Investigating the effects of land use change on ecosystem services: the Basilicata region (Italy) case study

Angela Pilogallo[1], Lucia Saganeiti[1], Francesco Scorza[1] and Beniamino Murgante[1]

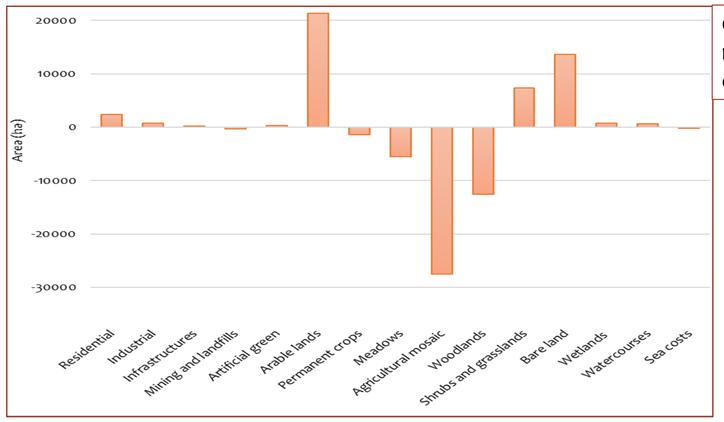
[1] University of Basilicata, Viale dell'Ateneo Lucano 10, 85100 Potenza, ITALY

Abstract By the end of this century effects of land-use change on ecosystem services (ES) are expected to be very relevant. While land-use models can help investigate the effects of a combination of drivers at different scales, ES approach can help in better understand the trade-offs between different development scenarios making explicit the relations that every variation induces within the relationship between man and territory and among different environmental components. In this work, we report changes in land use over a 28-year period considering the territory of the Basilicata region. We estimate the ES Value (ESV) change in the Basilicata region following land use/land cover (LULC) modifications occurred over the period 1990-2018 and examine the comparison between the actual ESV and gain and loss derived from LULC changes, and gross domestic product (GDP) at the municipal level.

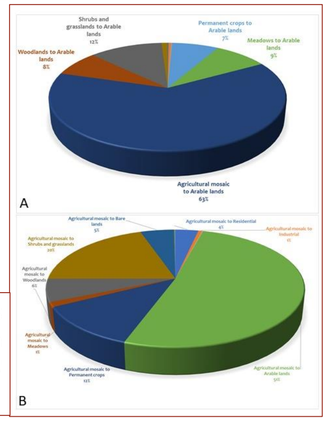
Study area and land use changes The Basilicata Region covers a total area of about 10,000 km² and is characterized by a prevalently mountainous territory. Only 8% of the total area is flat and it is mainly located along the coast.

Due to the presence of the Apennine chain that crosses it from north to south, two main sectors can be identified: a western one, characterized by higher altitudes and slopes and the eastern one where the hilly landscape prevails and slopes down to the low and sandy coasts of the Ionian Sea.

During the investigated time period, ranging from 1990 to 2018, most of the changes in land use occurred in the semi-natural classes linked to agricultural use, although the loss of woodland is also relevant.



Gain and loss for each LULC class resulting from changes occurred over the period 1990-2018



Transitions from all LU classes to "Arable lands" (A) and from "Agricultural mosaic" to all LU classes (B).

Methods The approach to assess the ESV is shifted from the work developed by Costanza et al., 2014 which quantifies the economic value of the aggregated ecosystem services through the following formula:

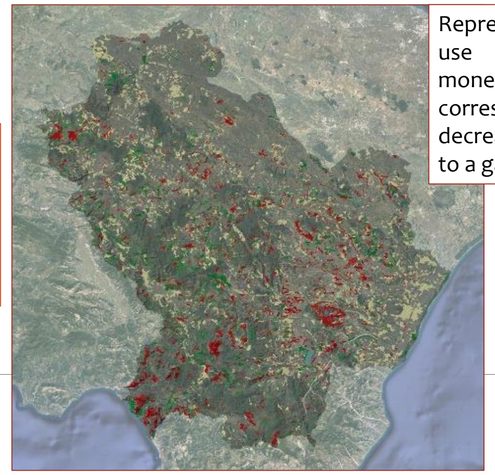
$$ESV = \sum [(VL_i \times A_i)]$$

where A_i is the area (ha) of the biome i and VL_i the annual monetary unit value, in our case expressed in €/ha/yr.

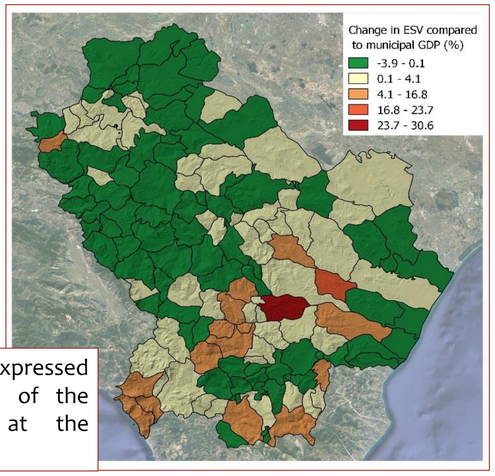
To understand the relationship between ESV and socio-economic features of all the municipalities, we considered the per capita GDP of the region referred to 2018 and equal to 22,200 € (EUROSTAT) and population data provided by the Italian National Statistical Institute (ISTAT).

LULC class	Biome	VL_i (€/ha/yr)
Residential	Urban	6954.08
Industrial	-	0.00
Infrastructures	-	0.00
Mining and Landfills	-	0.00
Artificial green	Urban	6954.08
Arable lands	Cropland	5811.95
Permanent crops	Cropland	5811.95
Meadows	Cropland	5811.95
Agricultural mosaic	Cropland	5811.95
Woodlands	Temperate forest	3275.03
Shrubs and grasslands	Grassland	4349.30
Bare land	Rock	0.00
Wetlands	Wetlands	26810.96
Watercourses	Lakes/rivers	13062.53
Sea costs	Coastal	9337.54

Results: how much do the effects of land use changes weigh on the GDP calculated on the municipal scale?

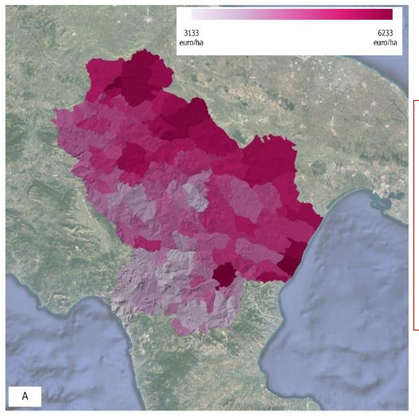


Representation of land use changes in monetary terms: red correspond to a decrease of ESV, green to a gain

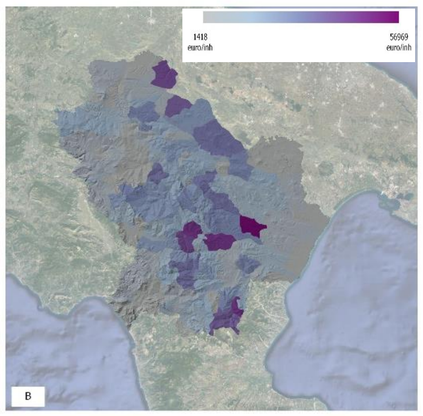


Change in ESV expressed as a percentage of the GDP assessed at the municipal level

Results: considering 2018 as the reference year, how much is the total amount of ESV standardized in relation to the territorial extent and the resident population?



2018 ESV normalized with respect to surface area (**A**) and resident population (**B**)



Conclusions

- The ES methodological framework represents a useful tool in interpreting changes in land use and in assessing the effects of territorial changes
- Although the strength of this approach lies in the possibility of expressing the values of individual territorial components at different scales, the use of significant aggregate indices of the overall capacity to provide ES is useful in identifying hotspots or, conversely, in defining regeneration priorities for particularly degraded areas
- The comparison with socio-economic parameters makes explicit the relationship of the population with ecosystems, thus allowing to assess the demand for ES and to orient regional programming more effectively
- The accuracy of the results depends on the resolution of the land use map but especially on the methodology and scale used for the estimation of VL_i

Main references

Costanza, R. et al. (1997) The value of the world's ecosystem services and natural capital. *Nature* 387, 253–260.

Costanza, R., et al. (2014) Changes in the global value of ecosystem services. Global Environmental Change 26, 152–158.