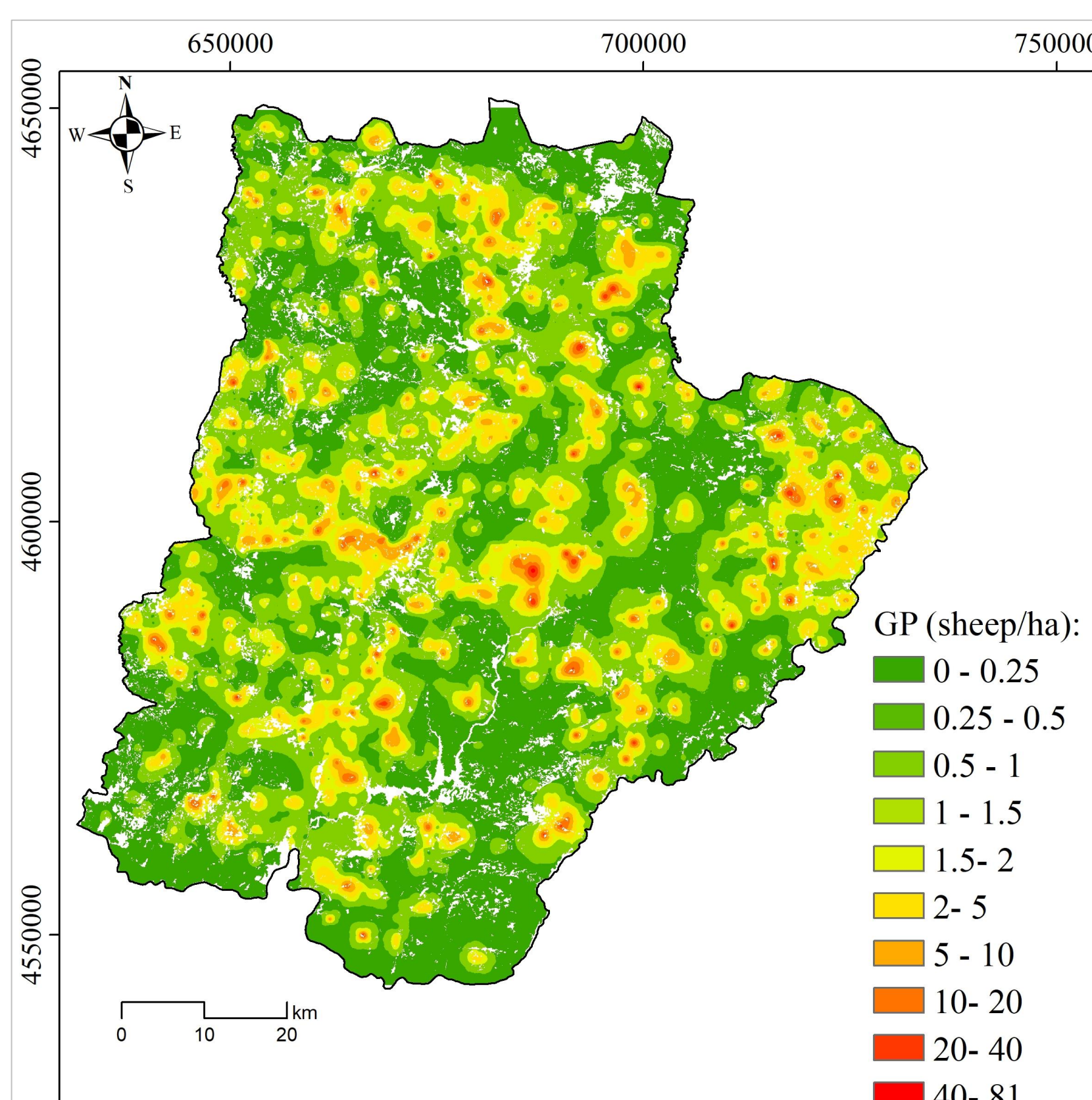


Fig 3: Grassing pressure in the Northeast of Portugal

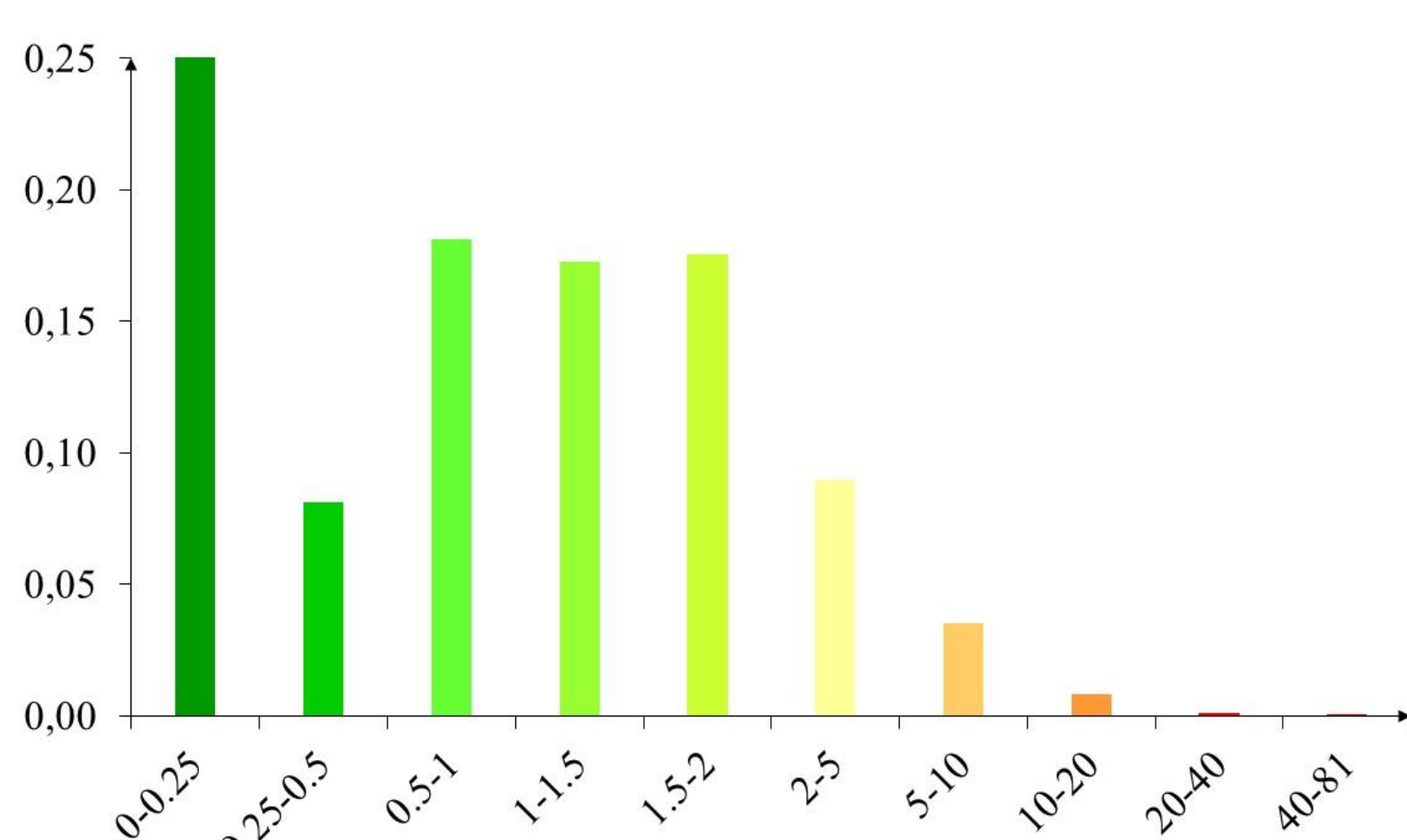


Fig 4: Relative frequencies of GP

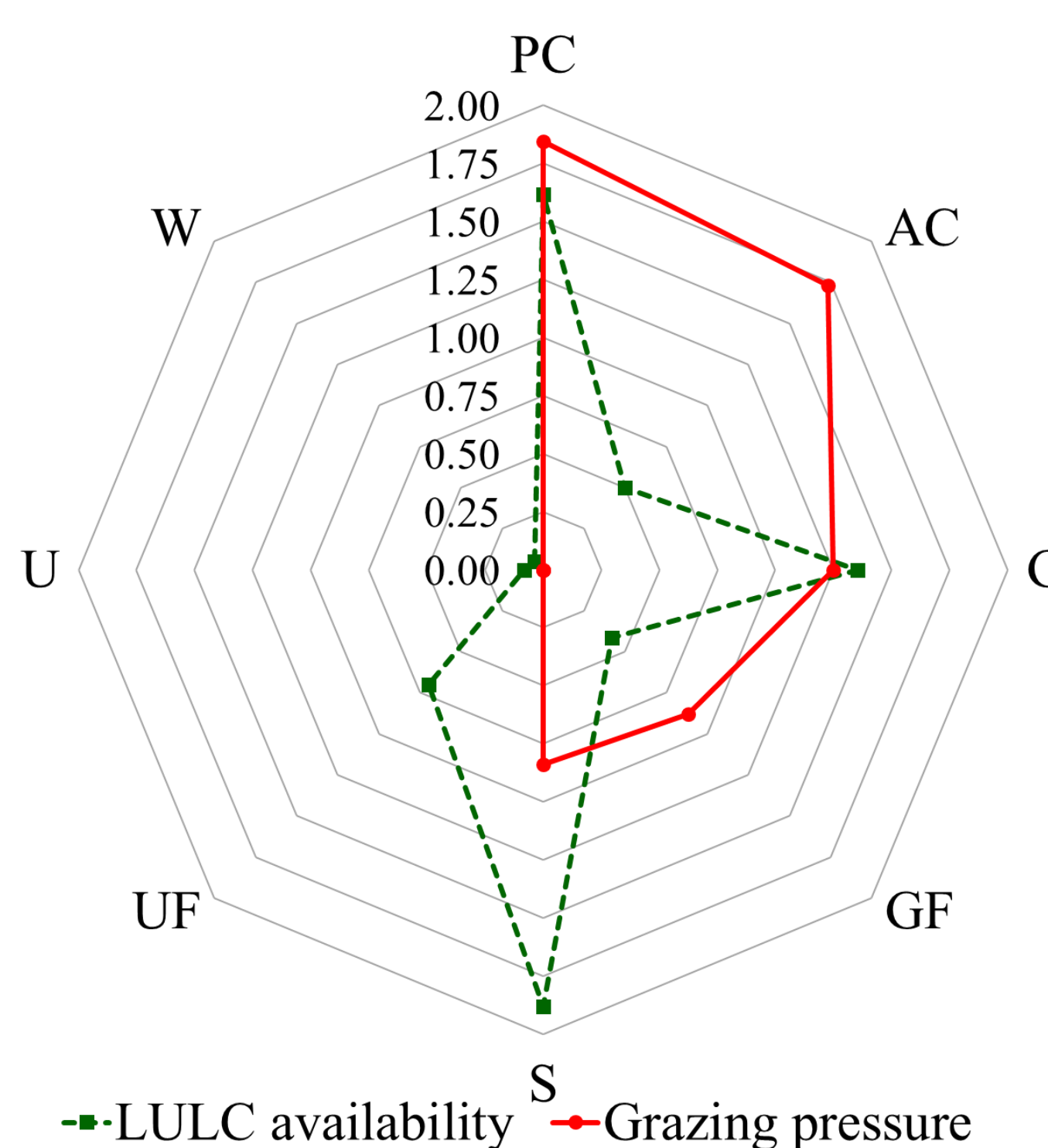


Fig 5: LULC availability (10⁵ ha) and its related GP (sheep ha⁻¹) (PC: Permanent crops, AC: Annual crops, G: Grasslands, GF: grazed forest, S: shrublands, UF: Ungrazed forest, U: Urban, W: Water).

Study area

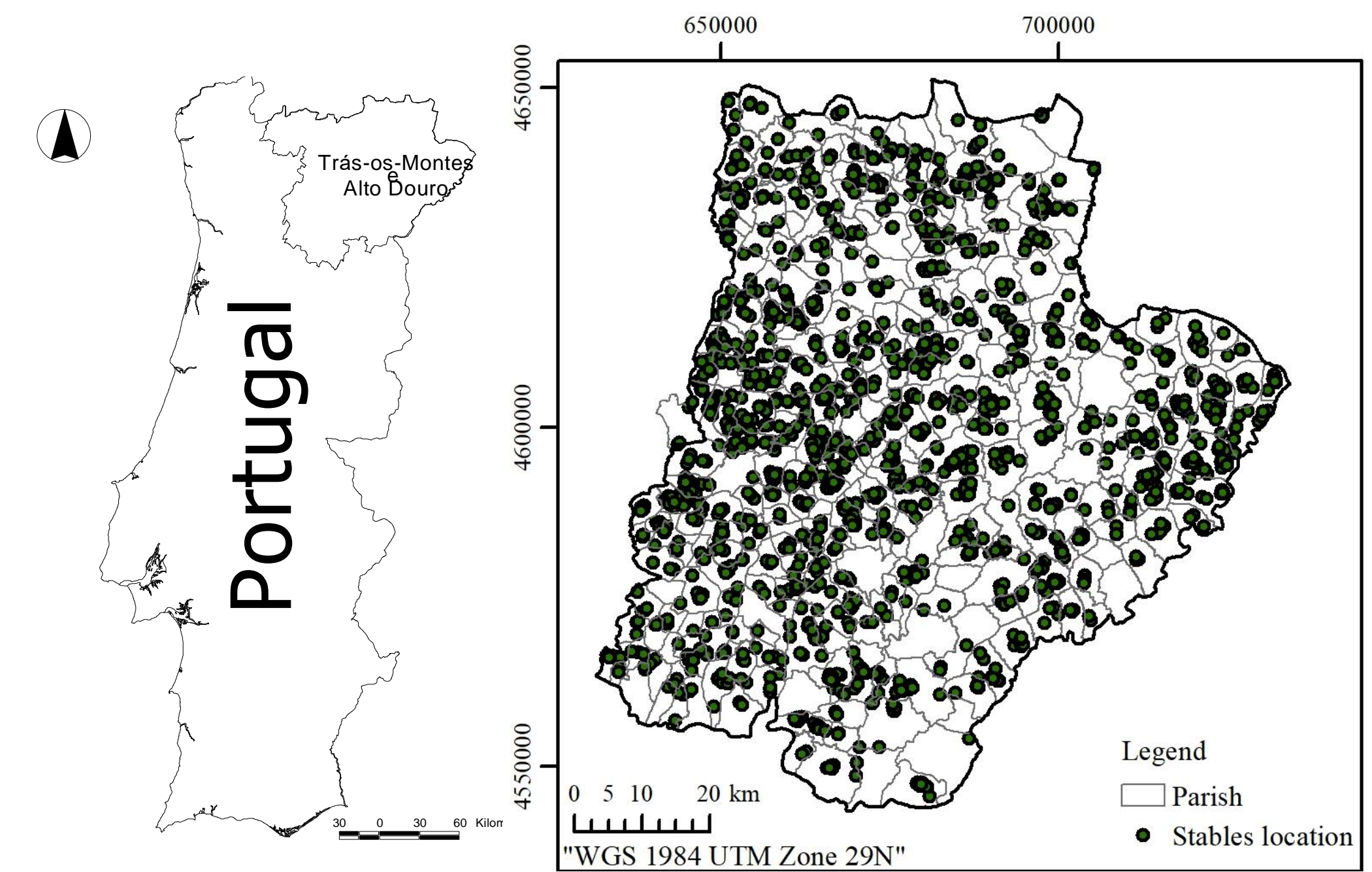


Fig 1: Study area

Methods

Geoprocessing integrates several geodatabases: a) land use; b) parishes boundaries; c) livestock stables location; and d) Sentinel-2 Multispectral Images. During the geoprocessing, the stocking density (SD) (sheep ha⁻¹) was calculated and spatially interpolated. Homogeneous LULC units (permanent crops; annual crops; forest; shrubland; grassland; water bodies) were obtained by supervised classification algorithms.

The land use geodatabase was used to establish a mask of the urban area and the ungrazed forests. Integrating LULC preferences with SD allows calculating and mapping the GP.

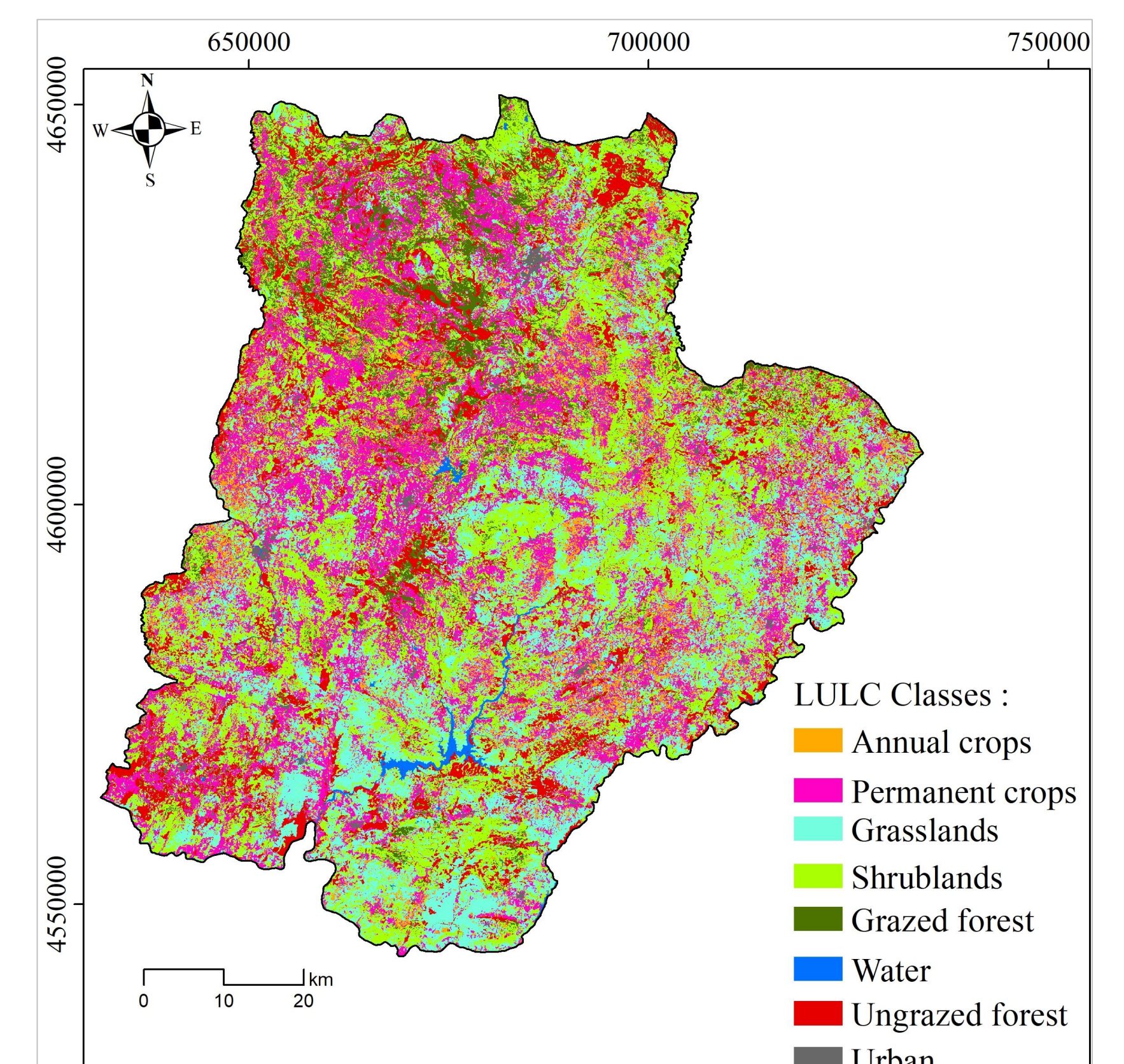


Fig 2: LULC map in 2018 for the Northeast of Portugal

Conclusions

The GP modelling and mapping could assist in the implementation of herding programs aimed at reducing fire hazard at a parish or at a regional scale. The GP found for LULC woodland matrix (forest and shrublands) is lower than all recommendations in the literature (1.65 sheep.ha⁻¹). The approach developed in this study could be helpful for future works on fuel load management strategies over the Mediterranean regions.