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COMPATIBILITY OF ABANDONED LAND IDENTIFICATION WITH OTHER SPATIAL DATASETS

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Abstract
The article analyses the identification of abandoned land on the example of the municipality of Jonava district of the Republic of Lithuania. Spatial analysis methods were used for the study. It was found that according to the spatial dataset of abandoned land (AŽ_DR10LT), the area of abandoned land in the municipality of Jonava district is 531.8 ha, which is 0.56 % of the total area of the district (including inland waters). The consistency of the identification of abandoned land in the study area with other spatial databases showed that identical areas in terms of land use are represented differently in different databases. The most frequent discrepancies were observed when assessing the relationship between abandoned land and land use identification in the spatial dataset of control land plots (KŽS_DR5LT). Both in absolute terms and as a percentage of the area covered, abandoned land was concentrated in blocks not formally associated with cultivated land, i.e. urban, forest and mixed blocks identified as plots. The compatibility of AŽ_DR10LT with the Spatial Data Set of (Geo) Reference Base Cadastre (GRPK) is much higher. It can be seen that the identification of abandoned land has been consistent with the GRPK and that some errors are topological in nature and occur during the spatial analysis process (e.g. inclusion of very small areas of abandoned land in buffers around linear features). However, areas of abandoned land are not included at all in the areas defined in the Forest State Cadastre. This is to be expected, as the identification of abandoned land is harmonised with the information contained in the Forest State Cadastre. The presence of abandoned land in neighbourhoods whose type is difficult to link to eradication processes can be explained by the detailed compilation of the different databases or by a lack of coordination in the compilation of the databases.
Key word: abandoned land, dataset, spatial data compatibility.

Introduction

As of 1 December 2023, there are 33954.4 ha of abandoned agricultural land in Lithuania. This is about 1% of the total agricultural land area of the country. Abandoned land includes the areas of agricultural land covered with woody plants (except plantations) on a plot of land or a part thereof, determined by remote sensing methods in accordance with the procedure established by the Government of the Republic of Lithuania or a body authorised by the Government of the Republic of Lithuania (Land tax law..., 2011). Since 2013, the State Enterprise "State Land Fund" has been systematically accounting, managing and actualising abandoned land throughout the territory of Lithuania. The accounting of abandoned agricultural land is carried out using remote mapping methods and in response to notifications of individuals and legal entities about inaccuracies in AŽ_DR10LT, in which they report the regularisation of areas of abandoned agricultural land or request to correct the areas of abandoned agricultural land due to changes of agricultural land on land plots based on the results of cadastral survey (Description of the procedure..., 2013). Note that for persons whose land plots have been identified as abandoned agricultural land, district and city municipal administrations apply an increased land tax for the current year, which can be up to 4 % of the value of the land plot.

Although the amount of abandoned land in Lithuania is decreasing year by year, the rational possible use of this abandoned agricultural land, assessed at national level, is a pressing issue today. The system of abandoned land monitoring is based on the realities of geographical information collection in Lithuania in the recent past. However, in recent years the geographical information infrastructure in Lithuania has developed significantly, the volume of collected data has increased and new data collection technologies have emerged. On the other hand, accurate and timely information on abandoned land is in demand for other tasks related to sustainable land management, such as managing greenhouse gas emissions and absorption, increasing the country's forest cover, etc. The development of an action plan for the sustainable use of abandoned land is envisaged in the Programme of the Government of the Republic of Lithuania (2021) for the implementation of Green

Deal measures, and is also relevant for climate change policy in terms of reducing greenhouse gas emissions, which contributes to the implementation of climate-neutral policy objectives of the European Union (Communication European Green...., 2019; EU Adaptation..., 2021; National Climate..., 2021). It is therefore important to assess the potential of the current methods of collecting and using information on abandoned land in general and how they can be improved to meet today's needs and opportunities. Therefore, in this paper we present the compatibility of the identification of abandoned land with other spatial datasets.

Methodology of research and materials

Improvement of the system of abandoned land identification and monitoring of its development is considered in more detail on the example of the study area – the territory of Jonava district of the Republic of Lithuania (Figure 1). It has extensive digital geographical data and favourable conditions for field verification data collection. Various methods of spatial analysis to analyse data reflecting the situation in 2021 were used in the study. That is, versions of datasets that were created with minimal differences in the date of creation or update compared to 2021 were used.

Fig. 1. Geographical position of Jonava district municipality in the Republic of Lithuania

The following datasets were used for the study:

- Spatial dataset AŽ_DR10LT of abandoned lands in the territory of the Republic of Lithuania;
- Spatial dataset KŽS_DR5LT of control land plots of the Republic of Lithuania;
- ORT10LT digital raster map of the territory of the Republic of Lithuania, scale 1:10 000;
- Spatial dataset of (Geo) reference base cadastre GRPK;
- The Forest State Cadastre of the Republic of Lithuania.

Discussions and results

According to the spatial dataset AŽ_DR10LT, the area of abandoned land in Jonava district municipality was 531.8 ha, which is 0.56% of the total area of the district (including inland waters). Visually, the concentration of abandoned land is higher in the southern part of the district than in the northern one (Figure 2).

Fig. 2. Abandoned land in Jonava district municipality according to AŽ_DR10LT

For the consistency of the identification of abandoned land, we assessed the relationship between abandoned land and the identification of land in the spatial dataset of control land plots (KŽS_DR5LT) (Table 2). We observed that, both in absolute terms and as a percentage of occupied area, abandoned land was concentrated in blocks not formally associated with cultivated land, i.e. urban, forest land, and in plots identified as mixed blocks.

Table 2

Distribution of abandoned land by block type in the dataset KŽS_DR5LT

Code	Discription	Area, m^2	Percentage	Location coefficient*
bl1	Cultivated land control plot – an area of land that is predominantly cultivated (arable land, meadows, orchards and berry fields)	48365	0.909	0.022
bl1b	Cultivated land control plot means an area of land predominantly under cropland (arable land, meadows, orchards and berry orchards) for which no aid was requested in the previous year	38284	0.719	0.605
bl2	Urban built-up area control plot	161949	3.043	2.559
bl3	Control forest land plot – a plot of land that is predominantly forest land (forests, groups of trees, scrubland)	5011650	94.156	2.064
bl6	Built-up area control land plot outside the city	23292	0.438	0.144
bl9	Control mixed land plot – a plot of land that is largely unused for agriculture (wetlands, quarries, temporarily waterlogged areas, etc.).	29789	0.560	0.499
gc14p	Paved road without a hard surface	1634	0.031	0.053
gc16p	Dirt and forest road	3243	0.061	0.087
hc31p	1-3 m wide stream, ditch, canal	137	0.003	0.015

Code	Discription	Area, m^2	Percentage	Location coefficient*
hc32p	3-6 m wide stream, ditch, canal	589	0.011	0.019
hc33p	6-12 m wide stream, ditch, canal	215	0.004	0.004
hd1	River	1915	0.036	0.028
hd4	Other surface water body (pool, peat)	1670	0.031	0.070

* Note: If the location coefficient is greater than one, this type of case is disproportionately high; if the location coefficient is less than one, this type of case is disproportionately low

Often, the presence of abandoned land in blocks whose type is difficult to relate to abandonment processes can be explained by the granularity of the compilation of the different databases, or by a lack of coordination during the compilation of the databases (Figure 3). For example, abandoned land is identified in water bodies, but this is explained by the fact that the identical contours of KŽS_DR5LT and AŽ_DR10LT are probably not sufficiently co-ordinated. In the urban blocks, the abandoned land identified is concentrated in the suburbs of Jonava. Blocks formed around linear objects (roads, ditches) often cross abandoned land polygons.

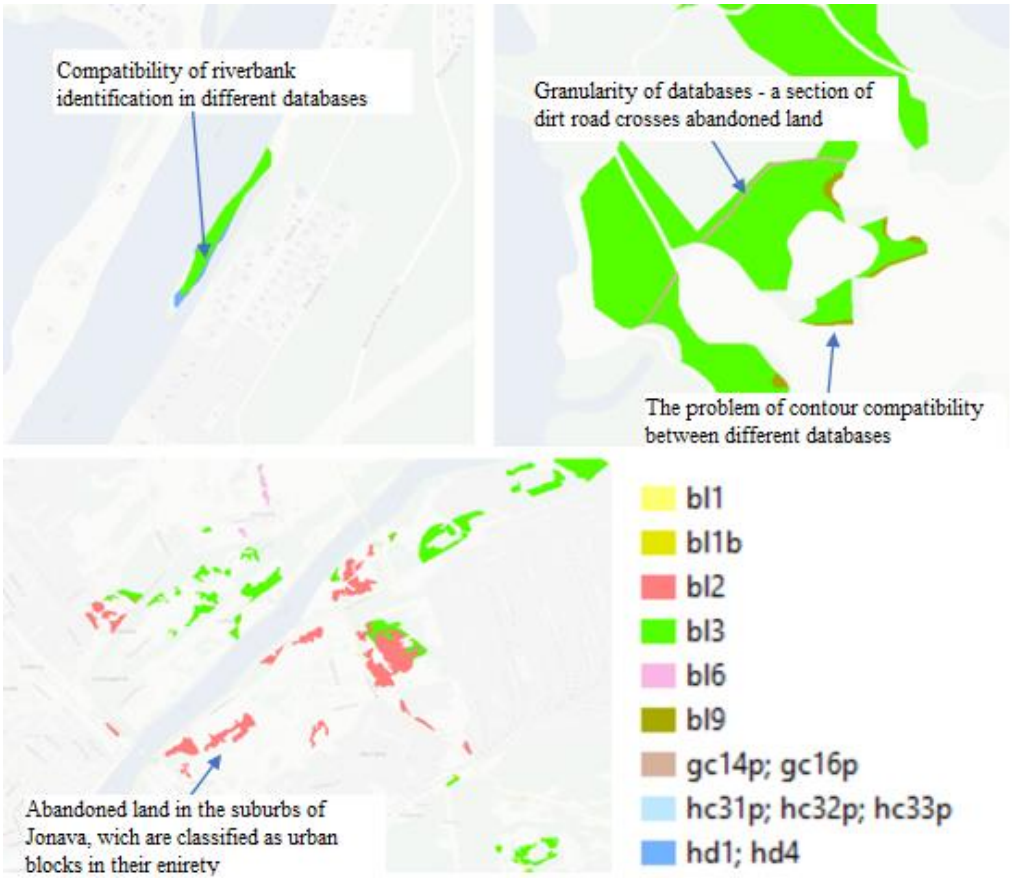

Fig. 3. Examples of compatibility problems between KŽS_DR5LT and AŽ_DR10LT

It should also be noted that the likelihood of abandoned land being present on farmland where no support has been claimed is significantly higher than on farmland where support has been claimed (locality coefficients of 0.605 vs. 0.022). Only about 1% of the abandoned land is classified as agricultural land (kept in the ŽŪN layer), mostly permanent grasslands (89.9%) and less often arable land (8.7%). Of the 6,817.8 ha of land mapped in the KŽS_DR5LT layer DG (permanent grassland), 15.7 ha (0.2%) are abandoned. Of the 3,869 ha mapped in the KŽS_DR5LT layer DE (soil erosion), 42.4 ha (1.1%) are abandoned. However, of the 1,421.5 ha mapped in the KŽS_DR5LT layer EASV

(ecologically important areas), there are practically no abandoned areas. However, the areas of abandoned land are completely outside the areas identified in the Forest State Cadastre. This is to be expected, as the identification of abandoned land is combined with information from the Forest State Cadastre. I.e. the information from the Forest State Cadastre serves as limiting information for the compilation of the AŽ_DR10LT, i.e. areas falling under the Forest State Cadastre may not be considered. In contrast, the set of KŽS_DR5LT can be seen as an additional source of information that can be used for the detection, characterisation and (especially) modelling of abandoned land. At the same time, we would like to draw attention to the lack of responsible use of specific terms in the compilation of databases controlled by various agencies. For example, in the KŽS_DR5LT, forest land is defined as forests, groups of trees and shrubberies, whereas in the Forest State Cadastre, forest land is defined as 'forested land – stands of trees, also non-forested land – logging sites, dead stands, forest clearings, forest squares, small forest swamps, forest nurseries, forest tree seed plantations and clonal collections, and land intended for afforestation. Forest land includes forest roads, quarters, technological clearings and lines, firebreaks, areas occupied by timber stores and other forest-related facilities (ditches, culverts, bridges, fire towers, etc.), recreation areas, animal feeding grounds, and other facilities located in the same areas". For example, according to the KŽS_DR5LT, the area of forest land in Jonava district is 44,463.4 ha, whereas according to the Forest State Cadastre it is only 39,151.7 ha. "The area of 'forest land' in both databases is the same only for 38,346.4 ha, i.e. as much as 13.8% of the area marked as 'forest land' in KŽS_DR5LT is not included in the forest land records of the Forest State Cadastre. The areas in the Forest State Cadastre are forest land. About 1.7% of the areas (688.9 ha) marked in the Forest State Cadastre are officially non-forest land. 429.7 ha are classified as non-forest land covered with tree seedlings, i.e. according to the legislation in force in Lithuania they are closer to abandoned land than to forest land. This means that they will only be treated as forest land when the average age of the trees reaches 20 years – until then, landowners have the right to cut down such trees.

The compatibility of AŽ_DR10LT with the Spatial Data Set of (Geo) Reference Base Cadastre (GRPK) is significantly higher (Table 3). It can be seen that the identification of abandoned land is aligned with the GRPK and that some of the errors are of a topological nature, occurring during the spatial analysis (e.g. the inclusion of very small areas of abandoned land in the buffers of linear objects). However, it should be noted that, again, incompatibilities between other databases are observed. For example, one third of the abandoned land in Jonava district is covered by forest according to the GRPK. By the way, forest is defined in the GRPK specification as "land plots with an area of at least 0.1 ha, covered with trees at least 20 years old, other forest vegetation, thinned areas or areas of former forest temporarily deprived of vegetation as a result of human activity and natural factors (cuttings, burned areas, dead plantations, areas)". Forests also include lands occupied by firebreaks, nurseries, forest seed plantations, animal feedlots. This description is in line with the concept of forest land used in the Forest State Cadastre. However, we can see that, despite the same definition, the elements collected in the databases may not be identical. It should be noted that the concentration of abandoned land is highest in the areas identified in the GRPK as tree and shrub plantations and grassland, followed by quarries and pastures or meadows. Abandoned land is not recorded in areas that are not intrinsically linked to land abandonment processes but have significant amounts of woody vegetation – gardens, built-up areas, industrial sites, etc.

Table 3

Distribution of abandoned land by spatial feature types in the GRPK layer PLOTAI

Code	Discription	Area, m^2	Percentage	Location coefficient*
ek0	Quarries	34999.309	0.65812529*	2.928
gt14	Buffers created from unpaved roads without solid base centrelines	0.001	0.00000002	0.000
gt16	Buffers created from the centrelines of dirt and forest roads	0.128	0.00000240	0.000

Code	Discription	Area, m^2	Percentage	Location coefficient*
hd21	Buffers created from the centrelines of streams, canals, drainage ditches narrower than 2 m wide	0.037	0.00000070	0.000
hd22	Buffers created from the centreline of streams, canals, drainage ditches with a width of 3-5 m	0.012	0.00000022	0.000
mj0	Tree belt	286.037	0.00537862	0.063
ms0	Forest	1790309.961	33.66490022	0.808
sd11	Cultivated land	13946.245	0.26224451	0.006
sd15	Trees, shrubs, plantations and shrubberies	3065152.629	57.63697890	24.087
sd2	Pastures and meadows	413105.887	7.76802272	2.047
sd4	Land not in use	231.144	0.00434641	0.002

* Note: The use of a large number of decimal places is intentional.

The problem of compatibility of the spatial datasets produced in Lithuania is illustrated in Figure 4.

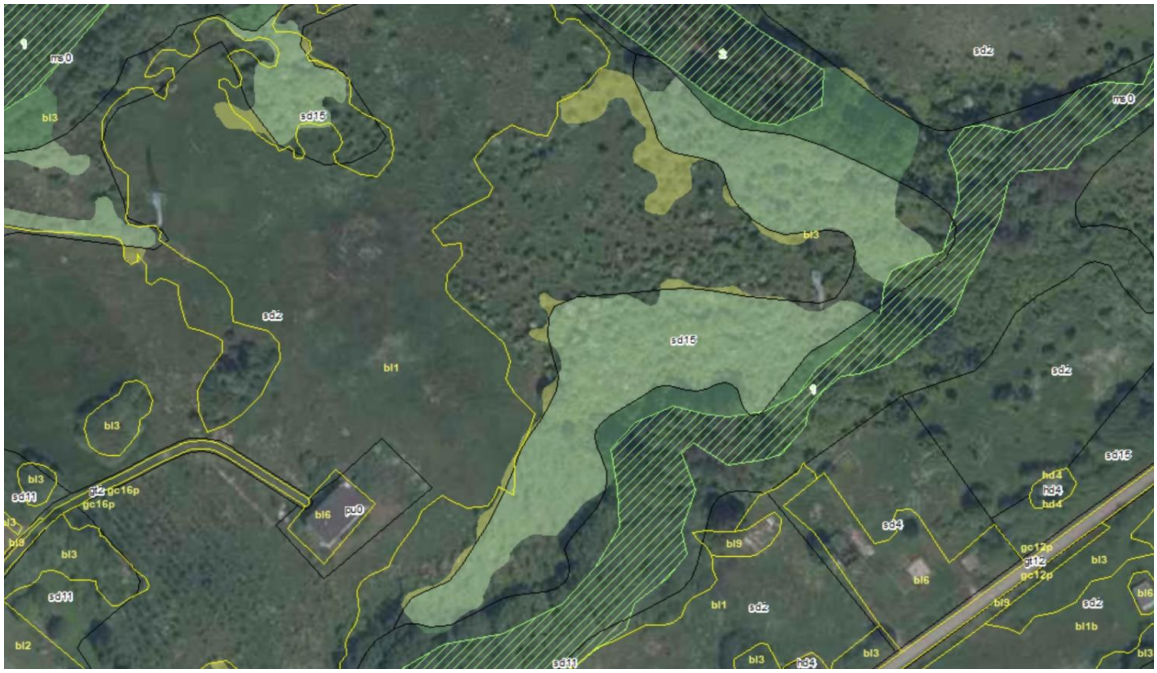

Fig. 4. Differences in land cover/land use identification (example) in different spatial databases created in Lithuania. The outline and type (attribute GKODAS) of elements from the GRPK layer PLOTAI are marked in black. Green colour indicates plots from the Forest State Cadastre and their land use category (1 – spontaneous stand, 2 – plantation). Land plots from the KŽS_DR5LT database are shown in yellow colour. Areas of abandoned land are shown in colour according to the type of land cover of the GRPK

The figure above shows that identical areas in terms of land use are represented differently in the different datasets. This is natural when different datasets are compiled by different authorised bodies. It should also be noted that, under different interpretations, the contours of the areas around the linear elements identified in the GRPK (roads, hydrographic features) are reasonably consistent, but problems arise in the rendering of the contours of the areal features of the area. The importance of

georeferencing is emphasised in most spatial datasets in Lithuania. In general terms, georeferenced data is general-purpose geodata about key topographic, engineering and geodetic features. The georeferenced data set for a defined territory, compiled according to the principles of geoinformation systems, is the georeferenced data set that is linked to the GRPK in a given case. The georeferenced data are compiled and updated by the public authorities in accordance with the standardised content and format of the databases, and are used as a basis for the production of thematic, i.e. applied, GIS (Geographical Information Systems) datasets. In our case, this also includes the identification of abandoned land.

Conclusions

When checking the consistency of the identification of abandoned land in the study area with information from other spatial datasets, we found that identical areas in terms of land use were represented differently in different datasets. Both in absolute terms and as a percentage of the occupied area, abandoned land was concentrated in blocks formally unrelated to cultivated land, i.e. urban land, forest land and areas identified in a mixed block. Often the presence of abandoned land in blocks whose type is difficult to link to abandonment processes can be explained by the detailed compilation of the different databases or by a lack of coordination in the compilation of the databases. It should also be emphasised that the information from the Forest State Cadastre serves as limiting information for the compilation of AŽ_DR10LT, i.e. the areas covered by the Forest State Cadastre cannot be analysed. On the contrary, the KŽS_DR5LT set can be considered as an additional source of information that can be used for identification and characterisation of abandoned lands and (in particular) for modelling the evolution of such lands.

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