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PROBLEMS OF CADASTRAL DATA DETERMINATION FOR FOREST LAND PLOTS IN LITHUANIA

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Abstract
Assessing the importance of cadastral measurements, to achieve work efficiency, it is important to identify the factors that affect the efficiency of measurement works, to provide measures that can help solve the problems that still exist in this area of activity. This topic is very relevant, because the analysis of specific examples can reveal sensitive problems of cadastral measurements and preparation of documents.
The aim of the research: to analyze the problems arising during the cadastral measurements of land plots.
The objectives of the research: to discuss legal acts and scientific literature regulating cadastral measurements of land plots; to identify the problems of establishing land plot cadastral data on selected land plots.
The research analyses 37 cadastral measurements of plots. The research looks at a few examples and discusses solutions - the most common problem is poorly defined boundaries and areas. Poorly prepared land reform land-use planning projects, the "accuracy" of preliminary measurements makes cadastral surveys difficult.
Key words: Land plot, forest, cadastral measurement

Introduction

Cadastral surveys are a guarantee of people's ownership and justice for the future. Due to the rush for land reform and the lack of qualified staff, preliminary surveys today pose a number of problems in terms of boundaries and the accuracy of the area of the land plot. Land reform has involved land restitution, land plot formation and on-site marking. Geodetic instruments were not used for cadastral surveys. Nowadays, land surveyors carry out cadastral surveys with very small errors, use electronic measuring instruments and carry out all measurements in the national coordinate system. It is quite common to encounter inaccurate primary data (Femenia-Ribera, 2022) using old cadastral maps. There are also problems with inaccurate and illegible drafts, inaccurately drawn up land reform projects, and boundary markers not being found in the area. Inconsistencies in the boundaries and areas of land plots are encountered when cadastral surveys are carried out in the national coordinate system.
Subject of the study: Cadastral survey files for 37 plots of land in forests.
The aim of the research is to analyse the problems encountered during cadastral surveys of land plots in forests.
Tasks: To discuss the legislation and scientific literature on cadastral surveys of land plots. To identify the problems of cadastral data establishment on selected plots of land.
At the beginning of the land reform, land plots were surveyed by means of preliminary surveys, which allowed for a faster identification of real estate objects and their boundaries. However, this haste led to inaccurate and poor quality land reform land-use plans and land plot surveys. Preliminary surveys were carried out by inadequately qualified specialists, using two-metre tape measures and tape measures, and only since 2008 have cadastral surveys become compulsory for the creation of new land plots. These shortcomings are becoming more apparent when cadastral data are revised and cadastral measurements are carried out with more accurate tools (Balevičius et al., 2015, Bikuvienė et al., 2017, Ponamariovienė et al., 2016; Živatkauskas, 2018).
Baranauskaitė and Živatkauskas A. (2017) analysing the cadastral measurements of forest plots, found that during the land reform, a fundamental error was made, land plots were formed on the basis of inaccurate preliminary measurements. As a result, cadastral surveys of land plots often result in a situation where the area of the land plot or the length of the boundary lines or even the location of the land plot does not correspond to the land reform project. Balčiūnas A. (2019) examines the compliance of land plot boundaries with the approved land reform project in Ignalina district. Cadastral measurements of 17 land plots in 5 (29.4%) of the land plots revealed non-compliance with the project. Discrepancies between the forest areas in the locations and cadastral maps are also

analysed by researchers from other countries (Park et al., 2022; Jeon et al., 2015, Forejt et al., 2020), and it is a topic of full relevance

Methodology of research and materials

Analysis of literature sources (legislation of the Republic of Lithuania, scientific articles), analysis of problematic situations of cadastral surveys of land plots. The research was carried out using data from cadastral measurements of 37 forest land plots. During the land reform, the land plots were measured with preliminary measurements. At the beginning of this reform, there was no strong legal framework to regulate the preparation of land reform land-use projects. Land reform projects were drafted in a hasty manner, without control or expertise. The method of preliminary surveys allowed for the rapid identification of immovable properties, their formation and delimitation. However, these days, cadastral surveys are problematic because they often involve overlapping plots, a mismatch between the actual boundaries and the cadastral data, and a lack of surface area. The study analysed different cadastral documents for 37 plots in forests.

Discussions and results

The most important laws regulating cadastral surveys in Lithuania are the Law on Land of the Republic of Lithuania, the Law on Cadastre of Real Estate of the Republic of Lithuania, the Law on Real Estate Register of the Republic of Lithuania, the Law on Spatial Planning of the Republic of Lithuania, the Law on Geodesy and Cartography of the Republic of Lithuania, the Law on Land Reform of the Republic of Lithuania, and the Regulations of Cadastre of the Republic of Lithuania. The procedure for cadastral measurements of land plots, determining the coordinates of the turning points and boundary markers of the boundaries of the land plots in the state coordinate system, shall be regulated by the Regulations of the Cadastre of Real Estate of the Republic of Lithuania and by the Rules on Cadastral Measurements of Real Estate Objects and on the Compilation and Adjustment of Cadastre Data.

When carrying out measurements using more accurate means than the previous measurements, the calculated area may differ from the area of the land plot registered in the Real Estate Register or the area designed in the spatial planning document or in the project of the land holding, but not registered in the Real Estate Register, by no more than the maximum permissible (marginal) area error (Table 1).

Table 1.

Table of maximum permissible (marginal) errors for the area of a plot of land (Lietuvos..., 2002)

Cartographic material used	Plot area, hectares	Scale of the plan				
		1:10000	1:5000	1:2000	1:1000	1:500
Orthophotographic maps	Up to 1	0,05√P	0,03√P	0,02√P	-	-
	1.0001-2.0000	0,06√P	0,04√P	0,03√P	-	-
	2.0001-4.0000	0,07√P	0,05√P	0,04√P	-	-
	4.0001 and more	0,08√P	0,06√P	0,05√P	-	-
Other cartographic material	Up to 1	0,07√P	0,05√P	0,04√P	0,03√P	0,02√P
	1.0001-2.0000	0,08√P	0,06√P	0,05√P	0,04√P	0,03√P
	2.0001-4.0000	0,09√P	0,07√P	0,06√P	0,05√P	0,04√P
	4.0001-10.0000	0,10√P	0,08√P	0,07√P	0,06√P	0,05√P
	10.0001 and more	0,12√P	0,10√P	0,08√P	0,07√P	0,06√P

Remark. P-land area (ha)

If the area of the land plot determined by the measurements exceeds the permissible tolerance, or if the boundaries (configuration) of the land plot do not correspond to the boundaries designed in the territorial planning document or land holding project, the land surveyor shall inform the client and the territorial department of the National Land Service under the Ministry of the Environment in writing about it. The territorial department, after examining the situation on the ground, shall determine the reasons for the difference and draw up a conclusion on the necessity of adjusting the boundaries of

the land plot in the locality or the necessity of adjusting the boundaries or the area of the land plot in the spatial planning document or in the project of the land holding. The cadastral surveys shall continue in accordance with the conclusions of the territorial division.
During the study 37 cadastral survey files were analysed. The analysis showed that the areas of 3 plots exceeded the permissible area tolerances (Table 2). The neighbouring plots of 3 of the measured plots were measured incorrectly (e.g. plot boundaries did not border the middle of the ditch, plot boundary in the middle of the road). The marking of 10 plots showed a boundary discrepancy, 5 plots have actual boundaries different from the plan boundaries and 1 plot does not correspond to the area recorded in the cadastral data file.

Table 2.

Comparison of areas

Cadastral measurements	Preliminary measurements	Difference	Permissibility	Cadastral measurements	Preliminary measurements	Difference	Permissibility
2.6523	2.6600	-0.0077	± 0.1468	12.0926	12.0100	+0.0826	± 0.4159
2.832	3.3300	**-0.4980**	**± 0.1642**	12.5438	12.6900	-0.1462	± 0.4275
3.0254	3.1000	-0.0746	± 0.1585	15.0771	15.0200	+0.0571	± 0.4651
3.8439	4.2500	**-0.4061**	**± 0.2062**	16.235	16.3600	-0.1250	± 0.4854
3.9874	3.9500	+0.0374	± 0.1789	19.6394	19.8400	-0.2006	± 0.5345
4.0132	4.0800	-0.0668	± 0.2020	20.368	19.8600	+0.5080	± 0.5348
4.5656	4.8500	**-0.2844**	**± 0.2202**	20.4831	20.9100	-0.4269	± 0.5487
5.2356	5.1300	+0.1056	± 0.2265	21.412	21.1700	+0.2420	± 0.5521
5.5464	5.4600	+0.0864	± 0.2337	21.555	21.5800	-0.0250	± 0.5575
5.7333	5.8900	-0.1567	± 0.2427	24.0918	24.5600	-0.4682	± 0.5947
6.4965	6.4700	+0.0265	± 0.2544	26.7531	26.9100	-0.1569	± 0.6225
6.6141	6.7500	-0.1359	± 0.2598	28.2819	28.5400	-0.2581	± 0.6411
7.816	7.5800	+0.2360	± 0.2753	28.3814	28.0200	+0.3614	± 0.6352
8.0275	8.1400	-0.1125	± 0.2853	30.0267	29.5500	+0.4767	± 0.6523
9.5452	9.8100	-0.2648	± 0.3132	30.0036	30.2600	-0.2564	± 0.6601
10.2487	10.2300	+0.0187	± 0.3838	34.7542	35.1200	-0.3658	± 0.7111
11.4436	11.6300	-0.1864	± 0.4092	35.9285	35.6300	+0.2985	± 0.7163
11.6335	11.8400	-0.2065	± 0.4129	37.4796	37.8400	-0.3604	± 0.7382

Examples are given for each situation.
The first example is in Panevėžys District Municipality. The land plot is formed and registered in the State Enterprise Centre of Registers through preliminary measurements. According to the Real Estate Register, the area of the plot is 3.3300 ha. The land plot was formed by the land reform land-use planning project in 2000 (Figure 1).

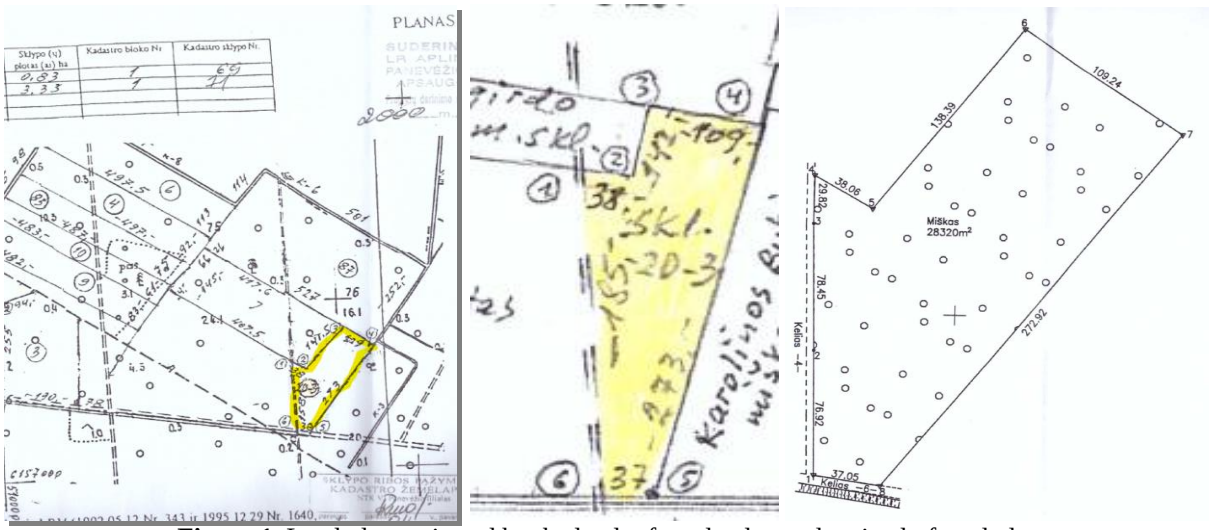

Figure 1. Land plot projected by the land reform land-use plan, its draft and plan

The site was cadastral surveyed in 2023. The plot has an area of 2.8320 ha. In accordance with point 21 of the Provisions of the Cadastre of Immovable Property of the Republic of Lithuania, the description of the procedure for compensating the difference in the area of private land and forest land, in the light of the situational drawing, and after examination of the original plan and the draft, it is noted that the land plot is marked in accordance with the lengths of the lines shown in the 2000 demarcation draft and the plan of the land plot. Table 3 compares the line lengths between the 2000 draft and the 2023 plot plan.
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Table 3.

Comparison of boundary lengths

Line	***Data for 2023***	***Data for 2000***	***Line***	***Data for 2023***	***Data for 2000***
1-2; 2-3; 3-4	76.92; 78.45; 28.82 (total 184.19)	185	6-7	109	109.24
4-5	38.06	38	7-8	272.92	273
5-6	138.39	142	8-1	37.05	37

The data analysis shows a maximum mismatch of 5-6 lines of 3.61 m. The other line lengths are reasonably accurate. In this case, there may be a measurement error as the distance is long enough at almost 140 metres. This is because all 6 remaining old boundary markers were found during the marking.
The area resulting from the marking is 2.8320 ha. It is lower than the one registered in the Real Estate Register and exceeds the permissible margin of error. The permissible area error of $0.09\sqrt{3.33}$ would be 0.1642 ha. Unfortunately, this has resulted in a plot almost 50 ares (0.4980 ha) smaller than the plot of land of the owner at the time of the restitution of the property rights (restoration in kind). This may have been due to the more complex configuration of the plot and the surveyor's inaccurate calculation of the area.
The landowners will not be compensated for the difference in the area of the land found, as the land was acquired in a sale and purchase transaction. The owners are only requesting a change to the cadastral data established for the land plot.
The second example is in Šakiai district municipality (Figure 2).

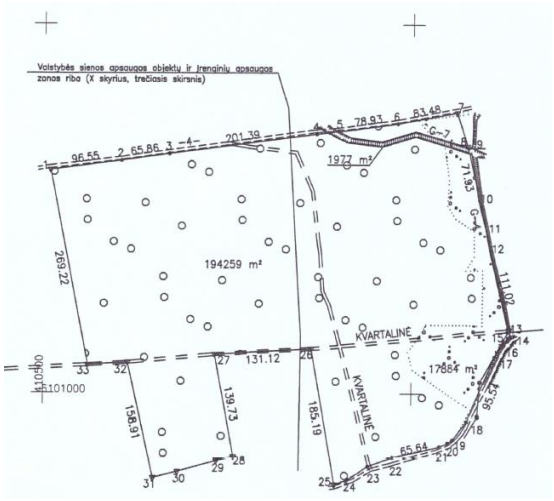

Figure 2. Forest plot

All points were measured by GPS and the coordinate corrections were obtained by connecting to the LitPos base station of the network of permanently operating GPS stations. The registered area of the plot is 21.17 ha, after the updated measurements it is 21.4120. The permissible area error of $0.12\sqrt{21.17}$ would be 0.5521 ha, the current area error of 21,4120-21,17 would be 0,242 ha. The area of the plot determined by the cadastral survey is within the tolerance of the error.

The survey of the plot found old boundary markers 25, 26 and 27, but the neighbouring plots were measured incorrectly, the boundaries of two of the plots were not in the middle of the ditch, and the boundary of another plot was in the middle of the road. For these reasons, a re-measurement is being carried out following the decision of the Šakiai Division of the National Land Service under the Ministry of the Environment to adjust the northern boundary of the land plot.

The third example is in Zarasai District Municipality. The land plot was formed and registered in the State Enterprise Centre of Registers through preliminary measurements (Figure 3).

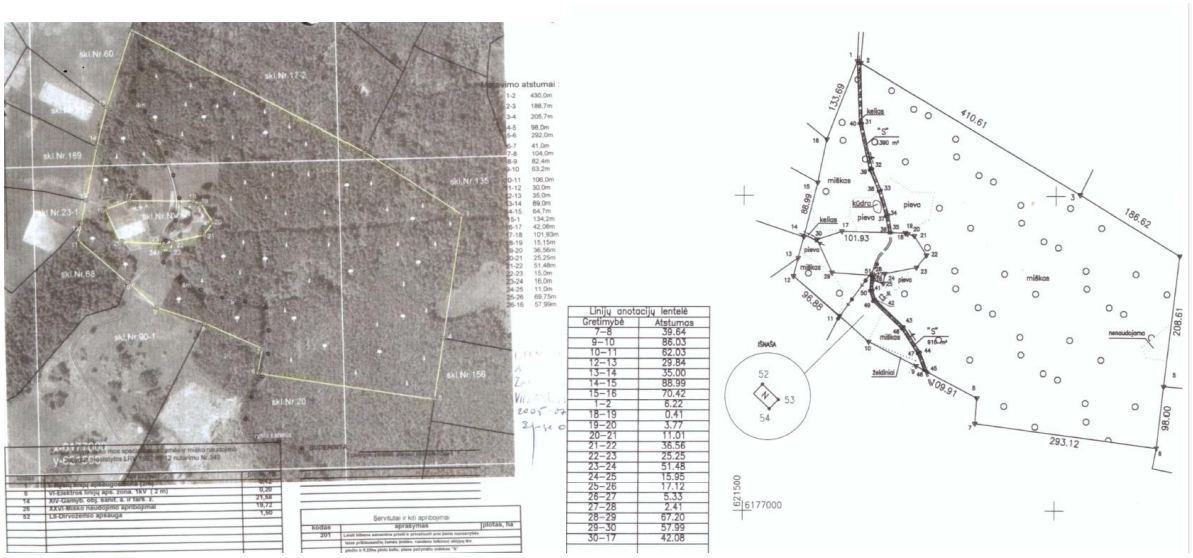

Figure 3. The plot measured in 2005 and 2023

According to the State Land Cadastral Data Register, the preliminary area of the land plot is 21.5800 ha. The cadastral measurements have resulted in a plot area of 21.5500 ha. The resulting difference in area is permissible.

The measurements are based on the 2005 plan. The survey includes 30 boundary markers, of which 19 are newly affixed and 11 non-standard boundary markers found have been replaced. A boundary discrepancy was observed during the marking. The territorial department of the National Land Service was contacted. The preliminary land reform land-use planning project of the cadastral area and the preliminary and cadastral survey data of the adjacent plots were examined and it was found that the boundaries do not correspond to the existing ones in the territorial planning documents. According to the documents examined, there are no grounds for changing the boundaries and line lengths and, in the absence of any surviving boundary markers, the boundaries must be restored in accordance with the zoning documents.

The fourth example shows that even a small difference in area can hinder cadastral surveys. The land plot has been formed and cadastral surveys have been carried out. However, it was not possible to register the cadastral measurements in the State Enterprise Centre of Registers, because according to point 31 of the Rules on cadastral measurements of immovable property objects and on the collection and adjustment of cadastral data, the person establishing the cadastral data of an immovable property object must use the data and information from the State Forest Cadastre of the Republic of Lithuania when carrying out the cadastral measurements. However, a check of the data from the State Forest Cadastre of the Republic of Lithuania on the area of the land plot and the data recorded in the cadastral data file has shown that the data from the State Forest Cadastre of the Republic of Lithuania on the area of the land plot's forest land (2.3754 ha) does not correspond to the area recorded in the cadastral data file (2.3663 ha). The plot also overlaps the boundaries of the adjacent land plot.

The fifth example is in Švenčionys District Municipality. The land plot was formed and registered in the State Enterprise Centre of Registers by preliminary measurements (Figure 4).

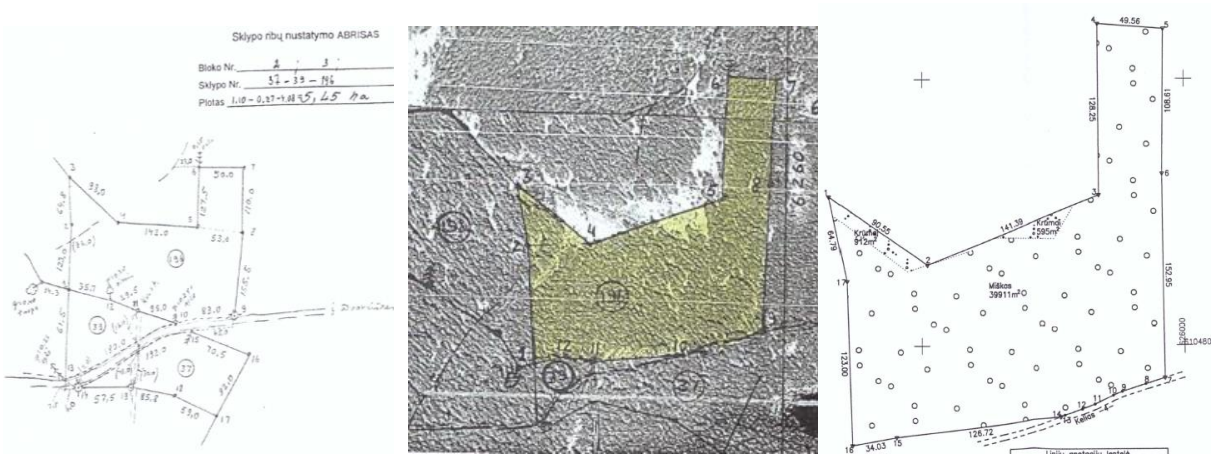

Figure 4. Land plot projected by the land reform land-use plan, its draft and plan

All points were measured by GPS and the coordinate corrections were obtained by connecting to the LitPos base station of the network of permanently operating GPS stations. Only one old boundary marker was found during the land survey. Comparison of line lengths between the 2004 draft and the 2023 plot plan in Table 4.

Table 4. Comparison of boundary lengths

Line	*Data for 2023*	*Data for 2004*	*Line*	*Data for 2023*	*Data for 2004*
1-2	90,55	98,00	5-6	110	108,61
2-3	141,39	142	6-7	152,95	155,5
3-4	128,25	127,5	7-8-9-10-11-12-13-14	83,90	83
4-5	49,56	50	14-15-16	160,75	160,2

The data analysis shows a maximum mismatch of 1-2 lines of 7.45 m. The other line lengths are reasonably accurate. The registered area of the plot is 4,0800 ha, the updated measurement gives 4,1468. The permissible area error of $0,06\sqrt{4,08}$ would be 0,1212 ha, the current area error is 0,0668 ha. The area of the plot as determined by the cadastral survey is within the tolerance of the error.
The sixth example is in the municipality of Vilnius district (Figure 5).

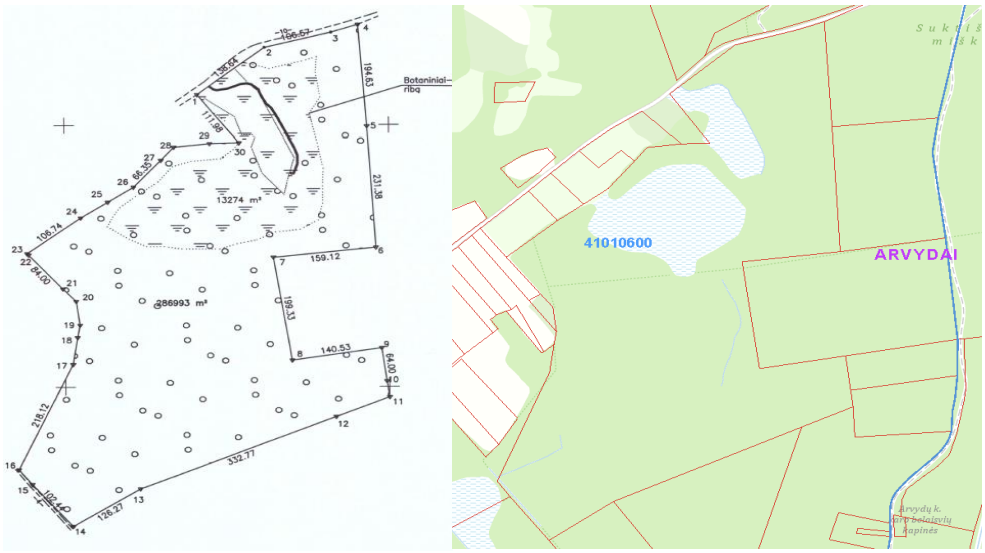

Figure 5. Forest plot

The boundaries of the plot of land on the cadastral survey plan at the boundary turning points 10-11 are found to be changing and do not correspond to the boundaries of the plot of land and the layout of the plot of land as marked in the project, i.e. the configuration of the plots of land is being changed. The cadastral survey of the land plot must be carried out in accordance with the boundaries and layout of the land reform land use plan. The boundaries actually used are different from the boundaries drawn up in the plan, but the land plot solutions are the same. The registered area of the plot 29.5500 ha after cadastral measurements, resulting in 30.0267 ha. The area of the plot determined by the cadastral survey is within the margin of error.

Conclusions and proposals

1. The most important laws regulating cadastral surveys in Lithuania are the Law on Land of the Republic of Lithuania, the Law on Cadastre of Real Estate of the Republic of Lithuania, the Law on Real Estate Register of the Republic of Lithuania, the Law on Territorial Planning of the Republic of Lithuania, the Law on Geodesy and Cartography of the Republic of Lithuania, the Law on Land Reform of the Republic of Lithuania, and the Regulations on Cadastre of the Republic of Lithuania. The procedure for cadastral measurements of land plots, determining the coordinates of the turning points and boundary markers of the boundaries of the land plots in the state coordinate system, shall be regulated by the Regulations of the Cadastre of Real Estate of the Republic of Lithuania and by the Rules on Cadastral Measurements of Real Estate Objects and on the Compilation and Adjustment of Cadastre Data.
2. The research analysed 37 cadastral survey files. The analysis showed that 3 plots had areas exceeding the permissible area tolerances (the area of other plots is not within the permissible limits). 3 nearby plots were incorrectly measured (e.g. the plot boundaries did not follow the middle of the ditch, the plot boundary in the middle of the road). 10 plots were marked with a boundary discrepancy, 5 plots had actual boundaries that differed from the plan boundaries and 1 plot did not correspond to the area recorded in the cadastral data file. The most common problem was poorly defined boundaries and areas. Poorly prepared land reform land-use plans, the 'accuracy' of preliminary measurements, and the lack of preserved boundary markers make cadastral surveys difficult.

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