Characteristics and drivers of grassland change in Northern Croatia during post-socialism

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Introduction

Shrub encroachment and agricultural intensification have been a widespread land use and land cover change in the former communist and socialist countries of Central and Eastern Europe, especially after the collapse of socialism in the early 1990'. Such changes have strongly affected grassland areas which are seen as hotspots of biodiversity in Europe. In this study we have investigated the changes in grassland cover as well as drivers behind those changes in a selected region in Northern Croatia during the post-socialist transition. By using the mixed methods approach we combined remote sensing, statistical modelling and a household-based questionnaire (n=285) to map the changes in the grassland cover and to assess the underlying socio-economic and demographic drivers of the documented changes.

Fig. 1. "I will mow your abandoned grassland, call 0912847001"

Materials and methods

The detection of bio-physical changes in land use and land cover is based on the unsupervised classification of Landsat TM and Landsat ETM+ satellite imagery for 1991 and 2011, respectively. The analysis was conducted using ESRI Arc Map 10.0 and TNTmips software. The images were classified by way of the unsupervised fuzzy classification method, and then classified into "grasslands" and "arable land" by analysing histograms and using auxiliary information such as georeferenced ortophotos from the Croatian State Geodetic Administration database. The data on forest cover and other types of cover were incorporated from previous research and the images were subsequently filtered by using a 3x3 modal filter. An overall correctness of 81% was achieved with K > 0.7.

Subsequently links between changes in land use and cover and potential environmental and socio-economic drivers of those changes were examined by multiple regression analysis. The nature of these established links was examined through a detailed questionnaire survey conducted on a structured random sample of 285 households in four municipalities.

Results

The Fuzzy C classification of the visible and the near IF Landsat images of the County have demonstrated a 2% loss in grassland areas in the 1991-2011 period. However, in the studied period only 40% of grasslands did not undergo any transitions while the remaining 60% are linked to different types of land use and land cover transitions. The biggest loss in grassland areas was recorded due to expansion of arable land in certain areas (+96 km^2) and the biggest gain due to abandoning arable land in other areas (77 km^2). This accounted for 2/3 of all changes in grassland areas. An overall grassland cover gain has been recorded at higher altitudes (> 400 m) and on steeper slopes (>12°) while at all other altitudes and slopes an overall loss has been recorded.

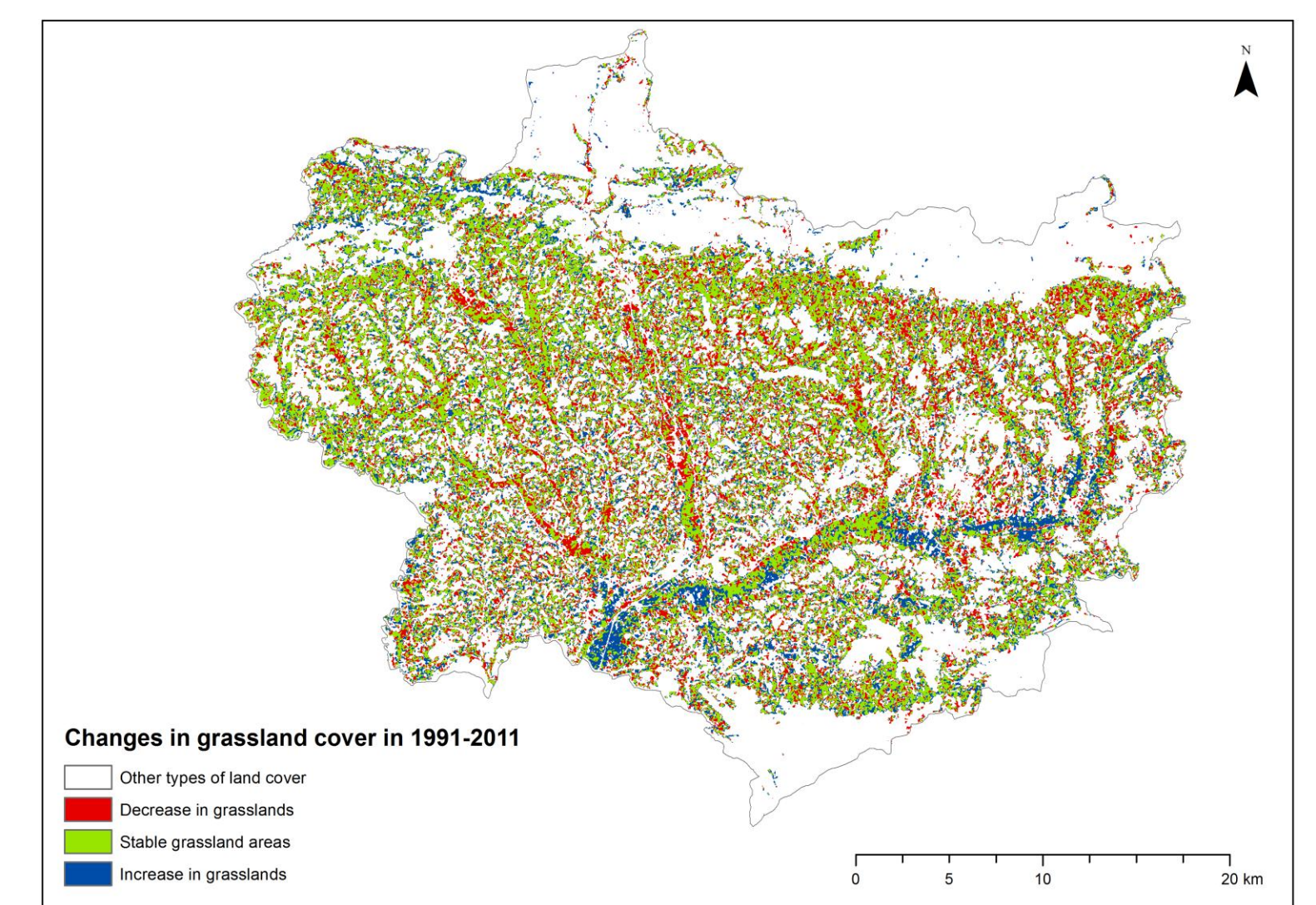Fig.2. The study area of the Krapina – Zagorje County (1244 km^2).

Fig.3. Changes in agricultural areas in Northern Croatia belong mostly to the arable land-grassland transitions.

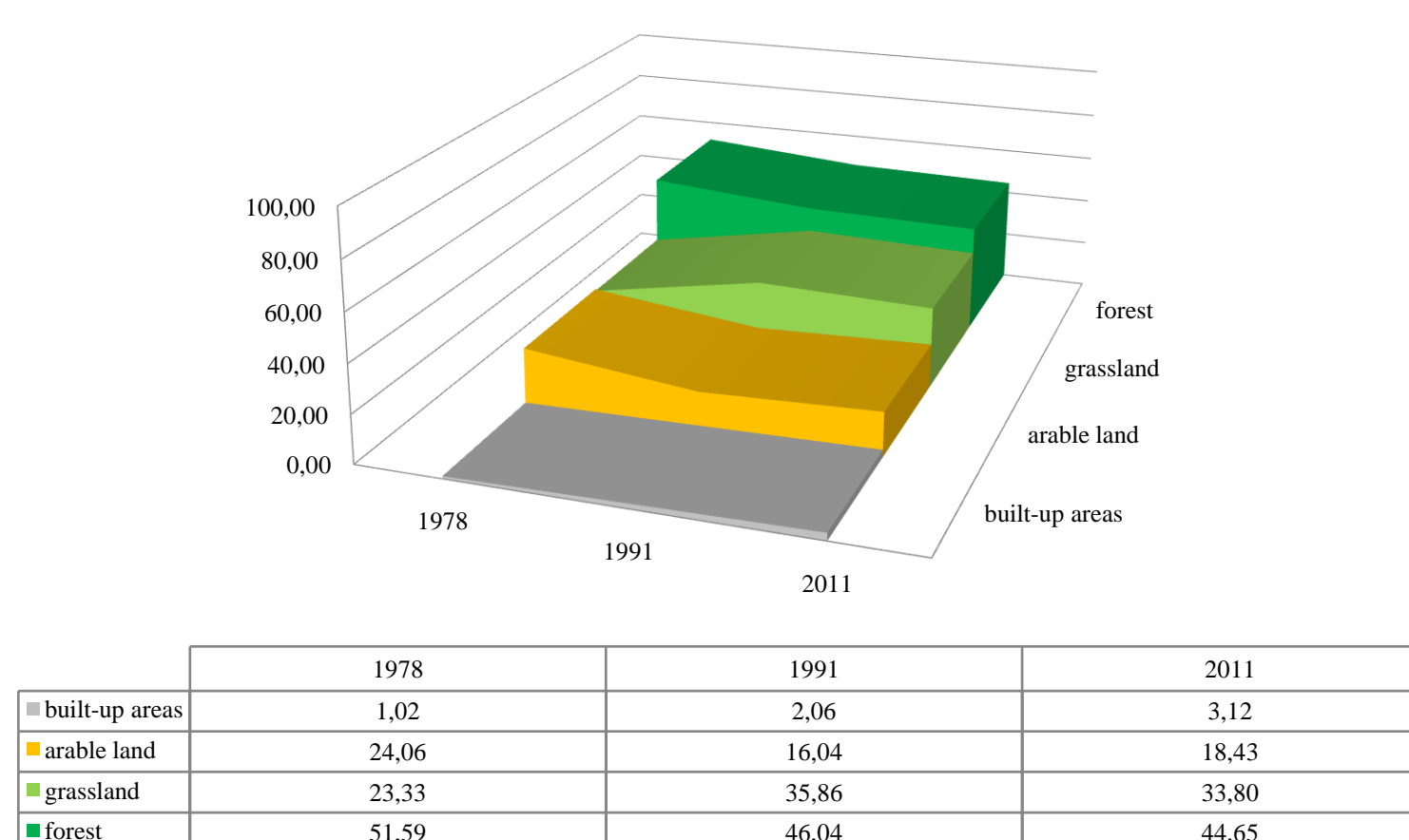|	1978	1991	2011
built-up areas	1,02	2,06	3,12
arable land	24,06	16,04	18,43
grassland	23,33	35,86	33,80
forest	51,59	46,04	44,65

Fig. 4. Changes in main categories of land use and land cover in Northern Croatia from 1978 to 2011. While the socialist period was characterized with strong rates of agricultural abandonment, in the post-socialist era a slight reversal of trends has been documented.

The multiple regression analysis has shown that areas seeing depopulation trends and population ageing, but also increases in the amount of educated people are characterized by shrub encroachment and farmland abandonment. On the other hand, flatlands and lowland areas are seeing higher rates of grassland to farmland conversion, demonstrating that both socio-economic and bio-physical variables are influencing land cover change in the region. The questionnaire survey has shown that the registered changes are in part consequences of households' adjustment to the new realities of ageing members, lower prices of agricultural produce, and increase in education levels. Such adaptations include geographic factors as well, such as distance from populated centres and accessibility of the land.

Conclusions

The traditional agricultural system based on small landholding and cattle herding, typical for rural areas throughout Yugoslavia, has survived 50 years of socialist experiments which favoured industrial development over agriculture. After the demise of socialism, changes such as the liberalization of the market and a lack of agricultural subsidies have had a major impact on traditional agricultural practices. The so-called "peasant-workers" have aged and are slowly abandoning agriculture, while new generations, brought up in different social and economic circumstances are increasingly without any agricultural experience. Traditional forms of cattle herding are suffering from greatest changes with the number of cattle per household being halved in the period of one decade. After 20 years of post-socialist management, such changes are becoming visible in the landscape, with probably the greatest impact on managed grassland areas. Grasslands are no longer needed in traditional agriculture as pasture or winter fodder for cattle (which are not being kept anymore), nor in new, modern, intensive types of agriculture based on higher yields. In order to preserve these valuable hotspots of biodiversity, it is becoming increasingly necessary to introduce a system which would find a new function for grasslands.

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