Nationwide indicators reflecting the current problems of the agricultural landscape in Slovakia: large agricultural parcels, farm size structure and share of woody vegetation

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Abstract: The main problems of the agricultural landscape in Slovakia are the largest parcels in the EU, the share of agricultural land managed by large agro-holdings, and the low proportion of woody vegetation. The authors have analysed these issues using agricultural beneficiary data and remote sensing products. The parcel size and farm sizes were analysed from agricultural beneficiaries' data, woody vegetation was analysed from the combined layer of Copernicus products and data from the Land Parcel Identification System. Regarding all three indicators, the situation is more problematic in the lowlands and partially in hilly areas. The proposed indicators could be applied to assess the impact of the new CAP (2023-2027), which supports the reduction of parcel size, improves conditions for small and medium farmers, and improves the share of green infrastructure in agricultural landscapes.

Introduction

Agricultural expansion and land abandonment are the main driving forces of landscape change in Europe (Plieninger et al. 2016). Intensive agricultural production threatens climate stability, ecosystem resilience, and ecosystem services. Environmental degradation caused by agriculture could lead to loss of biodiversity, decreased soil fertility, increased surface runoff, soil erosion, and flooding events (Vojtek and Vojteková 2019). Furthermore, the loss of semi-natural habitats negatively affects animal functional diversity and related ecosystem services, which can affect agriculture production (Martin 2019). The most valuable agricultural systems from the biodiversity and biocultural point of view are high-nature value farmlands, although they often operate in the most marginal agricultural land, under difficult social and economic conditions such as in mountainous regions (Lomba et al. 2014). Green linear elements such as tree lines, hedges, and dry stone are valued for their contribution to biodiversity and cultural value (Marshall and Moonen 2002; van der Zanden, Verburg and Mücher 2013).

The agricultural landscape in Europe consists predominantly of an intensive farming system, reinforced by subsidy policies of the European Union (Donald et al. 2002).

During the twentieth century, the agricultural landscape in most socialistic countries was shaped by the collectivisation of agriculture (Jepsen et al. 2015, Skokanová et al. 2016). Collectivisation was aimed at minimising private property and consolidating agricultural land into large-scale fields suitable for industrial agriculture. The main goal was self-sufficiency in food with less regard to natural conditions or economic efficiency. The agricultural collectivisation in Slovakia was one of the most extensive among eastern countries and resulted in the transformation of small farmlands into large block fields and intensified agriculture (Bezák and Mitchley 2014, Lieskovský et al. 2014, Skokanová and Slach 2020). These changes led to a reduction of high-diversity landscape features, an increase in parcel size, a reduction of agricultural mosaics, and biodiversity loss (Špulerová 2008). Satellite image analysis showed that today, the average parcel size in Slovakia is 12 hectares, which is the largest of all EU countries and significantly exceeds the average size in the EU (3.9 ha) (Gális 2020). Furthermore, the average parcel area in the lowlands and some hilly areas is more than 18 hectares, which is closely related to the very low share of woody vegetation in these areas and the dominant large farms. Large farms, which have an area of more than 50 ha, comprise 92-93% of the utilised agricultural area in Slovakia and Czechia, which is the highest proportion among EU Member States (Eurostat 2022). According to EUROSTAT, the average farm size in Europe in 2020 was 17.10 ha. Slovakia with an average farm size of 94.88 ha had the second largest farm after Czechia with an average farm size of 120.81 ha (Supplement 1).

The preservation of extensive agriculture has been an issue of growing importance over the last 20 years (Cullotta and Barbera 2011) since the European Union began to place greater emphasis through the Common Agricultural Policy (CAP) on greening to enhance biodiversity and mitigate biodiversity loss. The main agri-environmental goals by 2030 include expanding the land share of organic farming to 25 %; and maintaining or restoring landscape features on at least 10 % of farmland. These ambitious goals require an improvement in the environmental performance of European agriculture, with many implications for the CAP (Pe'er et al. 2022). The new post-2023 CAP instruments aim to achieve environmental and climate-related objectives and Agri-environment-climate Measures (AECM) in Pillar 2. In Slovakia, the new eco-schemes are aimed to reduce the maximum size of arable fields to 50 ha (20 ha in protected areas) and set aside non-productive areas. Additional measures such as tree line planting, wet areas grassing, setting up the agroforestry system, or afforestation will also change the shape of agricultural land.

Since the mid-1980s, indicators have been developed increasingly to evaluate the effectiveness of various political mechanisms. Most of them were introduced in response to EU regulations, and many share the common goals of reflecting agricultural extensification, farm income support, and environmental protection (Wilson and Buller 2001). In 2000, the European Union first introduced agri-environmental indicators into CAP due to the increasing awareness of the environmental problems caused by agriculture. 28 agri-environmental indicators have been set up to monitor the integration of environmental concerns into CAP. These indicators serve to provide information on the farm environment; track the impact of agriculture on the environment; assess the impact of agricultural and environmental policies on the environmental management of farms; inform agricultural and environmental policy decisions and illustrate agri-environmental relationships with the general public (EU-AI 2020). A review of agricultural sustainability indicators was provided by Latruffe et al. (2016); an overview of agri-environmental indicators in the EU was provided by Spânu et al. (2022). At a national level, the use and effectiveness of agri-environmental indicators in Slovakia were analysed by Baránková et al. (2010) and Valach (2022).

In the Slovak Republic, sets of agricultural and environmental indicators are used in agriculture and nature protection. The indicators used by the Slovak Ministry of Agriculture aim to monitor and evaluate the effectiveness of agri-environmental programmes. They include sectorial indicators such as agricultural holdings, an agricultural area, agricultural area under organic farming, irrigated land, or environmental indicators such as land cover, less favoured areas, farming intensity, or High Nature Value (HNV) farming, etc. A set of agri-environmental indicators was developed by the Slovak Environmental Agency coordinated by the Slovak Ministry of Environment (Baránková et al. 2010).

Monitoring the environmental performance of agriculture and assessing the environmental effects of policies requires information on agri-environmental interactions (OECD, 2001) that is enabled by a variety of indicators developed on the international, national, or local level. In this paper, we present a set of spatial indicators that reflect the main problems of the agricultural landscape in Slovakia. While the size of agricultural parcels has been analysed from satellite images (Gális 2020), we provide the analysis based on more detailed agricultural beneficiary data. The farm sizes reported in the EUROSTAT statistics miss the spatial representation. Here, we use agricultural beneficiary data to analyse the spatial distribution of farm size structure. Information about the distribution of woody vegetation is missing, even the woody vegetation plays a crucial role in the mitigation of climate change in agricultural landscapes. We analyse the woody vegetation from the Copernicus High-Resolution Layers and data from the agricultural beneficiaries' databases.

Methods

To analyse parcel size, we have used data from the EU Land Parcel Identification System (LPIS) designed for the implementation of area-related EU agricultural support schemes (Houšková et al. 2015). The LPIS database registers spatial, quantitative, and qualitative information on agricultural parcels and is updated every three years from detailed aerial images (Fecková 2018). Data on parcel types include the following groups of cultural crops: arable land, permanent grasslands, orchards, vineyards, permanent crops, hop plants, non-classified agricultural land, and forested agricultural land. The last three types of parcel cover are a minimal part of the agricultural area;

therefore, we grouped them for our analyses into the 'other' group. LPIS data are owned by the Ministry of Agriculture and Rural Development of the Slovak Republic and are accessible as a GIS vector layer at https://data.gov.sk.

Information on farm sizes was derived from the geospatial aid application (GSAA). This database contains information on the farms and farmers that claim EU agricultural support for agricultural parcels registered in the LPIS database. The GSAA database is owned by the Ministry of Agriculture and Rural Development of the Slovak Republic and is accessible at https://gsaa.mpsr.sk/.

For woody vegetation analyses, we combined forest data from Copernicus High-Resolution Layer Forests (HRL Forests) from 2018 and landscape characteristics data from Copernicus High-Resolution Layer Small Woody Features (SWF) from 2015 and LPIS from 2020. The Copernicus HRL Forests is derived from the multi-temporal Sentinel-2A and Sentinel-2B L2A satellite (Copernicus Land Monitoring Service, 2021) and contains information about forest type, dominant leaf type and tree cover density. The SWF layer is derived from VHR_IMAGE_2015 acquired by Pleiades 1A/B, WorldView-2, WorldView-3, GeoEye-1, Deimos-2, and Spot6/7 at resolution 5 m (Langanke 2015). The SWFs are considered linear structures such as hedgerows, scrubs, tree rows, riparian and roadside vegetation, and isolated patches of trees and scrubs of size 200 – 5000 m^2. From the LPIS database, we used the parcel map and the landscape features. Landscape features were digitised from aerial images to implement and control Good Agricultural and Environmental Conditions (GAEC) within EU agricultural support schemes (Gasiorková et al. 2010). It includes five groups of landscape features: solitaires, tree alleys, tree groups, wetlands, and hedgerows.

Following the FAO definition of forest (FAO 2020), we considered as a forest all pixels with tree cover density greater than 10 %. Therefore, we reclassified the Copernicus HRL Forest Tree Cover Density product using the Reclassify tool in ArcGIS Spatial Analyst Toolbox. Pixels with tree cover density greater than 10 % were reclassified as forest; pixels with lower density were excluded from further processing. The spatial resolution of Copernicus HRL Forests for 2018 is 10 m, but we down-scaled it to 5 m for spatial compatibility with the SWF layer. For downscaling, we used the Resample tool from the ArcGIS Data management toolbox and adopted the Nearest neighbour technique. In the next step, we merged the HRL Forests and SWF datasets using raster math algebra. Both layers showed some misclassification of grasslands, permanent crops, or other crops as forest or small woody features (Dostálová et al. 2021). Therefore, we used LPIS data to filter out Forest or SWF pixels located on agricultural parcels. We rasterised the LPIS parcel map, overlaid it with the combined Forest and SWF map, and removed all Forest or SWF pixels located on agricultural parcels. Using this filter, we also removed the green landscape features located inside the agricultural parcels. Therefore, we added the rasterised layer of landscape features from the LPIS database to the final product of the woody vegetation map.

For identifying the most problematic areas, we summarised the average values of analysed indicators to Geomorphological Units (Supplement 2) (Mazúr and Lukniš 1986) using Zonal Statistic as a Table tool. For visualisations, we averaged the values in a 2.5 km diameter circle using the Focal Statistic tool from ArcGIS Spatial Analyst Toolbox. The presented maps show the average value of the selected indicator in a 2.5 km neighbourhood and examples of areas with the highest, lowest and average values of the indicators analysed.

Results

Parcel size

The mean parcel size in Slovakia is 11.28 ha. The parcels with the largest average size are located in the Chvojnícka pahorkatina hills (124.15 ha), which is a geomorphological part of the Borská nížina lowland, and in the Podunajská pahorkatina hills (119.98 ha) and the Podunajská rovina lowland (118.40 ha), which are geomorphological parts of the Podunajská nížina lowland. The largest parcel covers 749.36 ha (Figure 1C).

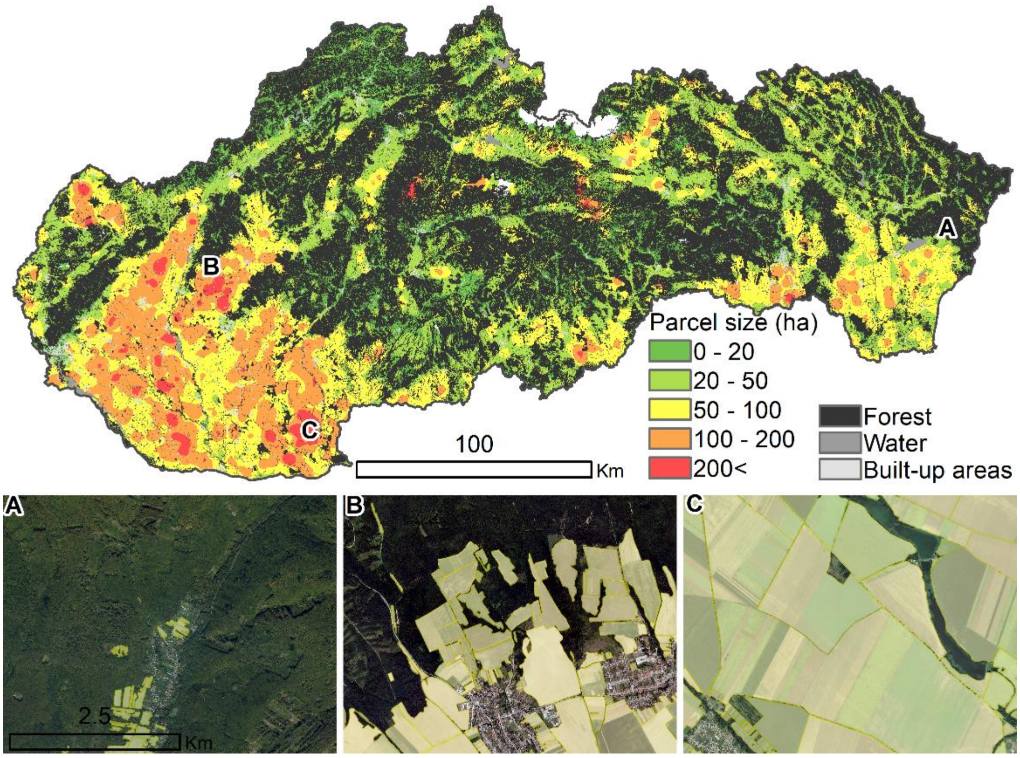

Figure 1 Average parcel size summarised in 2.5 a km neighbourhood. (A. Example of an area with the smallest parcels; B. Example of an area with middle-size parcels, C. Example of an area with large parcels. The yellow areas in the bottom figures represent agricultural parcels). Aerial images provided by GKÚ Bratislava, NLC. LPIS parcel data provided by the Ministry of Agriculture and Rural Development of the Slovak Republic.

The size of the parcel decreases with increasing altitude, complexity of the terrain, and increased forest cover. The medium-sized parcels are located in the sub-mountain areas (Figure 1B). The smallest parcels are located in mountains; however, small-scale structures are also located in sub-mountain and lowland areas. These are fragments of house gardens or traditional agricultural landscapes, such as small-scale vineyards, that have been registered to LPIS. The smallest parcel size is 0.38 ha (Figure 1A). The average size of arable land parcels is 21.00 ha, permanent crops 7.93 ha, other crops 6.68 ha, grasslands 5.41 ha, vineyards 4.62 ha and orchards 4.54 ha. Although the average parcel sizes appear to be relatively low, the large parcels cover most of the agricultural land (Figure 2).

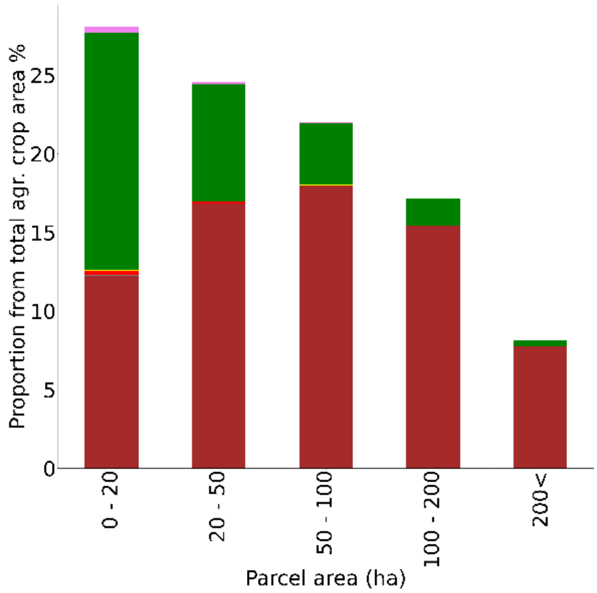

Figure 2 Distribution of agricultural parcels according to parcel size in Slovakia (violet – vineyards, green – permanent grasslands, brown – arable land, yellow – permanent crops, red – orchards, grey - others). LPIS parcel data provided by the Ministry of Agriculture and Rural Development of the Slovak Republic.

This is the most problematic for arable land because fields larger than 50 ha cover 58.57 % of arable land area and 91.72 % of fields larger than 100 ha are arable fields.

Farm size

The farms with the largest average size are located in the Borská nížina lowland (1914.04 ha), Žiar basin (1906.52 ha) and the Burda hills (1886.46 ha). The total number of registered farms is 17,176, and the average farm size is 107.12 ha. Most agricultural land (51.94 %) is farmed by large agroholdings, whose farms are larger than 1000 ha (Figure 4). As small farms are considered, farms with an area smaller than 5 ha (EC, 2017). In the case of Slovakia, there are 6,249 such farms (Figure 3A) with a total area of 16,732.06 ha. The largest farm is located in the Podunajská nížina lowland and covers 6,766.78 ha (Figure 3C).

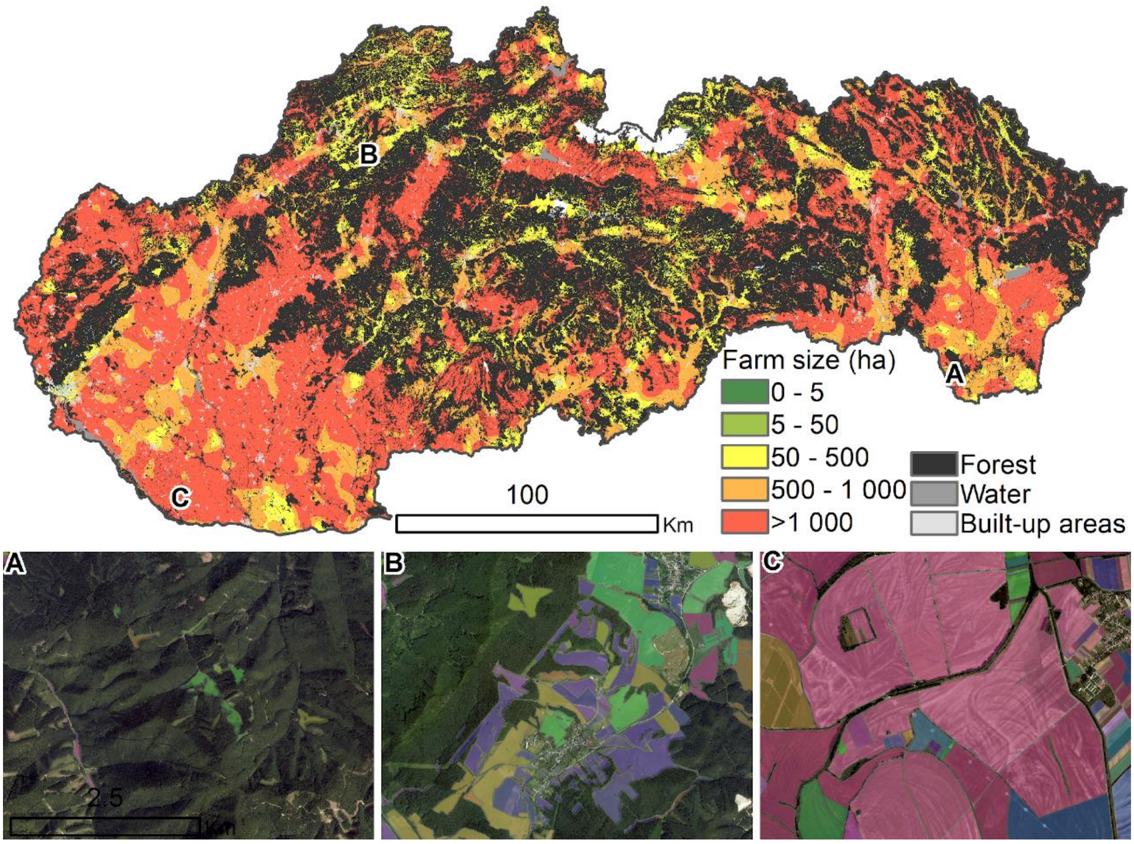

Figure 3 Average farm size summarised in a 2.5 km neighbourhood. (A. Example of an area with small farms, B. example of an area with middle-size farms, C. example of an area with the largest farms. The different colours in the bottom images represent different farms). Aerial images provided by GKÚ Bratislava, NLC. Farm data from the Geospatial Aid Application (GSAA) provided by the Ministry of Agriculture and Rural Development of the Slovak Republic.

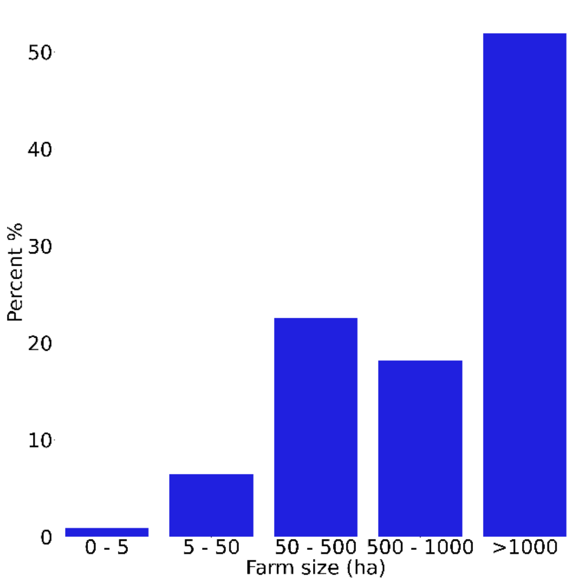

Figure 4 Distribution of agricultural farms in Slovakia according to farm size. Farm data from the Geospatial Aid Application (GSAA) provided by the Ministry of Agriculture and Rural Development of the Slovak Republic.

Proportion of woody vegetation

According to the Copernicus HRL Forests layer products, the forest area covers 2,322,007.49 ha (47.35 %) of Slovakia. The small woody features cover 150,305.63 ha (3.06 %). These two layers are partially overlapped, and in some areas biased by the misclassification of grasslands, permanent crops, or other crops to forest (Dostálová et al. 2021) or small woody features. Therefore, we used LPIS parcels to filter out such misclassifications. We filtered 56,646.99 ha (2.44 %) of forest pixels and 27,116.82 ha (18.04 %) of small woody feature pixels. In the end, we added 2,653 ha of landscape features (group of trees, wetlands, hedgerows, tree alleys) that are located on agricultural parcels and are part of the LPIS. The woody vegetation in Slovakia covers 2,302,802.52 ha (46.96 %) of Slovakia (Figure 5).

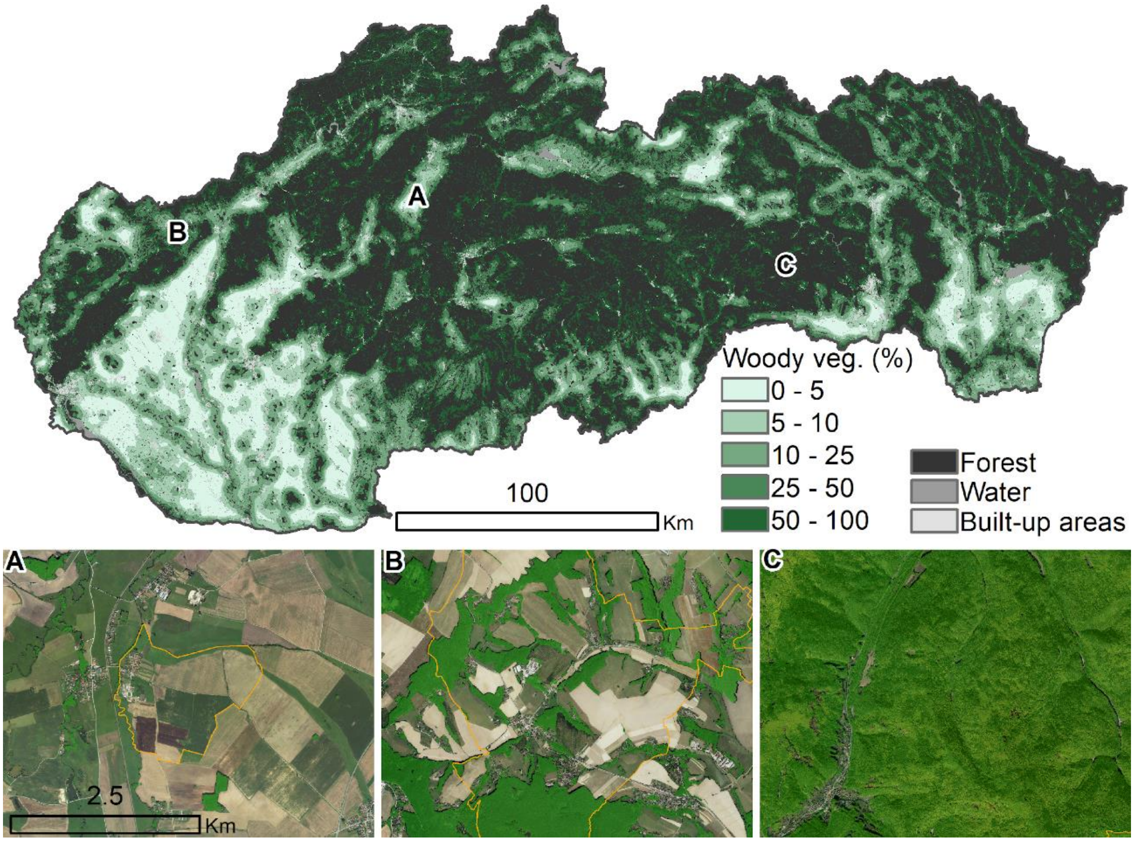

Figure 5 The proportion of woody vegetation summarised in a 2.5 km neighbourhood. (A. example of an area with a low proportion of woody vegetation, B. example of an area with a medium proportion of woody vegetation, and C. example of an area with a high proportion of woody vegetation. Green areas in the bottom images represent woody vegetation, and orange lines represent cadastral area boundaries). Aerial images provided by GKÚ Bratislava, NLC. HRL Forest and HRL Small Woody Features. Provided by the Copernicus team at EEA.

This is a relatively high coverage in comparison with most of the EU countries; however, the distribution of woody vegetation is unbalanced (Figure 6). In the lowlands and valleys, where green infrastructure is needed to minimise high temperatures and other changing climate conditions, the proportion of woody vegetation varies around

15 %. The lowest proportion of woody vegetation is in the Podunajská rovina lowland (10.69 %), Podunajská pahorkatina hills (12.60 %) and Východoslovenská rovina lowland (12.98 %).

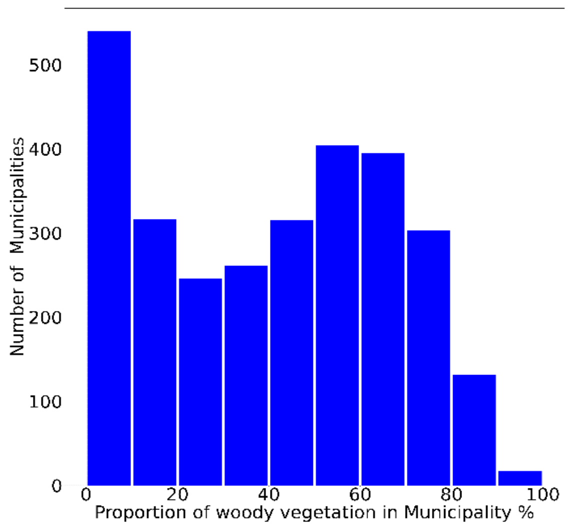

Figure 6 Proportion of woody vegetation cover in municipalities. HRL Forest and HRL Small Woody Features provided by the Copernicus team at EEA.

The lowest cover is in the Borcová village, where the woody vegetation covers only 0.12 % of the cadastre area (Figure 5A). In submountain areas, the proportion of woody vegetation is higher and covers 25-50 % of the area (Figure 5B). The highest coverage is in mountainous areas, except the alpine localities above 1450-1500 m asl. For example, the proportion of woody vegetation in Smolnícka Huta is 95.91 % (Figure 5C).

Discussion

Agricultural parcels could be delineated from satellite images (Kuemmerle et al. 2009, Graesser and Ramankutty 2017, Tetteh et al. 2020) or by using crowd-sourced data (Fritz et al. 2015). According to satellite images analysed by OneSoil company (Gális 2020), the average parcel size in Slovakia is 12 hectares, which is comparable to our average of 11.28 ha. The differences could be caused by differences in the definition of the parcel and spatial resolution. LPIS defines the parcel as an agricultural area with relatively stable natural or artificial boundaries where one type of agricultural crop (for example, arable land, grasslands, vineyard) is grown (Fecková 2018). The boundary between two or more crops (for example, wheat and maize) in one parcel is not distinguished. On the other hand, analyses based on satellite images consider boundaries between the different crops as parcel boundaries. The boundary could also be delineated by farming subjects working on one parcel or by owners of the parcels. The spatial resolution of aerial or satellite images plays a crucial role in the ability to distinguish parcels and their boundaries. Landsat ETM+ images with a spatial resolution of 15 and 30 m were used for parcel delineation in the border triangle of Poland, Slovakia and Ukraine (Kuemmerle et al. 2009) or in South America (Graesser and Ramankutty 2017). Sentinel 2 data with resolutions of 10 and 20 m have been tested for parcel delineation in Germany (Tetteh et al., 2020) and are used for the global parcel map product (Gális 2020). The last version of the Slovak LPIS data is manually vectorised from aerial images with a resolution of 0.25 m. LPIS is the most detailed and actualised agricultural parcel dataset; however, very small parcels less than 100 square metres are not recorded. According to Teetteh et al. (2020), the drawbacks of the LPIS parcels are insufficiently recorded grassland parcels used for purposes like nature conservation or horse farming, restricted access to LPIS in many countries, time lag, and different implementation methods in EU countries. In Slovakia, grasslands are recorded in protected areas and even in high mountains, and the database is fully accessible. LPIS is actualised every three years, so for timely information, the remote sensing approach is more appropriate. Different implementations of the LPIS methodology could be a problem in cross-border studies.

The size of agricultural holdings is one of the farm structure indicators provided by EUROSTAT. The average farm size in 2020 was 94.88 ha, our analyses show 107.12 ha. While EUROSTAT reports 1 862 650 ha of utilised agricultural area and 19,630 farms, our dataset reports 1 838 636 ha and 17,176 farms. A detailed comparison of the EUROSTAT data and our analyse is provided in Supplement 3. The differences are caused by different definition of agricultural area. EUROSTAT reports Utilised agricultural area (UAA) that is defined as the total area taken up by arable land, permanent grassland, permanent crops and kitchen gardens used by the holding, regardless of the type of tenure or of whether it is used as a part of common land. The Geospatial Aid Application database, used in this study, contains spatially detailed data on farms applying for agricultural subsidies. Small family farms that are not in the agricultural support system were not included in our analyses.

The average parcel size and the average farm size summarised in the 2.5 km neighbourhood helped us identify the most intensively managed agricultural land. In general, larger parcels and farms are in lowland and hilly areas with lower altitudes and relatively flat slopes. The transformation of small-scale traditional fields occurred during the second half of the 20th century (Izakovičová et al. 2022). Most of the agricultural fields that were suitable for mechanized agriculture were merged into large parcel blocks. Small fields were more likely to be preserved on steep slopes, less fertile soils and close to settlements (Lieskovský et al. 2014). Slope steepness and soil fertility were also significant variables in preserving the hedgerow network in arable fields (Sklenicka 2009). Following the transition to an open market economy in 1989, the overall decline in agriculture resulted in agricultural abandonment (Munteanu et al. 2017). Similar factors that have caused the preservation of small fields play an important role in their abandonment. Traditional agricultural fields located on steep slopes, and less fertile soils on less accessible areas were more likely to be abandoned

(Lieskovský 2015). Accession to the EU in 2004 and the adoption of CAP subsidies triggered agriculture recultivation (Griffiths et al. 2013, Pazúr and Bolliger 2017). However, CAP's direct payments effectively supported large farmers related to the size of the cultivated area, resulting in a general reduction in green landscape elements and an increase in the size of the parcels (Bezáková and Bezák 2022).

The socioeconomic variables influencing spatial variability of farm size were analysed by Janovska et al. (2017). At the European scale, wheat production was the only determinant significantly related to farm size. At the Czech national scale were significant land consolidation, unemployment rate, and soil fertility. Biophysical variables like slope steepness or altitude have not been analysed. The highest average size and the largest parcels were reported for arable land in Podunajská nížina lowland which is characterised by the lowest degree of ecological stability and low level of biodiversity (Miklós et al. 2019), but also by lower visual landscape quality (Lieskovský et al. 2017, Diviaková et al. 2022, Janeckova Molnarova et al. 2023). The homogenisation of the landscape can not only hinder satisfaction from the perception of the landscape but also have a negative impact on psychological well-being (de la Fuente de Val, Atauri and de Lucio 2006).

For the assessment of woody vegetation distribution, we combined the forest data from Copernicus HRL Forests, and landscape features data from Copernicus HRL SWF and LPIS, including solitaires, tree alleys, tree groups, wetlands, and hedgerows. We adjusted these data for our needs because there were overlaps due to different methodological approaches used in the classification of forest and small woody features. The cover of woody vegetation is quite high, 46.96 % of an area of the Slovak Republic, but its distribution is unbalanced and lacking, especially in lowland areas with the highest parcel sizes. The specific tool for implementing the concept of green Infrastructure is the document of the Territorial Network of Ecological Stability, which is defined as "an interconnected network of natural as well as modified semi-natural ecosystems keeping the natural balance" (Izakovičová and Swiader 2017, Skokanová and Slach 2020). Agriculture may also be a supplier of ecosystem services through landscape microforms like tree belts, and it is important to study the provision of ecosystem services by them during the design process of tree belts (Nowak et al. 2020).

The changes in land ownership after 1989 induced many local changes (mainly through land restitution) and resulted in a slow process of land subdivision and the emergence of smaller farms. On the contrary, Sklenicka et al. (2014) demonstrate a phenomenon called the Farmland Rental Paradox, where very small parcels tend to create large production blocks by being rented to larger farmers, which leads to significant homogenisation of the land-use pattern. Small and medium farms could provide more than food, as well as environmental and health benefits. A comprehensive study carried out on 169 farms in 10 European countries showed that semi-natural habitats, including fallows, occupied 23 % of the land but hosted 49 % of vascular plants, earthworms, spiders, and wild bee species. A 10 % decrease in these habitats if reclaimed for food production would cause exponential decreases in biodiversity, but only moderate linear increases in production (Jeanneret et al. 2021). The new Slovak CAP improves conditions for the development of small and medium-sized farms on the land market, through the Supplementary redistribution payment to support sustainability by capping the basic support on the first 150 ha of each farm and reducing the payment for additional acreage.

Substantial changes in the Slovak agricultural landscape are expected with the application of the new CAP (2023-2027). Adaptation of Eco-schemes should reduce the size of arable land to a max of 50 ha outside the Natura 2000 areas and 20 ha inside the Natura 2000 areas. Large arable fields should be split by the grass strips with a minimum width of 12 meters. In addition, at least 4% of arable land should be left as non-productive land. Agri-environmental and climate measures, such as planting tree lines, setting the agroforestry system, or afforestation of unfertile arable land, should increase the proportion of green infrastructure in the agricultural landscape. Direct support for farmers will be higher for farms up to 150 ha outside the less favourable area and 450 ha inside the less favourable areas. Such changes in agricultural landscape would affect soil erosion reduction (Cebecauer and Hofierka 2008, Zachar 1982), climate change adaptation (Bindi and Olesen, 2011, Kertész and Madarász 2014), carbon sequestration (Dinesh et al. 2022, Golicz et al. 2021), biodiversity (Kühne et al. 2022, Li et al. 2020, Tschumi et al. 2020), ecosystem services (Duru et al. 2015, Power 2010) and others.

Conclusion

Using agricultural beneficiary data, we analysed the spatial distribution of parcel size and farm size. Our analyses of detailed LPIS data confirmed the presence of large parcels in Slovakia, as previously reported by remote sensing analyses. We also verified statistical data on farm size and performed a spatial analysis of these data. Furthermore, by combining the Copernicus HRL and LPIS data, we created a novel map of woody vegetation and examined the distribution of woody vegetation in Slovakia.

Our indicators pointed to the main problems of the agricultural landscape in Slovakia, so it is a challenge to deal with them. Several strategic documents at the EU level draw attention to these issues and set a target to improve environmental conditions and greening farmland. The ambitious agricultural targets of the European Green Deal, in line with the EU Farm to Fork and Biodiversity Strategies, stipulate that at least 10 % of the EU's agricultural area is under high-diversity landscape characteristics. The expectation of greener CAP supported by eco-schemes has the potential to reward those farmers who start to manage land in a nature- and climate-friendly way and to incentivise the adoption of specific farming practices with higher environmental and animal welfare benefits.

The new CAP (2023–2027) introduced Ecoschemes that are targeted to reducing the size of arable land to 50 ha outside protected areas and 20 ha inside protected areas.

Such a change will be reflected in the parcel size indicator. Support for small and medium farms is secured through subsidy capping. The farm size indicator will reflect the effect of this support on the farm size distribution. The effect of the agri-environmental measures, aimed at introducing green infrastructure to the agricultural landscape, will be reflected in the increased proportion of woody vegetation.

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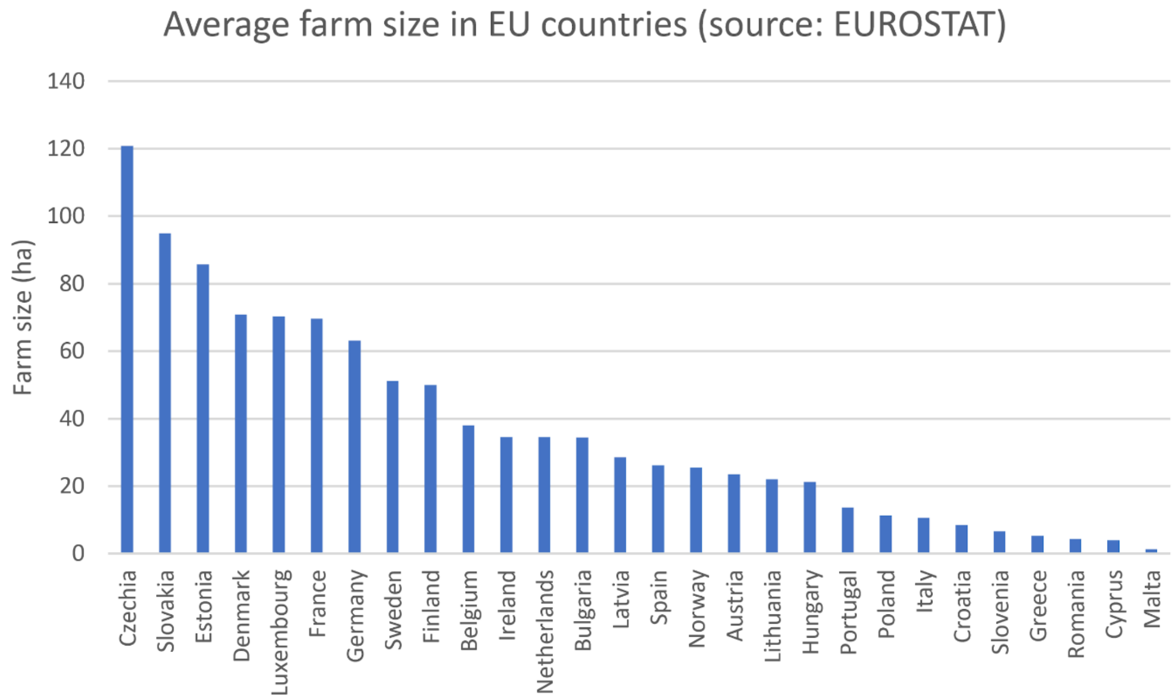
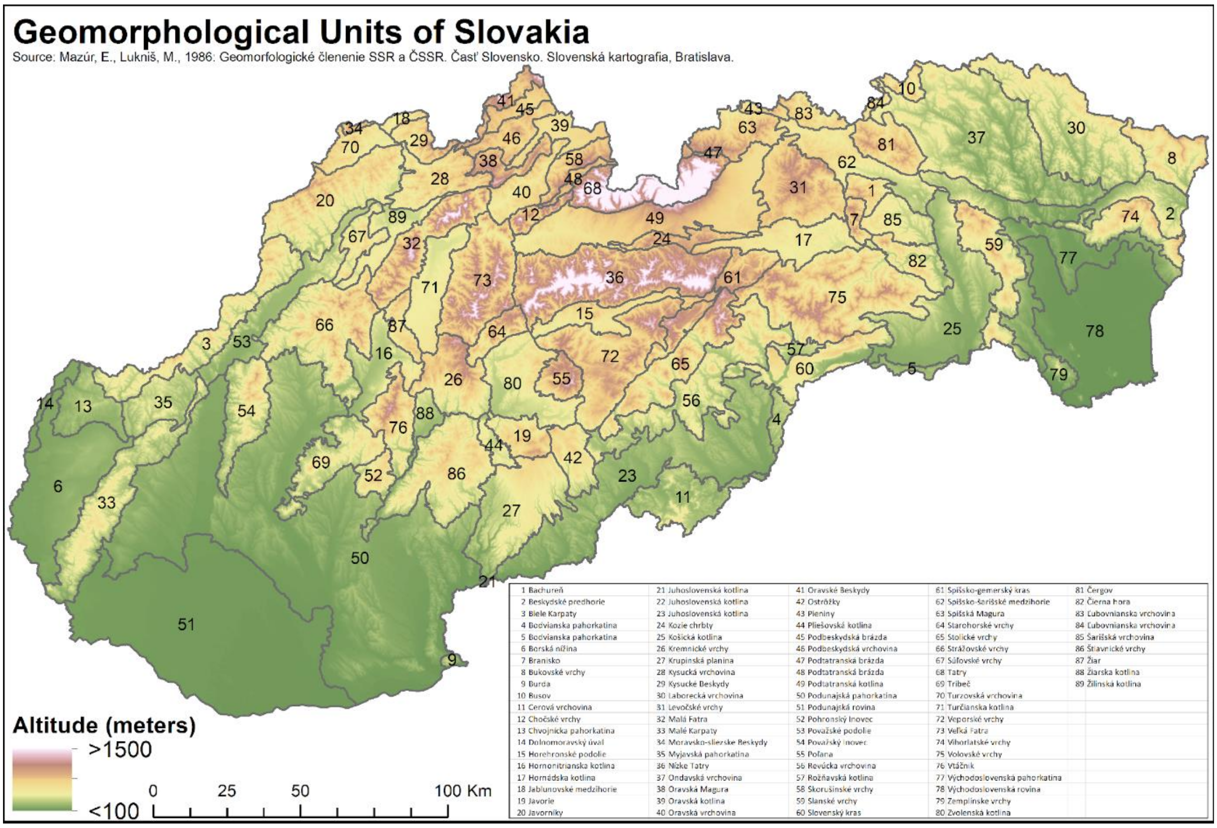
Supplement 1 Average farm size in EU countries (source: EUROSTAT)



Supplement 2 Geomorphological Units of Slovakia (source: Mazúr, E., Lukniš, M. 1986: Geomorfologické členenie SSR a ČSSR. Časť Slovensko. Slovenská kartografia, Bratislava)



Supplement 3 Farm structure in EU and Slovakia according to EUROSTAT and data from Geospatial Aid Application

Farm size (ha)	Farm size in EU source: EUROSTAT		Farm size in Slovakia source: EUROSTAT		Farm size in Slovakia source: Geospatial Aid Application	
	ha	perc.	ha	perc.	ha	perc.
0–2	2 999 490	1.91	1 620	0.09	3 131	0.17
2–4.9	6 099 940	3.88	11 520	0.62	13 600	0.74
5–9.9	7 892 900	5.01	25 900	1.39	16 732	0.91
10–19.9	11 090 770	7.05	34 570	1.86	39 386	2.14
20–29.9	8 353 790	5.31	27 100	1.45	72 082	3.92
30–49.9	13 695 610	8.70	40 350	2.17	97 787	5.31
50–99.9	24 642 590	15.65	71 700	3.85	135 394	7.36
100 <	82 639 080	52.50	1 649 900	88.58	1 635 072	88.87