ALEKSANDRAS STULGINSKIS UNIVERSITY (Lithuania)
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FOREWORD

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Universities from Estonia, Latvia and Lithuania joined their efforts to publish international scientific journal BALTIC SURVEYING. It is jointly issued by:

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In the first volume of the journal are included original articles on land administration, land management, real property cadastre, land use, rural development, geodesy and cartography, remote sensing, geoinformatics, other related fields, as well as education in land management and geodesy throughout the Baltic countries, Western and Easten Europe and elsewhere. The journal is the first one in the Baltic countries dealing with the issues mentioned above.
This scientific journal contains peer reviewed papers. For academic quality each paper has been reviewed by two independent anonymous academic reviewers having Doctors of science degree. Editorial Board has made the final decision on the acceptance for publication. Each author is responsible for high quality and correct information of his/ her article.
We believe that in the future scientists from other foreign countries will become authors of research articles, and the topics of articles will range widely.
We believe that journal will disseminate the latest scientific findings, theoretical and experimental research and will be extremely useful for young scientists

Published scientific papers will be submitted in Agris, CAB Abstracts and EBSCO Academic Search Complete databases. The data bases select the articles from the proceedings for including them in their data bases after individual qualitative and thematic examination.

Volume 1 is compiled by Department of Land Management and Geodesy of Latvia University of Agriculture. Address: Akademijas iela 19, Jelgava, LV-3001, phone +37163026152, e-mail: lifzige@llu.lv

Editorial board

CONTENT

AGRICULTURAL HOLDINGS AND THEIR LAND SIZE CHANGES IN LATVIA

Dace Platonova
Latvia University of Agriculture

Abstract
The latest land reform in Latvia has substantially altered the structure of use of farmland leading to a great number of very small and fragmented agricultural holdings, yet, in terms of occupied total area and UAA, medium size (10.0-50.0 ha) and slightly larger (more than 50.0 ha) land holdings dominate. In Latvia the number of agricultural holdings tends to decline. On the contrary, the average UAA per agricultural holding rose (by 66%), reaching 23.2 ha in 2010. One can conclude that positive structural changes take place in the agricultural industry – the number of small farms has declined and the number of and the area farmed by large market-oriented farms has risen, thus the difference between the sizes of land holdings that emerged during the land reform and the land areas farmed by agricultural holdings has increased.
Key words: land holdings, size of farm, utilised agricultural area.

Introduction

Rational size of a farmland is one of the preconditions for its sustainable development. Rational size of a farmland should be understood as the concentration amount of its production forces which secures high competitiveness within external and internal markets. Rational size of a farmland provides an opportunity to harmonize and use more productively all the production resources, to manage farms with less losses increasing the competitiveness.

The farm size can be characterized by direct and indirect indicators. Direct size of the holding is characterized by the gross production or output of goods in monetary units. As regards the indirect indicators, only equally specialised and intensified farm sizes can be compared. The owned or used real and notional land area (total area, agricultural land, cultivated area, arable land and sown area), number of employees, amount of assets, number of food-producing domestic animals, tractors and machinery and other indicators often characterise the size of the farm.

Although the land area is not a direct indicator characterising the size of the holding, it is most commonly used defining or describing the rational household size. The reason for widespread use of this indicator is not only the fact that the land area is a relatively constant value, but also the fact that agricultural land is the main resource of production, and the entire organisation of production, the amount of the necessary investments and machinery and the construction of residential and commercial buildings, drainage, road management and other activities depend on the use of the farm land in the area. Besides, the land area has an impact on the amount of the production.

Using the farmland size as the indicator characterising the size of a holding, it should not be forgotten that its rational value has to be determined in accordance with the industry specialisation, intensification and other factors that influence the rational size of the holding to allow efficient usage of the land and repayment of the capital investments.

These considerations prompted the choice of the subject and *the aim of the research* was set – to analyse areas of farmlands in rural regions of Latvia by their used areas.

Methodology of research and materials

The data on economically active farms in Latvia were generalised from the Central Statistical Bureau of the Republic of Latvia (years 2003, 2005, 2007 and 2010) within the research. They are described as farms that are producing agricultural production independently of the amount of production and its way of use or that are keeping good agricultural and environment conditions in the land. According to the studies, all the farms in Latvia were subdivided conditionally into 4 groups: very small farms up to 2.4 ha, small farms from 2.5 – 9.9 ha, medium size ones –10.0 – 49.9 ha, and the large farms that exceed 50.0 ha. Summarizing the State Land Service's (SLS) State Real Estate Cadastre Information System (SRECIS) data (years 2001, 2006 and 2012), all the registered holdings containing land parcels with the real estate purpose of agriculture as the main economic activity were analysed.

In the research on the problems and elements, the monographic description, analysis and synthesis methods were used, while the descriptive statistical analysis method was applied with data analysis.

Discussions and results

The latest land reform in Latvia has substantially altered the structure of use of farmland leading to a great number of very small and fragmented agricultural holdings. In the beginning of the reform, natural persons used only 5% of the total agricultural area (Jankava, 2003a), whereas already in 2012 natural persons owned and held in usufruct the most part of the land (94%) transferred for agricultural use. According to the data of the land survey of administrative territories and territorial units of the Republic of Latvia as of 1 January 2012, the average total size of land units owned and held in permanent usufruct by natural persons was only 8.2 ha, while the average size of their utilised agricultural area (UAA) was 4.9 ha. The average area owned and held in usufruct by legal persons was even smaller – the average total area was 4.5 ha, including 3.1 ha of UAA (Table 1).

Table 1

Number and size of land units owned and held in usufruct by natural and legal persons in Latvia as of 1 January 2012

Owner status	Number of land units	Total area, ha	UAA, ha	Average size of land units	
				Total area, ha	UAA, ha
Property owned and held in usufruct by natural persons	434,255	3,569,624.7	2,140,165.1	8.2	4.9
Property owned and held in usufruct by legal persons	27,271	123,294.6	84,802.1	4.5	3.1

After analysing the changes in the size of land holdings from year to year, one has to conclude that the average size of land holdings decreased by 15% during a period of eleven years. An analysis of the UAA reveals a similar trend. One can find that in the period 2001-2012, the average size of UAA per agricultural holding decreased by 21% (Table 3.2). In the beginning of the reform (as of 2011), the average size of UAA was equal to 9.2 ha, whereas in 2012 the average size of UAA per agricultural holding was only 7.3 ha. This leads to a conclusion that in the result of the land reform and other processes (land transactions), the average size of agricultural holdings in Latvia's rural areas is still decreasing.

Table 2

Number and size of agricultural land holdings in Latvia in the period 2001-2012

Indicators/Years	2001	2006	2012	Change from base year, %
Number of land holdings based on their total area, ths	251.31	269.27	313.85	24.9
Total area, ths ha	3,649.26	4,063.37	3,860.84	5.8
Average total area per land holding, ha	14.5	15.1	12.3	-15.2
Number of land holdings based on their UAA, ths	233.85	276.41	313.85	34.2
Total UAA, ths ha	2,143.17	2,441.64	2,298.25	7.2
Average UAA per land holding, ha	9.2	8.8	7.3	-20.7

However, the average indicators do not show the real distribution of land holdings in Latvia's rural areas. The data of the State Land Service (SLS) of the Republic of Latvia (RoL) (years 2001, 2006 and 2012) on total area and the distribution of UAA by size interval summarised by the author reveal that the sizes of agricultural land in Latvia are very different, as the smallest ones are less than 1 ha and the largest ones – several hundreds of hectares (Fig.1).

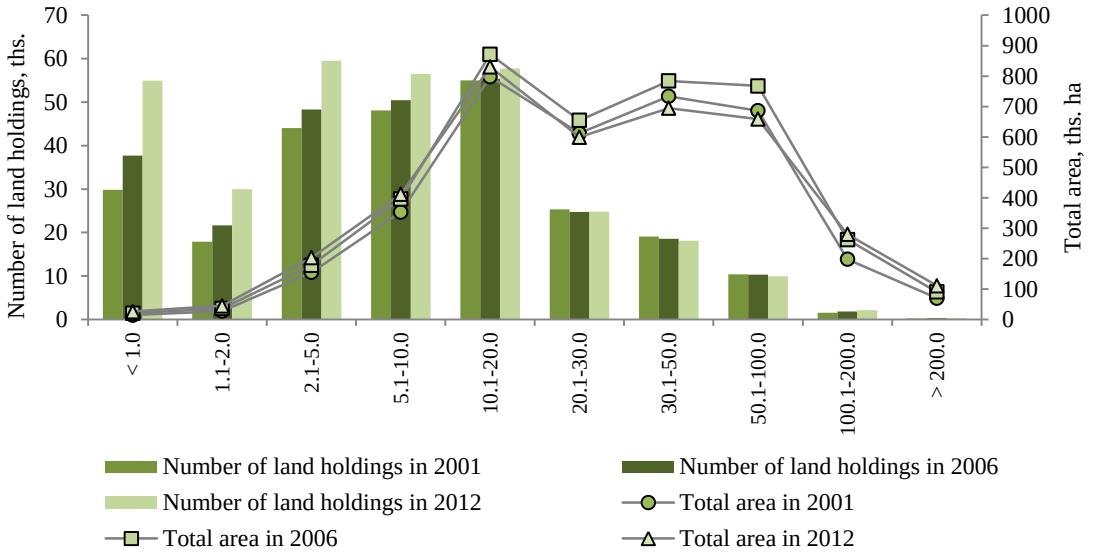

Fig. 1. Distribution of agricultural land holdings by number and total area in Latvia in 2001, 2006 and 2012.

The distribution of land holdings by their total area (Fig.1) shows that as of 1 September 2001, the highest proportion (22%) was comprised of land holdings sized 10.1-20.0 ha, land holdings sized 5.1-10.0 ha were also numerous (19%). Within the period of eleven years from 2001 to 2012, the greatest increase was observed for the size interval up to 1.0 ha, and the number of such land holdings rose 6%. Despite the fact that a stable situation has existed in the size interval of more than 100.1 ha since 2001, yet, the proportion of these land holdings in their total number accounted for less than one percent (0.8%) (Fig.1).

The analysis of various size groups in the distribution of land holdings by their total area (Fig.1) shows that as of 1 September 2001, the highest proportion (22%) was also comprised of land holdings sized 10.1-20.0 ha; the situation as of 1 September 2006 and 26 September 2012 remained the same.

However, the analysis of the other size intervals (Fig.1) shows that the distribution of land holdings by their total area slightly changed in 2006 and 2012. In the period of eleven years from 2001 to 2012, the total area proportion rose (by 3%) in the size interval of less than 10.0 ha and decreased (by 5%) in the size intervals of 20.1 to 100.0 ha, yet, their total area comprised the highest proportion (50.6%) in the total area.

It has to be noted that as of 2012, the number of land holdings in the size interval of more than 100.1 ha accounted for only less than one percent of their total number; yet, over the recent years, an increase in total area might be observed in these intervals, reaching 10% of the total area (Fig.1). Similar trends were observed in the distribution of land holdings by UAA (Fig.2).

The data of Fig.2 indicate that as of 1 September 2001, the highest proportion (49%) in the total number of land holdings belonged to land holdings with a size of UAA of less than 5.0 ha. Besides, there was an increase trend in the number of land holdings in this size interval; in the period of eleven years from 2001 to 2012, the number of land holdings in this size interval rose by 12%, yet, their UAA increased minimally (by 2%). Of the total UAA of Latvia, this group of agricultural land holdings (as of 26 September 2012) occupied only 13%.

Despite the fact that overall only 1% (as of 26 September 2012) of the total number of land holdings in Latvia were holdings with a UAA of more than 50 ha, their occupied UAA area was relatively large (16.8%) (Fig.2). However, one could observe a decrease trend in the number of medium size land holdings, whereas the UAA occupied by small and large land holdings tended to increase.

The summarised data give evidence that a relatively large number of small agricultural land holdings emerged in the result of the land reform in Latvia, yet, in terms of occupied total area and UAA, medium size (10.0-50.0 ha) and slightly larger (more than 50.0 ha) land holdings dominate (Platonova, Jankava, 2011).

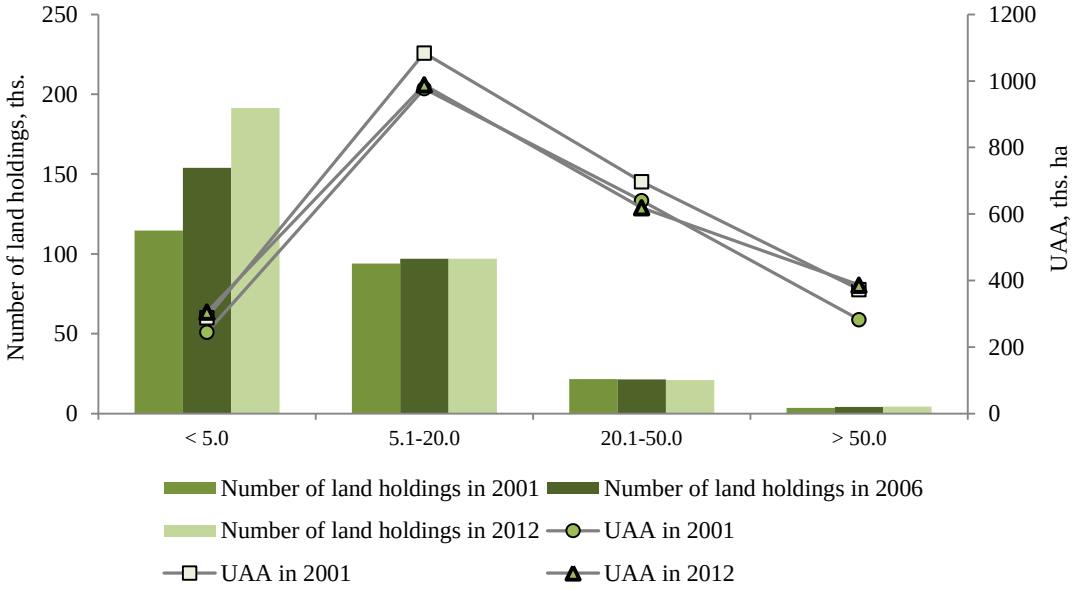

Fig. 2. Distribution of agricultural land holdings by number and UAA in Latvia in 2001, 2006 and 2012.

However, only an analysis of the data of the SLS of the RoL cannot produce information on the land area held by agricultural holdings, as data are available only on the land holdings that are registered with the SLS's SRECIS. In contrast, the CSB of the RoL collects data on the land held, i.e. owned and rented by agricultural holdings; therefore, within the present research, CSB data of the agricultural censuses (years 2003, 2005, 2007 and 2010) on economically active agricultural holdings in Latvia were also summarised.

In Latvia, the number of agricultural holdings tends to decline. As shown in Fig.3, the number of agricultural holdings decreased by 36% (from 131.4 thousand to 83.4 thousand) in the period 2003-2010. On the contrary, the average UAA per agricultural holding rose (by 66%), reaching 23.2 ha in 2010 (Fig.3).

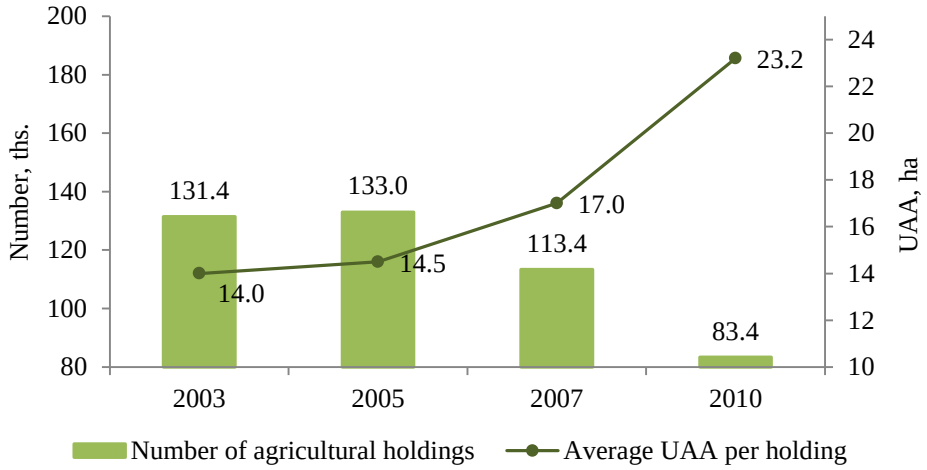

Fig. 3. Number of agricultural holdings and the average UAA per holding in Latvia in the period 2001-2010.

Land fragmentation and the small average size of farms are the result of land reform and privatization process not only in Latvia – similar processes are going on also in rural areas of our immediate neighbouring states – Lithuania (Atkoceviciene, Gudritiene, Sudoniene, 2011) and Estonia (Maasikamäe, Mugu, 2003), as well as in other Eastern and Western European countries (Hartvigsen, 2006).

According to the authors' research, based on RoL CSB data, in 2003, Latvian farms' average total area of agricultural land was 11.4 ha: besides, a third of the farms had a land area of less than 2.4 ha

(Fig.4). One of the preconditions for this situation was that the land reform law did not name the minimum land area, as opposed to the 1920s-30s reform when future division of the existing and new rural land properties of less than 10 hectares was prohibited (Likums par zemes..., 1937). Although, as it can be seen in Fig.4, over the time the trend of declining of very small farms and the increase in medium-sized and large farms can be observed (Fig.4).

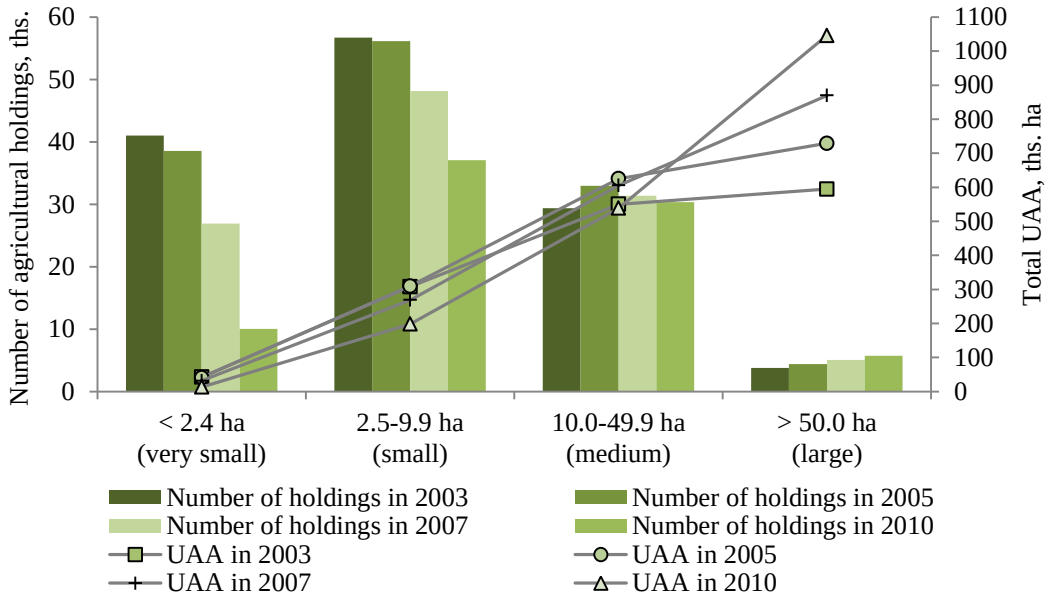

Fig. 4. Distribution of agricultural holdings by number and UAA in Latvia in the period 2003-2010.

The reason is mainly due to the fact that because of the gradually more favourable treatment of agriculture, in parallel with the land privatization process, land markets were developed, resulting in growing of farms through sale, lease or other transactions.

In the seven-year period from 2003 to 2010 in the UAA interval of more than 50.0 ha, not only the number of large agricultural holdings rose (by 53%), but also their UAA increased (by 76%). One can conclude that positive structural changes have been take place in the agricultural industry – the number of small farms has been declining and the number of and the area farmed by large market-oriented farms has been rising, thus the difference between the sizes of land holdings that emerged during the land reform and the land areas farmed by agricultural holdings has increased.

To identify associations between the economic size of agricultural holdings (in ESU) and the real size (in ha), the author analysed the data collected by Latvia's Farm Accountancy Data Network FADN (Table 3).

Table 3

Economic and physical sizes of farms in Latvia's regions in 2012

Region	Number of farms	Utilized agricultural area, ha	ESU, EUR	Rented UAA		Unutilised AA		ESU/ UAA
				ha	%	ha	%	EUR/ha
Zemgale	228	87.9	44,872	46.9	53.4	0.9	1.0	510
Vidzeme	222	75.0	32,836	42.7	57.0	1.3	1.7	438
Pieriga	175	68.8	41,059	33.3	48.4	1.1	1.5	596
Kurzeme	174	66.6	28,544	31.4	47.1	0.6	0.9	428
Latgale	201	44.6	17,595	15.8	35.5	1.6	3.7	395
On average in Latvia		64.1	31,770	33.2	49.5	1.2	1.8	474

An analysis of the data for Latvia's regions for 2012 leads to a conclusion that on average agricultural holdings managed a UAA of 64.1 ha. The largest average UAA was in Zemgale – 87.9 ha and Vidzeme with 75.0 ha. In contrast, the smallest UAA (44.6 ha) and the greatest proportion of unutilised agricultural area – 3.7% of the UAA – were in Latgale region (Table 3).

Even though the greatest farms, in terms of economic size, were in Zemgale, yet, per UAA ha, the highest economic size value was in Pieriga, EUR 596 per ha, exceeding the average level by 122 EUR, while in Latgale it was the lowest, EUR 395 (Table 3).

Table 3 shows that a certain association exists between the economic size and the real size of agricultural holdings – Zemgale is the leader both in terms of economic size and in terms of average UAA, whereas in Latgale region these indicators are the lowest. Riga region makes some corrections; therefore, one can conclude that other factors, too, could affect the economic size of farms, as the economic size of farms is employed to compare the production indicators and performance results of farms whose production patterns are different.

The area of rented land also plays an essential role in managing the land of farms. As shown in Table 3, in Latvia, a farm rents, on average, half of the UAA it manages.

The findings obtained show that in Latvia, under favourable conditions for agriculture, in parallel with the land privatization process, the land market has developed, resulting in the gradual emergence of larger and larger farms through sale, lease or other transactions, thus increasing the difference between the sizes of land holdings that emerged during the land reform and the land areas held by agricultural holdings. This is evidenced by a specialist of the Latvian State Institute of Agrarian Economics, A.Miglavs, and the head of the Land Policy Division, Spatial Planning Department, E. Kāpostiņš who in their research point out that the largest and most capable farms are able to use land more efficiently and the payback of their investments is shorter; besides, the farm productivity and efficiency rises in the agricultural industry on the whole. Such farms tend to expand by purchasing or renting the free land belonging to natural persons or municipalities (Miglavs, 2003; Kāpostiņš, 2003).

In the context of this problem, discussions take place in research papers of Lithuanian authors, too, (Lankelis, 2002; Atkoceviciene, Gudritiene, Sudoniene, 2011) who emphasise that with agricultural holdings becoming larger, their economic expenses per hectare decrease and, undoubtedly, small agricultural holdings are not able to survive under today's competition.

To make a detailed analysis of the economic indicators of farms, profit was analysed for small, medium and large agricultural holdings for a period of eight years, based on the information of Latvia's Farm Accountancy Data Network for the period 2005-2012 (Table 4).

Table 4

Changes in profit for various sizes of farms in Latvia in the period 2005-2012

Year	Small farms		Medium farms		Large farms	
	4-<15 ELV		25-<50		100-<500	
	profit (LVL)	change from base year (%)	profit (LVL)	change from base year (%)	profit (LVL)	change from base year (%)
2005.	311	-	9690	-	40864	-
2006.	1546	397.1	12947	33.6	53895	31.9
2007	8464	2621.5	13293	37.2	80839	97.8
2008.	-1891	-708.0	6896	-28.8	56063	37.2
2009.	-2800	-1000.3	-149	-101.5	6225	-84.8
2010.	-2300	-839.5	3188	-67.1	28655	-29.9
2011.	-1828	-687.8	3146	-67.5	26082	-36.2
2012.	-2784	-995.2	6350	-34.5	62954	54.1

The data (Table 4) on small farms (4-<15 ESU) show that profit tended to decline in the entire period of analysis. Beginning with the year 2008, these farms incurred losses. The greatest losses, compared with the previous year, were suffered in 2009. The profit of medium farms of economic size of 25-<50 ESU was volatile in the latest three years. This leads to a conclusion that the decrease in profit was not as significant as that for the group of farms of 4-<15 ESU. Farmers suffered the greatest losses in 2009 when, compared with 2008, the profit declined by 102% (25-<50 ESU). The greatest increase in profit for the largest farms (100-<500 ESU) was reported in 2007.

A comparison of the data (Table 4) suggests that the greater a farm is, the more profitable its performance is, which is evidenced by the changes in profit for the farm groups of various sizes.

Conclusions and proposals

1. Irrespective of large areas of agriculturally usable lands all over the territory of Latvia, farmland holdings are generally small and fragmented, which does not contribute to beneficial land use and its efficient management.
2. In the beginning of the reform (as of 2011), the average size of UAA was equal to 9.2 ha, whereas in 2012 the average size of UAA per agricultural holding was only 7.3 ha.
3. In Latvia, the number of agricultural holdings tends to decline - the number of agricultural holdings decreased by 36% (from 131.4 thousand to 83.4 thousand) in the period 2003-2010. On the contrary, the average UAA per agricultural holding rose (by 66%), reaching 23.2 ha in 2010.
4. The number of the very small (> 2.4 ha) economically active farms has decreased by 19% since 2003 and the number of the very large farms of over 50 ha has grown by 6%. It reveals a trend towards land consolidation.

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Information about author

Dace Platonova. Latvia University of Agriculture, Faculty of Rural Engineering, Department of Land Management and Geodesy, Lecturer, Mg.sc.ing., Doctoral student. Address: Akademijas 19, Jelgava, LV-3001 Tel: (+371) 63024618, e-mail: dace.platonova@llu.lv

AGRICULTURAL LAND USE AND ECOLOGICAL FARMING IN THE KREKENAVA REGIONAL PARK

Giedrė Ivavičiūtė
Aleksandras Stulginskis University, Kaunas Forestry and Environmental Engineering
University of Applied Sciences, Klaipėda State College

Abstract
The analysis of the declared agricultural land and ecological farming situated in the Krekenava regional park (RP), which is situated in the Middle Lithuania, is presented in the article. The Naujamiestis subdistrict was chosen for the comparison of the use of agricultural lands and ecological farming in the regional park. In 2011, the total agricultural land and crop area declared in the Krekenava Regional Park was 8184.19 ha, i.e. by 317.89 ha or 3.74 percent less than in 2009. 371 family farms were declared, i.e. by 53 farms less in comparison with 2009. In 2009, the declared area of agricultural lands in Naujamiestis subdistrict covered 9877.66 ha and it made up 63.32 percent of the total subdistrict's area. 359 farmers introduced declarations. The average area of the declared farms was 27.51 ha. In 2011, the declared area of the agricultural lands was 9851.33 ha i.e. smaller than 26.33 ha or 0.27 percent less than in 2009. The number of declared farmers in 2011 was 329, i.e. by 30 farms or 9.12 percent less than in 2009. Ecological farming is relevant to protected areas. The article analyzes the Krekenava RP and Naujamiestis subdistrict's farms applying ecological farming tools. The analysis of the 2009-2011 period showed that the declared areas in Krekenava RP have decreased, and the area of farms applying organic measures has increased by 81.69 hectares (nearly 2.5 times). The number of farmers applying organic farming measures in Naujamiestis subdistrict has increased twice and 12 farms i.e., 3.63 per cent of the declared ones had organic farms in 2011, the analyzed area was increased by 581.55 hectares or 3 times.
Key words: regional park, land use, agricultural lands, ecological farming measures, declared areas.

Introduction

Lithuania is historically an agricultural country. The agricultural sector plays a very important economic, social, environmental, ethnic and cultural function and is considered a priority for the country's agricultural industry (Čiegis, Zeleniūtė, 2008).

Farming in protected areas is difficult because it is faced with environmental and economic problems. Protected areas are divided into zones subject to different restrictions of economic activity, therefore economic activity differs as well.

The aim of protected areas is to preserve natural habitats and species (common on agricultural land) of the European Community interest. Such rate of the conservation and use of treatment of the territory is determined that non-intensive farming forming natural values should not be interrupted and should be continued in environmentally-friendly manner. If extensive farming disappears in natural grasslands, pastures and wetlands, these areas will overgrow with shrubs, trees and biodiversity will face a serious threat. As a result, only those activities are limited which could suddenly and irreversibly destroy natural values, for example, grassland ploughing, drainage works, liming, fertilizing and so on.

Sustainable development in agriculture is an organic farming helping solve important problems in rural areas (Brazauskienė, 2002). Organic farming is recognized as sustainable agriculture and it is an important expression of its potential options to address the competitiveness of agricultural products, rural employment and additional income issues and work together as a preventive environmental measure (Offermann, Nieberg, 2000).

The number of organic farms across Europe has been increasing since 1990. The growing demand for organic products has accelerated the growth of organic farming in Europe, and the development of organic farms is determined by the financial support from the EU funds.

The area of certified organic farms in Lithuania is increasing annually: in 2004 the area of organic farms covered 42955 ha, then there was an increase by 26475 ha accounting for 69430 ha in 2005. In 2006 the area increased by 32690 ha more and made up 102120 ha. In 2012 the certified organic farms covered the area of 162655 hectares and, compared to 2004, the amount has increased by 119700 ha. The number of certified organic farms has increased twice, i.e., from 1178 units (2004) to 2511 units (2012) (Viešosios įstaigos EKOagros…, 2012).

One of the reasons determining an increasing number of organic farms is the EU's state support. Benefits for the certified area used for organic farming and food production have the greatest impact from support measures (direct and compensatory payments) allocated to organic farms. (Kazakevičius, 2010).

Protected areas have to comply with the principles of sustainable farming, expansion of the area under organic farming and organic farming for measures to preserve the landscape, the importance of biodiversity, natural and cultural heritage values (Ivavičiūtė, Gurskienė, 2010).
The object of the research is declared agricultural lands in the Krekenava Regional Park and Naujamiestis subdistrict.
The aim of the research is to carry out the comparative analysis of the years 2009 and 2011 of the agricultural lands situated in the Kekenava Regional Park and the Naujamiestis subdistrict, to perform the analysis of farms applying organic farming measures as well as the analysis of the change of their areas.
The following **objectives** have been set:
1. To characterize the Krekenava Regional Park and the Naujamiestis subdistrict.
2. To carry out the analysis of the declared agricultural lands in the Krekenava Regional Park and the Naujamiestis subdistrict.
3. To perform the analysis of farms applying organic farming measures as well as the analysis of the change of their areas.

Methodology of research and materials
Comparative, analytical as well as statistical and logical research methods were used for the investigation of the years 2009 and 2011. The analysis of the agricultural lands in the Krekenava regional park and the Naujamiestis subdistrict was carried out following the data of the Agriculture Information and Rural Business Center on the declared agricultural land and crop areas.
The survey was conducted to determine whether agricultural land use and environmental measures for the Krekenava regional park and the Naujamiestis subdistrict differ because of the restrictions and recommendations (on the regional parks) to protect and enhance biodiversity, promote environmentally friendly farming methods and organic farming measures.
The study was carried out to determine how many farms included in the territory of the regional parks applied organic farming measures. The change of above farms' area for 2009-2011 was analyzed as well. Naujamiestis subdistricts, not incorporated into the territory of regional parks, were chosen for the performance of comparitive analysis.

Discussion and results
Description of the Krekenava Regional Park. The Krekenava Regional Park was founded in 1992 to preserve and maintain the landscape of the Nevėžis river valley, its natural ecosystem and cultural heritage treasures.
The Nevėžis old valley is the biggest treasure of Middle Lithuanian Lowland landscape. A lot of traces of the old riverbeds appeared when the river changed its course. During tides the river Nevėžis bursts from its banks and leaves a lot of silt in the flooded bank meadows forming many irregularly-shaped pools and ponds. The landscape of the Nevėžis old valley is little touched by people and it is a heritage of the post ice-age times. The Nevėžis Middle River Reserve was founded to preserve the treasures of nature and landscape. Natural treasures are abundant in the forests of the park as well.
Almost the entire park's territory is situated in Panevėžys district municipality of Panevėžys County, only the south-western edge intervenes into the Kėdainiai district municipality of Kaunas County.

The analysis of the location of Lithuanian regional parks shows that Middle Lithuania has only one regional park, i.e. the Krekenava regional park therefore the significance of this park is especially important.
Having prepared the plan of the Krekenava regional park and its zones in 2009 and having evaluated the character and distribution of cultural heritage, the following zones were singled out: conservation, ecological protection, recreational, economic and residential priority zones. The change of areas was predicted as well (Krekenavos, 2009). The analysis of the change of the regional park's areas reveals that the area of the park has decreased from 111749.0 ha to 11589.7 (Krekenavos, 2014) (Table 1) ha, i.e. by 159.4 ha or by 1.4 percent, respectively. The conservation priority zone was reduced most of all (by 2.5 percent). The ecological protection priority zone was increased by 1.9 percent and covering 4.6 percent (538.6 ha) of the whole park's territory. The agricultural zone has increased by 36.8 ha or by 0.7 percent, respectively.

Table 1

The areas of the functional priority zones of Krekenava regional park

Number	The name of the functional priority zone	Area, ha	Percent from the RP area
1	Conservation priority zone - reserve	4089.9	35.3
2	Ecological protection priority zone	538.6	4.6
4	Recreational priority zone	266.7	2.3
5	Economic priority zone	6582.2	56.8
6	The living zone	112.3	1.0
Total:		**11589.7**	**100**

The average productivity of soils of agricultural lands in the Panevėžys district municipality is 47.5 scores.

Panevezys district is situated in the zone of Central Lithuania and belongs to the zone of soils with average fertility of II B-1 district group, for use in the main commercial agricultural crops, i.e. winter wheat, barley, rape, flax, sugar beet (Mažvila et. al. 2010).

Agricultural lands make up 33.0 percent of the Krekenava regional park's territory (Raudonytė, 2009) (Fig.1). The average productivity of the agricultural lands situated in the park is higher than 45 scores.

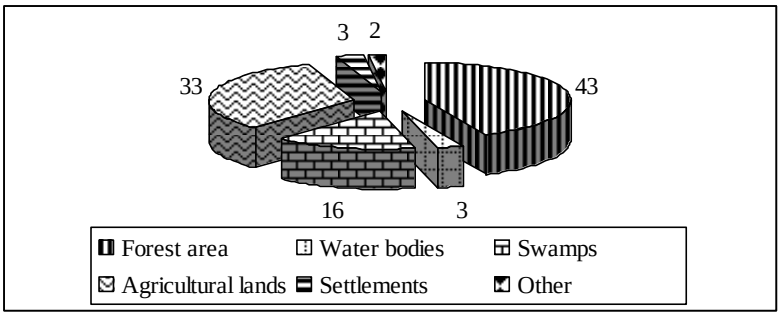

Fig 1. Distribution of agricultural lands in the Krekenava regional park, in percent.

The largest part of agricultural lands is covered by forests (43.0 percent). Moist, mainly mixed forests, in some places oak-woods and ash-woods predominate in the Krekenava regional park (Krekenavos, 2014).

The analysis of the declared areas of agricultural land use in the Krekenava regional park and Naujamiestis subdistrict. In 2009, Lithunian farmers and legal entities used and declared 2,420 thousand ha of agricultural lands, private agricultural land users and small landowners – 220 thousand ha, the members of the community gardeners – 16 thousand hectares (Mažvila *et. al*. 2010).

Following the data of the Agriculture Information and Rural Business Center (Žemės ūkio informacijos…, 2011) the declared area of agricultural lands and crops occupied 8502.08 ha in 2009, accounting for 73.36 percent of the total regional park's area. The number of the farmers, who had declared their farming lands, was 424. The average area of the declared farms was 20.05 ha.

In 2011 the total agricultural land and crop area declared in the regional park was 8184.19 ha (Fig. 2), i.e. smaller by 317.89 ha than in 2009. 371 family farms were declared, i.e. by 53 farms less in comparison with 2009.

The Naujamiestis subdistrict was chosen for the comparison of the use of agricultural lands in the Naujamiestis subdistrict and the regional park. The territory covered the area of approximately 15.6 thousand ha. There were 66 villages, 4 agricultural companies and agricultural cooperatives in the subdistrict (Naujamiesčio seniūnija…, 2014).

In 2009 the declared area of agricultural lands in Naujamiestis subdistrict covered 9877.66 ha and it accounted for 63.32 percent of the total subdistrict's area. 359 farmers introduced declarations. The average area of the declared farms was 27.51 ha.

In 2011 the declared area of the agricultural lands was 9851.33 ha i.e. smaller by 26.33 ha or by 0.27 percent less than in 2009. The number of declared farmers in 2011 was 329, i.e. by 30 farms or 9.12 percent less than in 2009.

The above analysis suggests that, comparing 2011 and 2009, the number of declared farms decreased (in the Krekenava regional park – by 12.5 percent, in the Naujamiestis subdistrict – by 9.12 percent),

and the declared areas decreased by 3.74 percent in the Krekenava regional park, by 0.27 percent in the Naujamiestis subdistrict, respectively.
In 2009 three farmers carried out farming activities in Krekenava Regional Park in the area of 6.18 ha of the Natura 2000 territory. In 2011 ten farmers carried out farming activities in the regional park in the area of 20.63 ha of the Natura 2000 territory (Fig. 2).
In 2009 two farmer's existing 4.3 hectare property in the Naujamiestis subdistrict was included into the Natura 2000 site. Two family farms occupying 4.04 hectares were declared in 2011.
Thus, the number of farmers in the Krekenava RP has increased by 7 farms in Natura 2000 area and the area has increased by 14.45 ha. The number of farms in Naujamiestis subdistrict remained stable, but the area decreased slightly (0.26 ha).

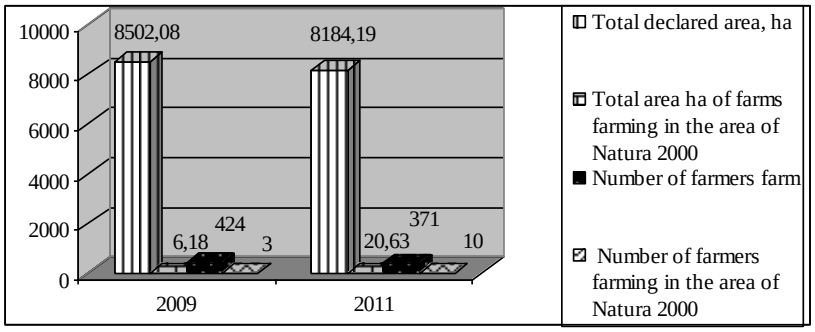

Fig. 2. Analysis of the change of declared areas and farmers‘ farms in Krekenava RP, in ha.

In 2009 in the Naujamiestis subdistrict, the total area of low disadvantage occupied 210.52 ha (1.35 percent from the total area claimed), the number of farmers was 20. As regards 2011, 17 households declared 276.12 ha of low disadvantage areas.
Comparing the declared data of Naujamiestis subdistrict of the years 2009 and 2011 one can see that the number of declared farmers farming in areas of low disadvantage for farming has decreased, and the area increased by 65.6 ha. Meanwhile, the areas of low disadvantage in the Krekenava Regional Park were reported neither in 2009 nor in 2011.
Ecological farming in Krekenava RP and the Naujamiestis subdistrict. The above analysis of declared areas reveal that the number of farmers' farms, which submitted declarations, as well as the area declared in Krekenava RP, decreased in 2009-2011.
Only 4 farmers (0.94 percent of all who had declared) applied organic farming measures in the area of 58.6 ha in Krekenava Regional Park in 2009. It made up just 0.69 percent of the total area declared. In 2011 such measures were applied by 7 farmers in the area of 140.29 ha (1.71 per cent) (Fig.3).
The analysis of the period of 2009 and 2011 showed that the declared areas in Krekenava RP have decreased, but the area of farms applying organic measures has increased by 81.69 hectares (nearly 2.5 times).

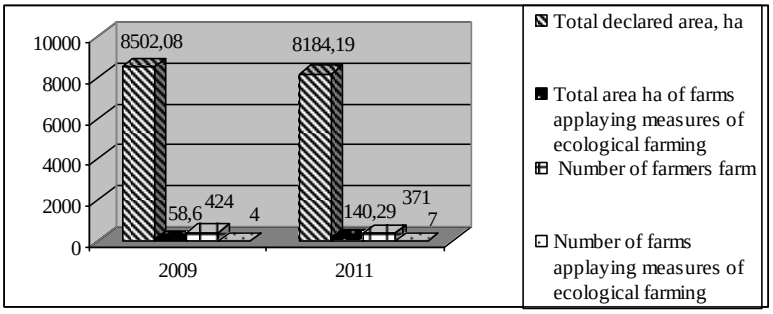

Fig. 3. Analysis of the declared areas and farmers‘ farms in Krekenava RP, in ha.

In Naujamiestis subdistrict both the areas declared farms and the number of farmers, who had submitted declarations in 2009 and 2011, have decreased. During the above period the number of farmers applying organic farming measures in Naujamiestis subdistrict has increased twice; 12 farms i.e., 3.63 per cent of the declared farms were organic farms in 2011 (Fig. 4).

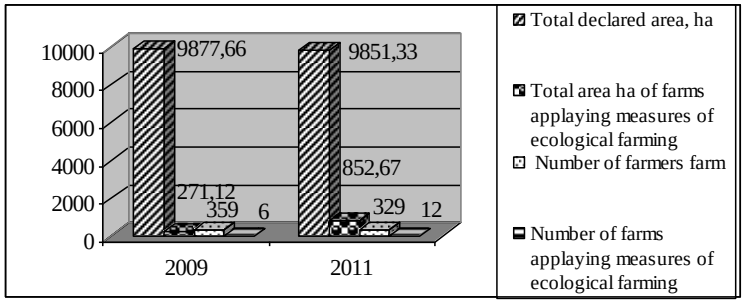

Fig.4. Analysis of the declared areas and farmers‘ farms in Naujamiestis subdistrict, in ha.

In 2009 the area of 271.12 ha (2.74 per cent of the total area declared), in which organic farming measures were applied, was declared in the subdistrict. In 2011 the area increased to 852.67 ha (8.66 per cent of the total area declared). The analyzed area increased by 581.55 hectares or 3 times.
The analysis of Krekenava RP and Naujamiestis subdistrict (which is not incorporated into the park‘s territory) of 2009 and 2011 showed that organic farming has been introduced in a number of farms and the area has increased.
The area of farms applying organic farming measures in Krekenava RP was only 1.71 percent, the measures were applied only by 1.89 percent of all the declared. Meanwhile, the percentage in Naujamiestis subdistrict, which is not incorporated into the area of Krekenava RP, is distributed as follows: 8.66 per cent of the total area declared and 3.65 percent from the number of farmers‘ farms who submitted declarations. It was thus found that the area of the farms applying organic farming measures in Krekenava Regional Park is the smallest compared to Naujamiestis subdistrict and Aukštadvaris RP, although one of the activities promoted in Krekenava RP is organic farming. Organic farming, clearly a viable option in many situations, is still not fully exploited and it is not wide spread in protected areas. Organic farming is important because conventional agriculture, which involves high-yielding plants, mechanized tillage, synthetic fertilizers and biocides, is so detrimental to the environment.

Conclusions

1. The area of certified organic farms in Lithuania is increasing annually. In 2012 the certified organic farms covered the area of 162655 hectares and, compared to 2004, has increased by 119700 ha. The number of certified organic farms has increased twice, i.e., from 1178 units (2004) to 2511 units (2012). One of the reasons determining an increasing number of organic farms is the EU's state support.
2. The largest area of Krekenava RP is occupied by the functional priority zone – Economic priority zone covers 56.8 percent of the whole park’s territory. The ecological protection priority zone covers 4.6 percent of the whole park’s territory.
3. The number of farmers in the Krekenava RP has increased by 7 farms in Natura 2000 area and the area has increased by 14.45 ha. The number of farms in Naujamiestis subdistrict remained stable and the area decreased slightly (0.26 ha).
4. Comparing the declared data of Naujamiestis subdistrict of the years 2009 and 2011, one can see that the number of declared farmers‘ farming in areas of low disadvantage for farming has decreased, but the area has increased by 65.6 ha. In the Krekenava regional park the areas of low disadvantage were reported neither in 2009 nor in 2011.
5. The analysis of 2009 and 2011 showed that the declared areas in Krekenava RP have decreased, but the area of farms applying organic measures has increased by 81.69 hectares (nearly 2.5 times). The number of farmers applying organic farming measures in Naujamiestis subdistrict has increased twice; 12 farms i.e., 3.63 per cent of the declared had organic farms in 2011, the analyzed area increased by 581.55 hectares or 3 times.
6. The area of farms applying organic farming measures in Krekenava RP was only 1.71 per cent, measures were applied only by 1.89 per cent of all the declared. The percentage in Naujamiestis subdistrict, which is not incorporated into the area of Krekenava RP, is distributed as follows: 8.66 per cent of the total area declared and 3.65 per cent from the number of farmers‘ farms who submitted declarations.
7. It is recommended to develop animal-breeding as well as ecological farming for the improvement of the condition of environment and the landscape in Krekenava Regional Park. It is necessary to form

clear and sufficient policy of the compensation for the restrictions of farming in the protected areas, which should reduce the load of ordinary economic activity in the protected areas, and their usage should become more favorable for protected valuables.

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Information about author

Giedrė IVAVIČIŪTĖ, Lecturer, Institute of Land Use Planning and Geomatics, Water and Land Management faculty, Aleksandras Stulginskis University. Address: Universiteto g. 10, LT – 53361 Akademija, Kauno raj. Tel. 8 – 37 75 23 72, e-mail: ivavice@gmail.com Fields of interest: landscape architecture.

ANALYSIS OF FARMING LAND USAGE IN SOUTHERN LITHUANIA

Vilma Sinkevičiūtė
Aleksandras Stulginskis University

Abstract
Peculiarities of farming land usage in southern Lithuania are analyzed in the article. The analysis of archival data and cartographical material reflecting the structure of farming land in Marijampolė, Šakiai, Kazlų Rūda, Alytus, Lazdijai and Vilkaviškis municipalities was accomplished. Information was taken from yearbooks and archives of public institutions of the Republic of Lithuania and other sources as well. It was determined after analysis of collected information that usage and location of cultivated land greatly depend on the land's productivity. The largest amount of undeclared farming land is in the districts where the land less favorable for farming is dominant. The analysis of the period of last 10 years has shown that the area of farming land decreased by 753 ha in Lazdijai district and by 194 ha in Vilkaviškis district, but increased by 5.5 ha in Alytus district on average per annum.
Key words: declared land, farming land, land usage.

Introduction

The structure of farming land in Lithuania has been continually changing: the plots of occupied territories have increased, the road net has developed, the plots of forests and sprouts have enlarged, etc.

The development and variety of landscape are determined by land-tenure formed in the interaction of natural processes and human economic activity; the landscape's structure is actively influenced by general principles and methods of land management.

There is much more abandoned agricultural land in the territories with large variety of agricultural land, and likely a part of it will be intensively used again, while another share (in particular, areas of overmoistured land) will remain in natural state or will be afforested.

The aim of this research is to analyze farming land usage. The object of the research is farming land in southern Lithuania. The objectives of the research are: to analyze the composition of farming land and to determine the tendencies of its change; to find out the causes of abandoned land disuse; to estimate in how many land plots land, cultivated by farmers, is located.

During the investigation the methods of literature sources and cartographical material analysis, logical mind, statistical analysis and graphical viewing were applied.

The analysis of archival data and cartographical material regarding the structure of farming land in Marijampolė, Šakiai, Kazlų Rūda, Alytus, Lazdijai and Vilkaviškis municipalities was accomplished. The information was taken from yearbooks and archives of public institutions of the Republic of Lithuania and other sources as well. Additional information was received from specialists preparing planning projects for the land reform. The dependence of cultivated land plot from productivity score was also determined. In order to analyze land usage in more detail, 64 owners of land parcels in Šakiai district, Griškabūdis cadastre locality were directly surveyed.

With the help of GIS – the inventory database of the Central regional land fund Žinv_DB50LT the analysis of the deserted lands of the territories was carried out at scale 1:50000. In Kazlų Rūda municipality these land plots were surveyed in the vicinity.

Results

Farming has been the main means of subsistence for people for a long time. People have been changing natural landscape by cutting the first trees in order to form a farmland site; they have created a new landscape – agrarian. When earthwork technologies and means have been improving, the landscape has changed expeditiously. Not only new technologies and human possibilities but also various political circumstances, change of land ownership forms and even traditions had an influence on the development of agrarian landscape (Ribokas G., 2009). To fulfil the conversion of land usage successfully, sufficient and well-timed sponsorship is required (Ribokas G., 2008).

Statistical data show that farming land composes more than 44% of the whole land-tenure in Europe. Farming land occupies the biggest part in Denmark, Ireland, the United Kingdom and Spain etc.

According to Abalikštienė (Abalikštienė E., 2013), the changes of land usage are related to variation of the number of economic activity subjects.

After the nationalization of the land and after the establishment of collective farms (kolkhozs) the boundaries between peasants' farms and historical villages disappeared. After the move of 115 thousand steadings and after the destruction of farmsteads and field plantings as well as after the draining of 80 % of the country's territory, 20-50 km^2 of reclaimed uncultivated plains with the islands of thin forests and other plantings of trees and shrubs started to predominate in the territory of Lithuania (Povilaitis, 2001). An intensive landscape anthropogenization influenced the changes of separate territory structures, but most of all it harmed the ecological stability of ecosystems. Large vacuums were formed in the landscape as well as the mosaicness and contouriness of land-tenures decreased (Bučas, 1988). According to the agricultural inventory data of 1935, the agricultural land in Alytus, Lazdijai and Vilkaviškis districts made up from 79.81 to 92.02 % (according to the agricultural data of 1930 – from 77.3 to 90.75 %) of the total district area. In the districts of the southern part of Lithuania in 1935 farming lands made up from 83.7 to 92.0 %, forests – from 1.3 to 5.1 %, wetlands and peatbogs – 2.5-3.1 %, land under the buildings – 2.2 % and other landed property (water reservoirs, roads, sands, etc.) – 2.1-5.9 % (Žemės…, 1938), respectively. After the comparison of the agricultural inventory data of the years 1930 and 1935 it was defined that in Alytus, Lazdijai and Vilkaviškis districts the area of farming lands (arable lands, orchards, meadows, pastures) had increased by 0.5 % during five years, however, the areas of wetlands and peatbogs had decreased by 0.3 %. The areas of forests, lands under the buildings and other land areas remained unchanged.
The area of arable land in analyzed territories within the period of 1935–2013 has changed marginally. The areas of arable land during the prewar period had increased, and it was determined by important historical processes related to establishement of granges. Agricultural production incresed even in economically unproductive lands. Later these areas had also stabilized. However, not all arable land was used efficiently. A lot of land were lying waste. The difference between present areas of arable land and crop (fig. 1) show that cultivated land was not used efficiently.

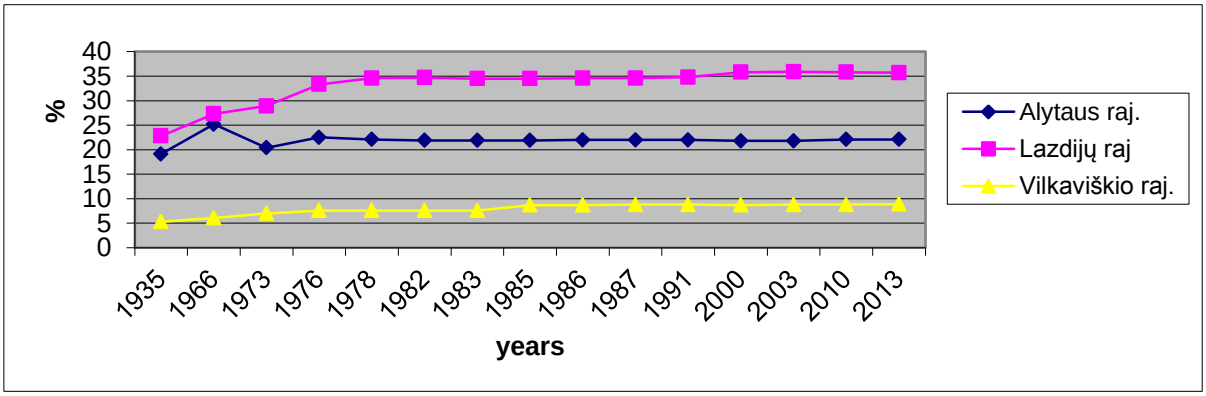

Fig. 1. The difference between the areas of arable land and crops.

It was influenced by land transfer to non-agricultural land, spontaneous deterioration of farming land (origin of swamps, shrubbery, afforestation) due to natural processes and wrong human economic activity (owners not always properly maintained land after repossessing it) as well as to afforestation of unproductive farming land.
More detailed analysis of southern Lithuania districts reveals that areas of farming land in the major part of the studied territory has decreased. The analysis of the period of the last 10 years shows that the area of farming land decreased by 753 ha in Lazdijai district and by 194 ha in Vilkaviškis district but increased by 5.5 ha in Alytus district on average per annum. The main reason of abatement of farming land areas was afforestation of farming land. It was encouraged by the support of structural funds for afforestation of agricultural land. The development of urbanized territories has also caused such changes. The development of a market economy and emerged possibility to have one's accommodation in the country determined territorial changes of the rural occupation and usage. The area of territory with buildings and intensity of building have been increasing; violations of cultural heritage are observed; the landscape of ecologically and esthetically most valuable territories is changing. Intensifying the sale of the land sale to non-Lithuanian citizens might cause occurance of negative tendencies forming consumer approach towards protection, management and use of landscape.

After comparing the land fund data with the agriculture inventory data (Table 1) it is seen that there is more farming land according to the land fund data.

Table 1

The comparison of data of land accounting (2013-01-01) and agriculture inventory (2010)

Municipality	2013-01-01 agricultural land, thousand ha			Vacant land of state and horticultural community			The data of agriculture inventory (2010), thousand ha	
	Total Area	Farming land	Arable land	Total area	Farming land	Arable land	Farming land	Difference with accounting
Alytus	94.59	79.29	61.82	82.2	70.97	56.82	64.84	-6.13
Lazdijai	75.19	57.39	44.89	56.95	46.42	33.97	39.12	-7.3
Varėna	53.59	46.84	34.98	46.03	39.31	28.33	27.84	-11.47
Kazlų Rūda	19.22	16.27	11.9	17.87	15.98	11.65	13.73	-2.25
Marijampolė	57.07	52.43	44.72	53.21	51.17	43.96	47.57	-3.6
Šakiai	107.09	96.95	91.79	99.98	95.15	91.08	89.4	-5.75
Vilkaviškis	105.14	94.67	81.94	90.98	75.99	73.6	80.52	4.53

The largest difference of agricultural land is in Varėna district municipality, and the smallest is in Marijampolė municipality.

The consolidated data of declarations provided by subjects of agricultural activity can be used for the accounting of farming land areas. These declarations are presented to the National Paying Agency in order to receive direct payments for crops, meadows, grassland, gardens and berry plantations, or for farming land of good agrarian state. Declaration data represent not all areas of farming land but only those that are used for growing crops. Conformity of crops grown on arable land to the recommended crop structure can be used to judge about decreased intensity of land usage. In 2013 fallow composed over 7.0 %, perennial grass ca. 34 % and the rest areas (annuals) constituted ca. 59 % (1250.8 thousand hectares) in total in Lithuania. The largest areas in this crop group are composed of cereal and crops grown for processing and food. The percentage of annuals is higher in the districts with rich soils or with light soils unsuitable for growing perennial grass. The findings showed that the areas of farming land declared during 2008–2013 in the investigated districts were unequal (Table 2).

Table 2

The comparison of declared areas within 2008–2013 with the data of farming land accounting

Municipality	Declared area			Area of farming land according to land fund composition, 2013	Undeclared area	
	2008	2010	2013		ha	%
Vilkaviškis	79,264.23	79,702.81	79,883.33	97,303.17	17,419.84	17.90
Marijampolė	44,892.40	45,460.78	46,354.11	53,851.17	7,497.06	13.92
Šakiai	90,263.68	90,449.73	91,040.62	98,796.12	7,755.50	7.85
Kazlų Rūda	12,767.16	12,530.90	12,558.50	16,758.49	4,199.99	25.06
Lazdijai	36,609.11	36,208.37	37,294.01	59,163.49	21,869.48	36.96
Alytus	60,715.08	59,118.30	58,765.66	81,892.64	23,126.98	28.24

The data in Table 2 shows that the highest amount of undeclared farming land is in Lazdijai district, where the land less favorable for farming is dominant.

Usage of cultivated land is very much dependent on land's productivity. Mathematical analysis was accomplished and the dependence, showing how productivity score influences the area of cultivated land located in different cadastre locality, was determined. The average area of cultivated land and average productivity score of cadastre localities in Vilkaviškis district were calculated. Girėnai, Vištytis and Gražiškės cadastre localities were not included in the analysis because they are attributed to low productivity lands and agricultural activity in these territories is minimal, though areas of cultivated land are quite large.

The observation data (Fig. 2) show the dependence of cultivated land on agricultural productivity score.

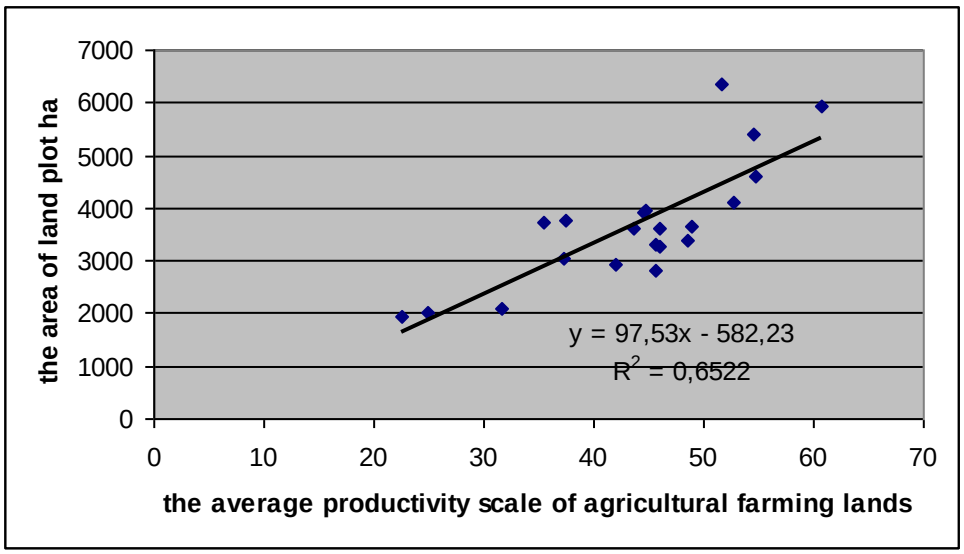

Fig. 2. The dependence between the area of cultivated land and productivity score in cadastre localities of Vilkaviškis district.

After mathematical data-processing the obtained correlation coefficient is equal to 0.8. It shows that analyzed correlations are strong. Determination coefficient is 0.65 and therefore it can be predicated that cultivated land area depends on land productivity by 65 % on average. Calculated Student's criterion is equal to 5.96, while the value of Fisher criterion was 35.62. The obtained correlation and determination coefficients are real and reliable with 0.95 confidence level.

The majority of farmers associate the economic reconstruction of the land use with the planting forests in of unproductive land join the project with the help of labour force or their small means (Česnulevičius, 2005). According to E.Knappe (Knappe, 2001), for a long time agricultural territories were connected with land cultivation and animal-breeding for the steady supply of inhabitants with food.

The areas of uncultivated lands can be found both in good soils and in less productive lands as well. It is necessary to stimulate land lease in the places with strong farms and agricultural companies. There are vicinities where land is given to use without any fees. There is another variant - to sell the uncultivated land. It is possible to reactivate uncultivated agricultural lands ecologically and economically by using alternative ways of the land use. One of such alternatives is the planting forest in such land. It should be useful to use the support for rural development and plant forest in land with unproductive soil. In such a case the environment protection should be improved as well. The investigation on the deserted lands in Kazlų Rūda municipality was carried out. With the help of digital database the plots of the deserted lands were surveyed in the vicinity in order to find out if land plots have not been actually cultivated and due to what reasons they have been left deserted. Kazlų Rūda municipality covers the area of approx. 55,400 ha. There are 909.82 ha of deserted land in the municipality. The land is distributed into 3,284 plots. The smallest area of the deserted land plot covers 0.02 ha, the largest one – 2.40 ha. One of the reasons for the appearance of deserted lands are the defects of land reclamation systems. Overlogged and starting to bog up land is an obstacle for its proper use (the largest areas of such lands are situated in Plutiškiai and Antanavas subdistricts). The other reason is the land of low productivity. Forests occupy the largest part (about 60 %) of the area in the Kazlų Rūda municipality (Kazlų Rūda and Jankai subdistricts). In the large part of the outer woods unproductive soils dominate. They often remain uncultivated and overgrow with woody vegetation. The third reason for the appearance of deserted lands is the shortage or absence of enterpreneural farmers or companies able to rent land and cultivate it.

Currently land plots' enlargement is a relevant issue. In order to analyze land usage for agricultural acitivity in more detail, a survey was carried out and the results showed that the majority of land users work on the the land located in 4–5 plots (Fig. 3). The data of 335 farmers were analyzed.

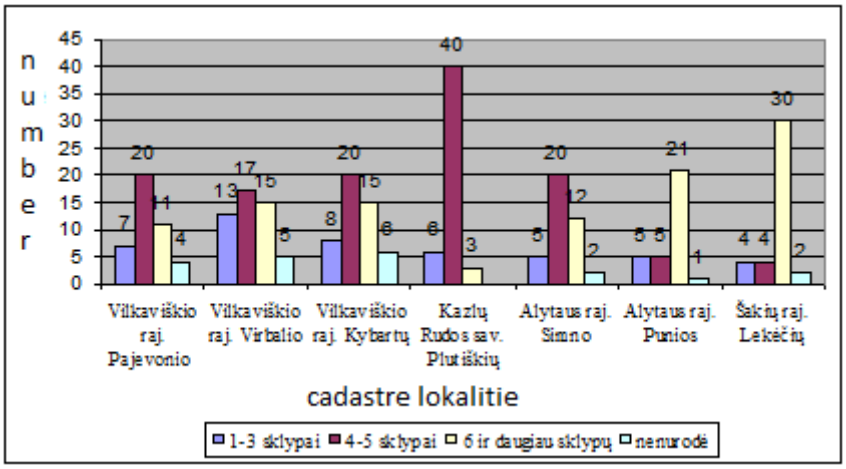

Fig. 3. Location of cultivated land in parcels.

There are also quite a few land users (107) whose cultivated land is located in more than 6 fields.
The location of cultivated land area in several parcels is also determined by land productivity. Farmers look for productive land and either buy or rent it.
The intensity of agricultural land use is described by:

- the area of unlegalized to use state land. Less of unlegalized land indicates more intensive land use;
- the areas of free state land. Larger amounts of the privatized state land also indicate more intensive land use;
- the declared area of farming land compared to the statistical area. A relative increase of areas of declared farming land denotes higher degree of farms' formation and activity of land use;
- the relation of area of labour-intensive or commodity production agricultural plants with the total area of farming land. Annual crop, gardens and berry plantations are ascribed to these plants. The remaining area is comprised from perennial grass, meadows, grassland, fallow and unbroken soil;
- the level of viable farms' formation. The larger area is occupied by the land used by farmers and legal entities of agricultural activity (where relatively more agricultural plants for commodity production are grown), the more intensively land is used (Table 3).

Table 3

The indexes of the intensity of agricultural land usage 2013 01 01
(data: Land Fund of the Republic of Lithuania, 2014)

No	Indeces	Units	Kalvarija municip.	Kazlų Rūda municip.	Marijam-polė municip.	Šakiai district	Vilkaviškis district	In Lithuania
1.	Farming land in agricultural land (2013-01-01)	Thous. Ha	31,181.96	15,906.21	52,438.45	97,256.71	94,672,99	29,1456,32
2.	thereof – in state land	Thous. Ha	10,166.68	28,62.33	7,681.58	14,899.97	24,373.98	59,984.54
3.	thereof – unlegalized to use	Thous. Ha	5,205.36	125.19	547.70	2,505.42	2,698.60	11,082.27
	(3:2)	%	51.20	4.37	7.13	16.81	11.07	18.48
4.	The area of free state land (farming land)	Thous. Ha	2,582.80	1,031.57	970.92	2,173.96	7,844.72	
	(4:1)	%	8.28	6.48	1.85	2.24	8.29	
5.	Farming land used by farmers' farms (declared)	Thous. Ha	17,796.65	10,143.88	28,372.67	64,529.78	66,278.20	187,121.18
	(5:1)	%	57.07	63.77	54.11	66.35	70.01	64.20

6.	Number of farms registered in the register of farmers' farms	Units	1030	703	1972	3122	3201	10,028
7.	Farming land of farmers' farms	Thous. Ha	8,282.48	4,687.36	14,017.77	22,711.52	29,451.38	79,150.51
8.	Farming land of legal persons' private farms	Thous. Ha	63.97	95.29	921.87	1743.25	1149.62	3,974.00
9.	In total (7+8)	Thous. Ha	8,346.45	4,782.65	14,939.64	24,454.77	30,601.00	83,124.51
	(9:1)	%	26.77	30.07	28.49	25.14	32.32	28.52

The data (Table 3) show that unlegalized to use farming land in Vilkaviškis district municipality comprises 11.07 %. Farming land of farmers' farms and private farms of legal persons composes 32.32 %. Agricultural land is used intensively enough. Other indeces are similar indeces of other municipalities in Marijampolė County and in the state on average.

Conclusions

1. Arable land (51%) comprises the largest part in the rural landscape structure of the analysed part of Lithuania. The part of the agricultural farming land (2 %) on this territory remains uncultivated.
2. The mathematical analysis shows that use and location of cultivated land highly depend on land productivity.
3. The most of undeclared farming land is in the districts where land less favorable for farming is dominant.
4. The analysis of the period of last 10 years shows that the area of farming land decreased by 753 ha in Lazdijai district and by 194 ha in Vilkaviškis district but increased by 5.5 ha in Alytus district on average per annum.

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Vilma Sinkevičiūtė. Assistent at the Land Management department of Lithuanian University of Agriculture. Address: Universiteto 10, LT-53067 Akademija, Kauno distr. Tel. +370377523372, e-mail: vilma.sinkeviciute@gmail.com

ANALYSIS OF LAND PARCEL BOUNDARIES DEFINED BY CADASTRAL MEASUREMENTS

Giedrius Balevičius, Vaiva Stravinskienė
Aleksandras Stulginskis university

Abstract
Cadastral measurements of land parcels are conducted under the guidance of territory planning documents designed by resolutions of the Government of the Republic of Lithuania which in turn regulate the collection of real property cadastral data. However, not always boundaries of the measured land parcels correspond to the documents of territory planning and factual consumption of land. This problem becomes obvious when measuring agricultural land which is most frequently formed in land management schemes during the land reform. The aim of the research is to analyze the correspondence of land parcels after cadastral measurements to the documents of territory planning, identifying discrepancies between line lengths and areas of land parcels. Having investigated the correspondence of agricultural parcels to territory planning documents on the basis of the line lengths designed, it was found that higher line lengths occurred after conducting cadastral measurements. Having identified discrepancies between the areas of agricultural parcels and territory planning documents, one can make an assumption that significant differences could be noticed which manifest inadequacy existing in territory planning documents.
Key words: territory planning documents, areas of land parcels, cadastral measurements

Introduction

Territory planning is realized by applying general, special, and detailed planning. Cadastral measurements are undertaken by using territory planning documents whereas since 2014 land holding schemes have been used for this reason.

During the research the analyzed cadastral measurements were performed on the basis of the land reform land management schemes, which, according to the size of the planned territory and the extent of solutions specified are currently known as land holding projects. Cadastral measurements of agricultural land parcels are undertaken on the basis of the land reform land management projects, which up to 2004 were compiled in the form of old inaccurate cartographic material. Therefore, the most significant mistake made in the process of cadastral measurement was the formation of land parcels according to the preliminary data. For this reason discrepancies of land parcel boundaries, which coincided neither with project solutions nor factual use of land, occurred. While performing cadastral measurements of land parcels, frequently discrepancies of line length and area in the range of the permissible or not permissible correlation were reported. It occurred due to the fact that parcel boundaries were not marked by landmarks whereas field measurement drawings (abriss) were made not in the required quality (Vaitkevičienė ir kt., 2010; Živatkauskas, 2012). According to the current methodology of cadastral data quality regulation, specific errors of cadastral data were identified and they were corrected. However, it was time and money consuming. (Zakarevičius ir kt., 2007)

The **aim** of the article is to analyze the compliance of land parcels measured by cadastral measurements with documents of territory planning and land holding projects.

The following **objectives** were set:

1. To investigate the compliance of boundaries in agricultural parcels with territory planning documents in accordance with line lengths of land parcels.
2. To identify discrepancies of agricultural land parcels with regard to the documents of territory planning and land holding projects.

Methodology of research and materials

Analysis, comparison, and generalization methods were applied in the research. The comparison method was applied in order to define the compliance of territory planning documents and cadastral measurements with regard to areas and line lengths of land parcels. The object of the research is agricultural land parcels, randomly selected and located in various municipalities of the Republic of Lithuania, namely Raseiniai district municipality, Kaunas district municipality, Kalvarija municipality, Vilnius district municipality and Elektrėnai municipality (see Picture 1).

Plans of land parcels compiled during the land reform as well as temporary plans of land parcels and the undertaken cadastral measurements of land parcels were used during the research. The accuracy of

cadastral measurement data was verified comparing them with the data of territory planning documents of the parcels.

Fig. 1. Arrangement of the analyzed parcel territories in Lithuania.

Cadastral measurements of 14 plots were used for the analysis. These are land plots compiled at the scale of 1:5000 and 1:10000. During the analysis the accuracy of cadastral measurement data was verified, comparing them with the data of territory planning documents of the parcels.

The research part was composed of two stages. During the first stage differences of land parcel area and line length between the primary data (plans of land parcels compiled during the land reform) and currently undertaken cadastral measurement plans were defined. The second stage of the research contained verification of land parcel plans formed during the land reform conducted to estimate the validity of the plans. First of all, parcel boundaries were artificially adjusted according to line lengths of land parcels formed during the land reform. In addition, areas of land parcels were calculated and subsequently compared with the ones marked in the plans of land parcels formed during the land reform. In certain cases the data of line length were adjusted due to its absurdity and total discrepancy (it was assumed that the wrong length of lines was provided in tables or it was marked in the drawing incorrectly).

Plans of land parcels compiled during the land reform were formed using orthographic maps and other cartographic material. All plans were compiled at the scale of 1:5000 or 1:10000. The maximum error permissible within the area depended on the type of cartographic material, plan scale, and parcel area under the guidance of Real Estate Cadastre Regulations approved by the republic of Lithuania (Lietuvos..., 2005). Thus, the accuracy correspondence of undertaken cadastral measurements in land parcels to requirements was determined.

Discussion and results

While forming a land parcel as an object of the real estate, the compiled plan of the land parcel and collected cadastral data form the basis of a cadastral map. When marking the boundaries of the land parcel on the map and recording cadastral data into the real estate cadastre, errors may occur at any point of data storage and processing. When collecting cadastral data and measuring land parcels, errors may be found due to calculation, drawing, paper deformation, obsolete cartographic material used, poor quality of cartographic work, etc. Therefore the control of cadastral data of land parcels is required. (Jonauskienė ir kt., 2009; Balevičius ir kt., 2012).

The data obtained during the analysis (Table 1) illustrate the differences between the analyzed land parcel cadastral measurements and the primary data defined with regard to the area and the total line length. Moreover, it is estimated if the defined error of the area corresponds to the one permitted by the law. The following cartographic material was used during the research: orthographic maps were used when analyzing 7 objects (parcels 1-7) whereas, when analyzing the remaining 7 parcels (parcels

8-14), the other cartographic material was used. Orthographic maps are characterized by higher accuracy than other cartographic material. As a result, the maximum error permitted for the other cartographic material is higher. In practice orthographic maps are the main and most frequently used cartographic material.

The scale of cartographic material also influences the assessment of error accuracy: the higher the scale is, the higher the permitted error is. Finally, when identifying the maximum error permitted, one considers the area of the land parcel analyzed: the larger the parcel is, the higher the permissible error of the parcel is.

Table 1

The summary of the primary and current data of the parcels analyzed

Cartographic material used	Scale	Parcel number	Initial area ha	Specified area ha	Error of an area ha	Permissible error of the area ha	Total error of line length m
Orthographic maps	1:5000	1	0.54	0.54	0.00	0.02	-8.78
		2	0.70	0.68	-0.02	0.03	-37.11
		3	0.77	0.78	0.01	0.03	11.03
		4	0.78	0.78	0.00	0.03	-6.41
		5	4.10	4.10	0.00	0.12	-2.64
	1:10000	6	0.87	0.85	-0.02	0.05	0.37
		7	4.55	4.55	0.00	0.17	-9.52
Other Cartographic material		8	31.81	32.12	0.31	0.68	135.13
		9	6.00	6.00	0.00	0.24	-0.02
		10	6.81	6.88	0.07	0.26	134.54
		11	5.68	5.68	0.00	0.24	16.14
		12	5.80	5.80	0.00	0.24	-0.54
		13	27.94	27.94	0.00	0.53	44.54
	1:5000	14	1.50	1.47	-0.03	0.07	0.22

The research findings showed that the difference errors of the current area from the primary area in all parcels did not exceed the defined maximum permissible errors of land parcel areas. The highest area error was found in Parcel 8 where it was equal to 0.31 ha which constituted 46% of the maximum error permitted for this parcel. Seven parcels were discovered with the areas completely corresponding to the primary data. Parcel 2 contained the highest error. Its error of 0.02 ha constituted 67% of 0.03 ha error permitted.

It was noticed that differences between the current and primary areas in the objects analyzed were not as big as differences between total line lengths. The highest discrepancies in line lengths were discovered when analyzing Parcels 8 and 10. Exclusive discrepancies of line lengths explained the obtained high error of Parcel 8 measurement (Figure 2). However, the error of Parcel 10 area was lower whereas the total error of lines was very similar.

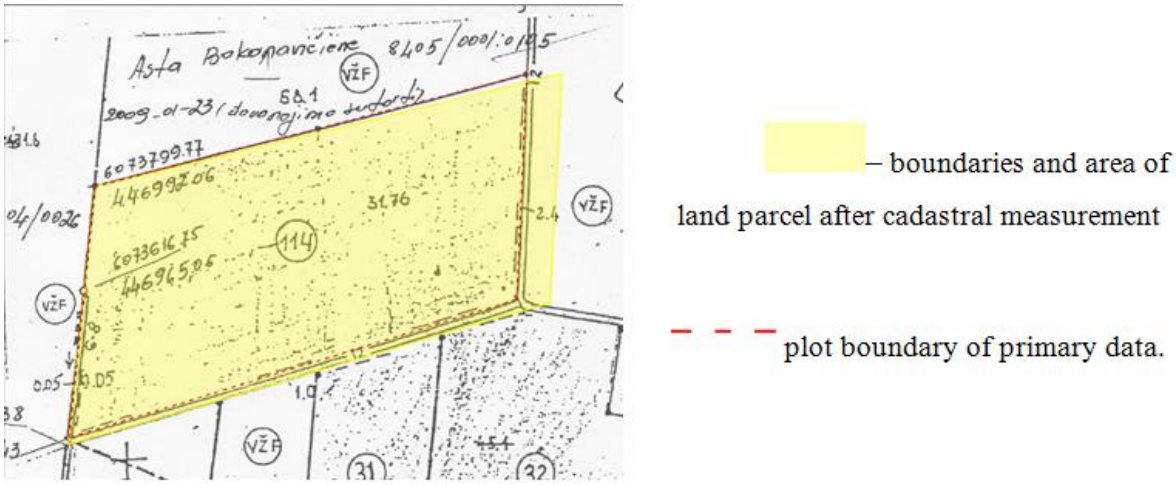

Fig 2. Comparison of primary and current measurement boundaries of Parcel 8.

Only Parcel 9 was measured rather precisely because its area corresponded to cadastral measurements while line lengths did not vary. This case is unique due to proportional geometric shape of the parcel. It does not contain triangles or polygon figures and for this reason measurements were undertaken in a very uncomplicated way. The cases where primary measurements were conducted so precisely were rarely found. The analysis of all 13 parcels showed that only this one could be regarded as accurately and correctly measured as well as containing a perfectly compiled plan. One must pay attention to the fact that different cartographic material was used the accuracy of which is lower than that of orthographic maps. In general, the analysis of six parcels, the defined area of which corresponded to the performed cadastral measurements, showed that they all had greater or lesser discrepancies of lines.

The analysis of cartographic material revealed that orthographic maps featured higher accuracy of defining the area than other cartographic material. With regard to the line length, it was difficult to identify which cartographic material was more precise. Excluding the largest parcels, which were characterized by the highest errors, orthographic maps were slightly more advantageous.

While comparing the accuracy of cadastral measurement data at different scales, causes for higher error to occur were not found and the scale of cadastral measurements performed affected only the identification of the maximum permissible error.

During the analysis, when verifying the primary data, parcel boundaries were adjusted according to distances defined. In addition, conditions to represent the primary data with maximum accuracy were provided. In some cases adjustment of line lengths was unavoidable. Otherwise parcel boundaries would not correspond to the reality or they were impossible to connect. The total results are illustrated by the summary of the primary measurement and specified data. (Table 2).

Table 2

Summary of the primary measurement and specified data in the parcels analyzed

Cartographic material used	Scale	Parcel number	Initial area ha	Specified area ha	Error of an area ha	Permissible error of the area ha	Total error of line length m
Orthographic maps	1:5000	1	0.54	0.54	0.00	0.02	0.02
		2	0.70	0.66	-0.04	0.03	-39.09
		3	0.77	0.78	0.01	0.03	23.84
		4	0.78	0.78	0.00	0.03	-6.41
		5	4.10	4.15	0.05	0.12	0.00
	1:10000	6	0.87	0.78	-0.09	0.05	-9.41
		7	4.55	4.50	0.05	0.17	0.00
Other cartographic material		8	31.81	29.12	-2.69	0.68	0.00
		9	6.00	6.00	0.00	0.24	0.00
		10	6.81	6.89	0.08	0.26	26.05
		11	5.68	6.03	0.35	0.24	0.00
		12	5.80	5.81	0.01	0.24	0.00
		13	27.94	26.36	-1.58	0.53	9.97
	1:5000	14	1.50	1.46	-0.04	0.07	0.00

The analysis of the obtained data revealed that specified Parcels 2, 6, 8, 11 and 13 exceeded the error permitted while Parcels 8 and 13 were characterized by the largest areas, the error of which was supposed to be the highest. Taking into consideration the fact that Parcels 8 and 13 were characterized by the largest areas, their error was supposed to be the highest. The situation was aggravated by the fact that their error exceeded the percentage standard with regard to errors of other parcels. It is obvious that during the collection of the primary data, technologies were not advanced and the accuracy of measuring large areas was low. Even nowadays measurements of such parcels do not avoid errors. The analysis of Parcel 8 in detail showed that artificial adjustment of its boundaries without changes in length resulted in 2.69 ha error of the parcel area. This outcome proves invalidity of the primary data. Parcels 2 and 10 were characterized by highest errors in line length whereas errors of their area were insignificant. The research findings showed that the dependence on the cartographic material type and scale used was very low. On the other hand, orthographic maps were slightly more precise.

The conclusion can be made that the primary data of parcels are full of errors. They can be related to personal factors, natural and weather conditions, inaccuracy of the equipment used or other reasons of

typical mistakes. It is irrational to use such plans and data. Special conditions to specify the data of plans compiled during the research must be provided or these plans must be replaced by new ones due to the frequency of errors found in the primary data.
Currently the practice of surveyors shows that is it problematic to coordinate the specified data of such plans because the coordinating institutions frequently give priority to preliminary or inaccurate measurements and require the total compliance with documents of territory planning, ignoring their inaccuracy or errors. In such cases newly prepared (specified) files are rejected during the process of coordination. The situations are considered absurd when on the basis of preliminary measurements, during which the length and area of sides were often rounded or, when the length of the parcel sides coincides, the present area of the plot defined differs from the initial one by exceeding the maximum permissible error, the inspecting institution rejects the adjustments until the facts proving errors are introduced. Thus, time of surveyors and customers is wasted and prestige of inspecting institutions suffers. In order to avoid it, more convenient and straightforward procedure of document coordination must be introduced.
Other researchers have the same result. The boundaries of land plots determined during preliminary surveys, followed by cadastral surveys, which are much more accurate, must be left at the same place. Boundaries must be fixed as they were determined during preliminary surveys. Ownership determining boundaries between contiguous lands is important. The western countries recognize that, where there is a visible boundary and where there has been actual uninterrupted ownership either in person or through ancestors in title for thirty years or more of the land extending beyond that described in the title and embraced within the visible bounds, the party who possesses it acquires the right to the land beyond their title (Gegieckaite, 2008).
The Association of Lithuanian Surveyors proposed to provide a possibility to solve such issues by coordinating specified adjusted intersecting parcel boundaries upon the agreement of owners. Inspection of the data in such parcels would solve the problems concerning the primary area and line length error abolishment by employing up-to-date measurement equipment and creating the general system of all parcel maps with more precise databases.

Conclusions

1. Having researched the compliance of agricultural parcels according to the line lengths projected, it was discovered that higher line lengths are obtained having performed cadastral measurements. It can be determined by numerous factors such as the position of the parcel and configuration in nature, neighbouring plots with co-boundaries, factual use of land or incompliance of territory planning documents with real measurements.
2. Current data (outcomes of cadastral measurements) with regard to the area of land parcels correspond to the primary data, not exceeding the error permitted. However, lengths of parcel boundaries strongly deviate from each other.
3. The dependence of errors on the cartographic material type and scale used is very low. Nevertheless, orthographic maps are slightly more precise. It was identified that primary plans of parcels compiled during the land reform were not valid.
4. When discrepancy of parcel boundaries occurs with regard to the cartographic basis of planning documents, legal conditions to specify design solutions must occur.

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Information about author
Giedrius Balevičius. MSc in Land Management, lector at the department of Land Management, Aleksandras Stulginkis University. Address: Universiteto g. 10, LT-53361 Akademija, Kauno r. Tel (837) 75 23 72, e-mail:gbalevicius@gmail.com
Vaiva Stravinskienė. MSc in Land Management, lector at the department of Land Management, Aleksandras Stulginkis University. Address: Universiteto g. 10, LT-53361 Akademija, Kauno r. Tel (837) 75 23 72, e-mail: Vaiva.Stravinskiene@asu.lt

APPROACHES OF CONSOLIDATION OF LAND PROPERTIES IN RURAL AREA OF LATVIA

Anda Jankava[1], Velta Parsova[1], Virginija Gurskiene[2]
[1]Latvia University of Agriculture, [2]Aleksandras Stulginskis University, Lithuania

Abstract
The article deals with land consolidation solutions in three rural territories of Latvia, creating perspective monolithic land plots in order to prevent land fragmentation and improve the structure of land properties. Although all three project territories are located in geographically analogical circumstances, established structure of land properties, their infrastructure and location in relation to Riga and other cities and towns prescribes different objectives of land consolidation. The proposed land consolidation methodology could be powerful tool in hands of local municipalities in order to promote development of to rural area in general, agriculture and other sectors.
Key words: land consolidation, land fragmentation, monolithic land plot, structure of land properties, land parcel.

Introduction

To create a legal basis for rational land use, sustainable development of the territory and land protection, balancing land use and land protection, as well as private and public interests in land use, in 2013 by Parliament of Latvia was approved 1st reading of Land Administration Law, where land consolidation is defined as one of measures of land administration. Land consolidation as powerful tool for rural development for many centuries is known in old Western European countries - Germany, Denmark, the Netherlands, Scandinavian countries and other parts of the world. Many of territory development activities in rural area of these countries are closely related to the solution of significant ownership problems and conflicts in land use. In many cases they are condemned to failure, especially if there is no land, or it is located not in the right place, or it is not available at appropriate area and shape. Solutions of transport infrastructure, surface water protection, development of biotope networks and tourism infrastructures, as well as development of rural environment and human settlements is not possible if is lack of the land for their arrangement. For this purpose it is necessary to find a property - friendly, socially sustainable and land - protective solutions (Leonhard, 2012). European spatial planning policy is no longer conceivable without land consolidation as a sustainable land use and rural development instrument. Current land consolidation in Western European countries has been used for more than 100 years. Accumulated experience can be useful for countries in transition, too, because for more than 50 years during soviet - agricultural collectivization period land consolidation was not essential. But since 1990 land consolidation again could be an important tool to improve the production conditions in agriculture and forestry, as well as to improve results of land reforms in these countries. Therefore, land consolidation again is in order of the day of many governments (Thomas, 2012; FAO, 2003; FAO, 2004; FAO, 2008). On issues of opportunities and objectives of land consolidation have been focused many of Western and Eastern European scientists (Thomas, 2012; Demetriou, 2014; Vitikainen, 2004; Maasikamae, 2005; Horjan, 2005; Pasakarnis, Maliene, 2008, etc.). Also, for the results to be achieved are many publications describing economic, social and environmental consequences of land consolidation. Although in general objectives and tasks of land consolidation in all countries are similar, each country has developed or is developing own land consolidation system, methods and procedure of its implementation. It may be based on historical experience, effects of land reform, structure of land properties and other conditions. Currently in Latvia is going on preparation to start this process. Comparing with neighboring country Lithuania, where due to methodological assistance of Danish colleagues and financial support of EU was implemented large number of land consolidation projects, in Latvia proposals of foreign experts to initiate land consolidation for solutions of land reform results problem did not have meet considerable attention. There can be variety of objective and subjective reasons – lack of normative base and financial resources, uncertainty about benefits of land consolidation, etc. Several Latvian authors have investigated theoretical issues of land consolidation, evaluating its preconditions, as well as offering solutions for land consolidation implementation (Platonova D., A. Jankava, 2011; Parsova V., Kapostins E., 2012). Necessity of land consolidation is required by inconvenient farm structure and land fragmentation, which leads to reduced efficiency of agricultural production and have a negative impact on the income of the rural population (Pasakarnis, Maliene, 2008). The number of land

properties in rural area of Latvia over the years is growing, but average area of the farms is decreasing (Table 1).

Table 1

Number and area of land properties (2001 - 2012)

Indicators	Units of measurements	Years		
		2001	**2006**	**2012**
Number of land properties according to their total area	thous.	251.3	269.3	313.8
Average of total area of land property	ha	14.5	15.1	12.3
Average of farmland of land property	ha	9.2	8.8	7.3

Source: author's calculation according to data of State Land Service

Data of Central Statistical Bureau show that in period 2001 - 2010 number of farms has decreased even for 54 % (from 180.3 thous. to 83.4 thous.), but their average area according to farmland area per farm has increased for 87 % (from 12.4 ha in 2001 to 23.2 ha 2010). Data show that farms still are small and fragmented.

Due to widespread fragmentation and growing importance of rural area for implementation of non-agricultural projects, land consolidation can be an important element in strategies and projects which are aimed to improve the quality of life in rural area through more efficient management of natural resources and environment protection, creating infrastructure and job opportunities, providing services and improving living conditions in rural area (The Design of ..., 2003). In this context, land consolidation can become an effective tool not only for land fragmentation problems, but also for sustainable rural development in a broader context.

Up to now land consolidation in Latvia is not putted into practice, although concept of land consolidation is defined in the Land Survey Law and established as one of the land survey activities. In the draft of Land Administration Law land consolidation is defined as *a set of measures which include rearrangement of land parcel boundaries and change of land ownership rights in order to improve use of the land*. Land consolidation should be carried out in the following cases:

- to improve the structure of farms;
- for rational use of natural resources;
- for improvement of infrastructure;
- for public needs;
- for elimination of inter-areas (Land management ...).

In framework of this article is presented a possible land consolidation solution in three local municipalities of Latvia: municipality territories Tervete, Iecava and Olaine. The land consolidation projects are planned as thematic spatial plans. According to the legislative acts thematic spatial plan is observed as one of the spatial planning documents, the main objective of which is to provide compliance of real properties to planned perspective land use (Teritorijas attīstības plānošanas..., 2011). It is envisaged that the land consolidation project for economic development of the municipality would be initialed by local municipality. It would be a basis for improvement of land property structure throughout the municipal territory or just in a part of municipal territory.

Methodology of research and materials

This article offers proposals for solutions of land consolidation in three local municipality territories, using methodology of land consolidation in order to prevent fragmentation of the land, which is described by V.Parsova and E.Kapostins (Parsova V., Kapostins E., 2012). This methodology is based on the condition – if landowner owns several land parcels, which are included in one or several land properties, and these land parcels have no common boundary, should be featured (designed) so-called *monolithic land plots,* which can be divided into existing and perspective monolithic land plots.

Existing monolithic land plot is untedly used territory, which is formed of one land parcel or set of several land parcels, which have common external boundary. All land parcels are adjacent to each other, or they are not adjacent to each other, if they are separated by municipal road. Existing monolithic land plot can consist of:

- land parcels owned by one person, but included in several land properties;
- co-owned land parcel, if any of co-owners in the some time is co-owner of the adjacent land parcel, which is included in other land property.

Perspective monolithic land plot is defined as land owned by person, together with additional territory owned by other persons and included in perspective land property. Perspective monolithic land plot may consist of several land parcels with different ownership rights. The goal of design of perspective monolithic land plots is to create a land plot with compact shape (configuration) and land area that would be suitable for use in compliance with planned perspective land use (Parsova V., Kapostins E., 2012). In land consolidation project are designed perspective monolithic land plots, but in some cases can be rearranged existing monolithic land plots, too.

Perspective monolithic land plot is designed within the frame of particular type of land use. All land parcels, included in perspective monolithic land plot according to the territory plans have to have the same intended use of the land.

For designing of perspective monolithic land plots are chosen territories as follows:

- which are characteristic by fragmented property structure – land parcels owned by the some person have no common boundaries;
- where existing property structure does not match with intended purpose of land use – territories are not suitable for use in compliance with planned perspective land use;
- further use of which could be affected by development and construction of new public infrastructure, planned by local municipality.

Development of land consolidation project and design of perspective monolithic land plots have to be done gradually, following to certain priorities. Perspective monolithic land plot can form territory which includes a number of land parcels, and each land parcel may be owned by different persons. Therefore each perspective monolithic land plot should have its subject. *Subject of perspective monolithic land plot* is owner of main land parcel included in perspective monolithic land plot.

As *main land parcel* is defined land parcel, where around is provided creation of perspective monolithic land plot. As main land parcel of built-up perspective monolithic land plot is defined land parcel, where are located constructions. Setting priorities and order in which perspective monolithic land plots are connected with subject of perspective monolithic land plot have to be distinguished between two types of perspective monolithic land plots – open and built-up monolithic land plots.

Designing *built-up monolithic land plot* the first priority is given to landowner who lives in a building on the land parcel and uses the land in compliance with planned perspective land use. Whereas the second priority is given to landowner who does not live in the building on the land parcel but uses the land in compliance with planned perspective land use. Priority always have to be given to the subject of perspective monolithic land plot who uses its land in compliance with planned perspective land use. In those cases perspective monolithic land plot have to be created next to the farmstead.

Designing *open monolithic land plots* the first priority again is given to landowners who use their land in compliance with planned perspective land use. As main land parcel of open monolithic land plot have to be chosen either the largest land parcel or land parcel for which are received EU support payments. At the same conditions priority have to be given to the person ownership rights of which is restituted, as well as to person, which receives EU support payments.

Designing perspective monolithic land plots in municipality territories Tervete, Iecava and Olaine were set up a condition that one landowner can have not more than three monolithic land plots. For development of land consolidation projects were used textual and spatial data (cadastre map) of Cadastre information system, as well as for better evaluation of the situation were applied data of Geospatial Information Agency - orthophoto maps. Some information, for example, information on leasehold was acquired from local municipalities.

Discussions and results

All three municipality territories are located in the middle of Latvia, lowland of Zemgale, where the soil is suitable for agriculture (Fig. 1).

Fig.1. Disposition of municipality territories Olaine (1), Tervete (2) and Iecava (3) in Latvia.

However, situation in land use in each of them is different, which is affected by disposition of municipality territories in regard to capital of Latvia - Riga and other cities and towns, as well as by traffic lanes crossing mentioned territories. Different in all three municipality territories is proportion of farmland - in Tervete farmland makes up 71% of total area of municipality territory, but in Olaine - only 16% (Table 2).

Although the main condition of land consolidation in all municipality territories is the some – formation of perspective monolithic land plots, land consolidation solutions in each municipality territory is different because it is influenced by characteristic feature of each municipality from point of view of their disposition, area of farmland and developed property structure.

Table 2

Land area and its proportion in municipality territories Olaine, Tervete and Iecava on 01.01.2012

Category of types of land use	Municipality territories					
	Olaine		Iecava		Tervete	
	area, ha	% of total area	area, ha	% of total area	area, ha	% of total area
Farmland	4611.9	16	14210.3	46	6592.4	71
Forests	16056.4	55	13384.1	43	1885.3	20
Other	8452.8	29	3540.7	11	806.2	9
Total area	**29121.1**	**100.0**	**31135.1**	**100.0**	**9283.9**	**100.0**

Source: author's calculation according to data of State Land Service

Municipality Olaine has very advantageous geographic location. Olaine town together with rural area is located on the midway between Riga city (23 km) and Jelgava town (21 km). Territory consists of two geographically separate parts – main part around Olaine town and territory of summer cottage village Janupe, which have no common boundary. Municipality territory is crossed by transit and communication infrastructure, there is a well- developed road network, as well as railway. There are located build up territories – 47 gardening societies where buildings are used for permanent living, and 21 village. Often landowners are interested to subdivide their land mostly for construction of private residential houses. Such tendencies have been observed not only in populous areas but also in the rural area. Building mode in the villages is different. In villages located close to the auto road Riga – Jelgava is allowed to construct not only dwelling houses but commercial or mixed commercial and industrial buildings, too, mainly warehouses, distribution centres, etc. At the same time in Olaine direction is going on expansion of industrial zone of Riga. It is determined by advantages of geographic location of municipality Olaine – nearness to major transport roads, the Riga port, Riga airport and the centre of Riga city. Although farmland in municipality Olaine is relatively less than the other two municipalities, there are registered more than 450 farms with total land area about 3900 ha and more than 500 household plots with total land area 1700 ha (Olaines pagasta teritorijas..., 2008).

Before development of land consolidation project was analysed existing real property structure, existence, availability and location of infrastructure, natural and artificial barriers (roads, railways, rivers and other elements) which encumber management of properties. It was also existing property structure compared with planned (permitted) land use and assessed possible land use in future. After analysis it was determined that perspective monolithic land plots in municipality Olaine have to be formed for three objectives:

- development of agriculture;
- development of industrial zones;
- in some places for development of private residential houses.

Comprehensive assessment of ownership structure and possibilities to form monolithic land plots in land consolidation project hawe been included 278 land parcels owned by 136 landowners, including:

- 62 landowners who own several land parcels which are included in one or several real properties and are separated one of another (there are not formed monolithic land plots);
- 8 landowners who own several land parcels which are included in one or several real properties but are adjacent one to another (there are formed monolithic land plots);
- 66 landowners who own one land parcel, mostly it is unmanaged, abandoned land.

Area included in the project is 1993 ha - 34% of agricultural land in municipality Olaine.

Municipality Iecava is located in central part of Latvia, its administrative center is located 45 km from Riga city, 30 km from Jelgava town and 21 km from Bauska town. Municipality territory is crossed by dense and well- developed road network – from the north to south it is crossed by auto road Riga - Bauska, which is section of international highway Via Baltica. There are located well- developed water supply, sewerage and wastewater treatment systems, as well as number of gas pipelines of international and national importance. The most developed sectors are agriculture and related to it industrial production, processing of agricultural products, forest exploitation and processing of timber. Main sector of agriculture is crop production, not a lot – cattle breeding, but also are developed other specific sectors - beekeeping, horse breeding, gardening, as well as non-traditional agriculture – breeding of ornamental birds, rabbits, deers, etc. Overall, in the municipality are registered 260 farms.

In land consolidation project were included 530 land parcels owned by 216 landowners, area included in the project is 4560 ha or 23% of agricultural land in municipality Olaine. 53.7% of the landowners have the land area of which is less than 10 ha, but its total land area is only 11% (Table 3).

Table 3

Breakdown of land properties and intervals of land area
included in the land consolidation project in Iecava municipality

Interval of land area, ha	Land properties		Total area	
	number	%	ha	%
0-5	67	31.0	156.2	3.4
5-10	49	22.7	347.8	7.6
10-25	63	29.1	1026.2	22.5
25-50	16	7.4	528.4	11.6
50-100	13	6.0	929.1	20.4
100-200	4	1.9	502.6	11.0
200-400	4	1.9	1069.8	23.5
Total	**216**	**100.0**	**4559.8**	**100.0**

Source: author's calculation according to data of State Land Service

The data in Table 3 show that in Iecava municipality there are a lot of small land properties and property structure is relatively fragmented.

Territory of *municipality Tervete* has very favourable conditions for agricultural production. Implementing drainage on 90 % of total area of farmland have been established not only proper moisture regime of the soil, but also created fields of large area with good technological qualities, furthermore length of cultivation belt is 1000 m and more. The land is well cultivated and crop productivity is highest in Zemgale lowland but production cost per production unit is lowest in the country. Really all farmland is under production, main type of land use is crop production. Municipality Tervete differs from other two municipalities with the fact that the land is managed by several large agricultural companies. The largest of them is joint-stock company "Agrofirma Tervete",

which manages about 3000 ha of land, 2/3 of which has ownership status but the rest is leasehold land. There are two agricultural companies, each of them is managing more than 1000 ha, but most area of the land is leasehold land. Besides there are several farms, which are managing about 100 ha. As the biggest problem farmers distinguish fragmentation of farmland which makes agricultural production more difficult and inefficient.

In land consolidation project were included 153 land parcels with total area 2000 ha owned by 9 landowners. Since there are located large agricultural companies, in frame of the project was also taken into account land of leasehold, too, which makes considerable part of the managed area. Agreement on leasehold usually is sign for long term (more than 5 years, in some cases over 15 years), therefore land of leasehold can be included in land consolidation project. Thus, total area of land consolidation project in Tervete municipality was 3458 ha consisting of 57 existing monolithic land plots (Table 4).

Table 4

Number of land properties, included in land consolidation project in Tervete municipality

Number of property	Owned land parcels		Leased land parcels		Total area, ha	Number of monolithic land plots
	number	area, ha	number	area, ha		
1	11	75.4	3	39.5	114.9	7
2	3	10.6	-	-	10.6	3
3	4	61.9	-	-	61.9	4
4	7	66.0	-	-	66.0	3
5	3	61.0	-	-	61.0	2
6	87	1275.9	26	612.5	1888.4	19
7	7	164.3	13	300.5	464.8	4
8	5	83.1	-	-	83.1	4
9	26	203.8	20	503.1	706.9	11
Total	**153**	**2002.0**	**59**	**1455.6**	**3457.6**	**57**

Source: author's calculation according to data of State Land Service

Surveying the territory included in land consolidation project and evaluating structure of existing land properties, is established a fact that land of agricultural enterprises, especially of largest, consist of several land parcels which are mutually distant, with inconvenient external boundaries, as well as disadvantageous shape for mechanised machining. Land fragmentation encumbrances agricultural production and landowners are not interested to cultivate all owned land therefore part of it remain unmanaged. Position of authors is that for best land management to one landowner has to be formed not more than 2 - 3 monolithic land plots.

Based on the methodology (Parsova, Kapostins, 2012), perspective monolithic land plots in all three municipalities were formed gradually, step by step. In beginning was chosen main land parcel as the basis for formation of monolithic land plot, after were determined external boundaries of monolithic land plots including necessary land parcels. External boundaries were determined taking into account existing in the field infrastructure (roads, buildings, etc.), location of drainage systems and other natural elements. There was observed the initial requirement - to one landowner to form not more than 3 monolithic land plots.

Forming monolithic land plots by exchange of land parcels or their parts was achieved relatively good results. In Olaine municipality to 128 landowners the land was formed in one monolithic land plot and to 8 landowners – in two monolithic land plots. In Iecava municipality carrying out land consolidation process was almost doubled (for 88%) number of land properties which are included in one monolithic land plot. Only 16 land properties, instead of former 80, are included in two monolithic land plots and only 6 land properties - in three monolithic land plots. Also in Tervete municipality instead of 57 existing monolithic land plots were formed 15 monolithic land plots, int.al. to 6 landowners the land was formed just in one monolithic land plot (Table 5).

Table 5

Number of monolithic land plots in Olaine, Tervete and Iecava municipality before and after land consolidation

Number of monolithic land plots	Number of land properties in land consolidation project					
	Olaine municipality		Iecava municipality		Tervete municipality	
	before	after	before	after	before	after
1	74	128	103	194	-	6
2	47	8	80	16	1	-
3	8	-	16	6	2	3
4	3	-	7	-	3	-
5	2	-	1	-	-	-
6-10	1	-	5	-	1	-
10-20	-	-	3	-	2	-
>20	-	-	1	-	-	-
Total	**136**	**136**	**216**	**216**	**9**	**9**

Source: author's calculation according to data of State Land Service

Conclusions and proposals

1. Assessing results of land consolidation in aspect of formation of monolithic land plots in Olaine, Tervete and Iecava municipality can be concluded that such project can facilitate development of local municipality and use of land in accordance with planned purpose of use.
2. Land consolidation projects can be developed for needs of different purposes taking into account existing situation, structure of established land properties and agriculture enterprises, as well as other conditions.
3. In order to carry out land consolidation it is necessary to evaluate structure of existing land properties and determine need for land consolidation in order to solve imperfections of their territorial location.
4. Land consolidation, promoting development of territory of local municipality and agricultural sector, have to be included in spatial planning process in order to improve the structure of land properties.
5. In order to facilitate the effective and efficient use of land local municipality having determinant role in spatial planning have to be involved in land consolidation process.

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Information about authors

Anda Jankava, Dr.oec., professor at Department of Land Management and Geodesy, Latvia University of Agriculture. Address: Akademijas 19, Jelgava, LV-3001, Latvia, phone: +37129356448, e-mail: Anda.Jankava@llu.lv. Fields of interest: land management, land consolidation, land reform.

Velta Parsova, Dr.oec., professor at Department of Land Management and Geodesy, Latvia University of Agriculture. Address: Akademijas 19, Jelgava, LV-3001, Latvia, phone: +37129118285, e-mail: velta@parsova.lv. Fields of interest: real property cadastre, real property formation, land administration and land management, land consolidation, land reform.

Virginija Gurskiene, Doctor of technology science, docent. Institute of Land use planning and geomatics. Water and land management Faculty, Aleksandras Stulginskis University, Lithuania. Adress: Universiteto g. 10, LT-53361, Akademija, Kaunas district, Lithuania. E-mail: virginija.gurskiene@asu.lt Fields of interest: real property cadastre and register, land use planning.

COMPARISION OF LAND REFORM OF LATVIA AND RUSSIA IN CONDITIONS OF TRANSITION PERIOD

Vivita Baumane[1], Olga Pasko [2]
[1] Latvia University of Agriculture, [2] Tomsk Polytechnic University

Abstract
For many centuries land relations in the territories of Latvia and Russia have been developed by different influences of different foreign forces. The comparison of orientation and dynamics of the land reform in countries with similar initial parameters allowed analyzing the impact of changes in property relations on activities of farms, their productivity, involved costs and the benefits. The main conclusion is that the land reforms in Latvia and in Russia were not the main objective of agricultural land use saving and development of agricultural enterprises.
Key words: land reform, land use, agricultural enterprises.

Introduction

For many centuries land relations in the territories ofLatvia and Russia have been developed by different influences of different foreign forces.
The Saeima of the Republic of Latvia in the session on July 22, 1940 accepted the "Declaration on Land Proclamation as National Estate". The Saeima proclaimed all the land with its riches, forests, lakes, rivers as national or the state's property. Latvia and Russia from 1940 till 1990 were included in the Soviet Union, therefore there was a common legal basis for land use and agricultural enterprises (Zemes reformai Latvijā, 2000).
The land reform of Latvia in 1990 was one of the cornerstones of the political stability and the independence. No other reform, no further enacted law has been as comprehensive and influencial on each person's life in Latvia and Russia as the land reform.
The need for land reform in Latvia and Russia was caused not by the progressive development of successive economic relations, but by the tensions of political and socio-economic situation in the countries.
On November 21, 1990 the Supreme Council of the Republic of Latvia adopted the law "On Land Reform of the Republic of Latvia in Rural Territories" known in history as the first law of economic reforms which regulated the right to acquire real estate after May 4, 1990 (Zemes, mana, tava.. 2002).
The land reform of Russia was performed using methodologies and recommendations of the World Bank. It was assumed that the creation of conditions for equal development of different forms of agricultural enterprises' management, the formation of a mixed economy based on diversity and equality of different forms of ownership of the land, the development of market structures and competition will provide self-regulation of land relations and optimize the use of land resources (Czaki, Nash, 1997).
The aim of article is a comparative study of the mechanisms and outcomes of the land reforms in Latvia and Russia. The research objectives of article are:
1. Compare the legal basis of the reforms.
2. Analyze general and specific features of these processes.
3. Compare the results of reforms.

To solve the research objectives, the following research methods were used: *the monographic descriptive method* in the research of historical development, theory aspects and problem elements and *the empirical research method* to develop general statements from separate facts and to determine regularities.

Methodology of research and materials

The research was chosen to analyze the process of the land reforms in Latvia and in Russia. For the analysis normative acts of the land refors were selected. The previous research and the authors' opinions were taken into account. This study uses publicly available data on agricultural land use in Latvia and in Russia.
Applying scientific research methods (*monographic descriptive method* and *empirical research method*) common and different features of the land reforms were assessed.

Discussions and results

The research analyzes and evaluates the laws that regulate (govern) agricultural activities in Latvia. These laws can be divided into three major grups: land use and agricultural production supporting legislation; laws that restrict land use; laws that regulate the land use. According to the Agricultural law, it is intended to promote support for the rational land use in Latvia by promoting: improvement of agricultural land, by co-funding drainage and sewerage system reconstruction and renovation, as well as liming of acid soils. Crops Development Support Programmes which co-finances sown areas, new fruit and berry orchards, seed production and covers the industry risks; modernization of agricultural production process; biological and non-agricultural development; other financing programs.

In Russia the main emphasis was with collective forms of land use on the individual (private owner, farmer) methods of radical liberal or command-administrative. The phrase "farmer will feed Russia" became the reform slogan and the incentive - aspiration to reach the western level of production. By the level of the capital-labor farms the United States surpassed the Russian collective farms by 4 - 5 times and installed capacity by 5 - 6 times. A farmer in the West in the process of high technological production takes possession of 20 - 25 professions, while a farmer in Russia trained only in 2 - 3 professions (Петриков 1998: 12). It was considered that the high level of competition in the market will induce commodity producers to continually improve technology and qualifications and, consequently, there will be an increase in labor of productivity and efficiency.

The reforms started in the 90s of the previous century from different starting points: in Latvia small commodity agricultural production dominated, in Russia - cooperative forms of management (the share of state and collective farm co-operative sector production amounted to 72%, while private farming – to 28%) (Иванюга, 1999). Mechanism of the land reforms in Latvia and Russia are described in Table 1.

Table 1.

National characteristics the mechanism of realization land reforms in Latvia and Russia

Latvia	Russia
The transition from the land nationalization to its denationalization, privatization of land, decentralization of ownership of the land. Multiple forms of ownership: physical persons; legal persons; municipalities and state.	The transition from the land nationalization to its denationalization, privatization of land, decentralization of ownership of the land. Multiple forms of ownership of the land: private (individual, total lobar and total joint); private - physical and legal persons; state, which is divided into federal property and property subjects of Federation, municipal, other forms of ownership.
From 1989 till 1990 – to exit from the collective farm (state farm), the consent of its members with the land allocation of the reorganized farms is not required. Provides for the establishment of peasant farms by allocating workers of collective farm and state farms with their shares of land and property.	To exit from the collective farm (state farm) the consent of its members with the land allocation of the reorganized farms is also not required. Provides for the establishment of peasant farms by allocating workers of collective farms and state farms with their shares of land and property.
Land reform legislation does not impose restrictions on who may be owner of agricultural land.	People access to land resources; do not have relations of collective farm and state farms production. Significant differences in the formation of government support for land owners as independent commodity producers.
Workers of collective farm and state farms obtained the land in usage in the first part of the land reform, but in second part - in ownership.	Workers of collective farm and state farms obtained in ownership land share of agricultural land from reorganized farms. Other categories of citizens' land is given from the agricultural land of district fund.
-	In accordance with the Law "On land turnover importance of agriculture" citizen is permitted to redeem the property that does not exceed 10% of the area of farmland administrative district. Land share does not depend on the length of employment, labor contribution.
Financial support - privatization certificates, paysteps; Mortgage and Land Bank of Latvia	Financial support - Agricultural Bank of Russia

Latvia	Russia
-	Terms allocation area - 1 month
Land owners are physical and legal persons, the state and municipalities. Possible to lease land for a fee from the owner.	Abolished the state monopoly on the land. Made the transition to multiple forms of land ownership. Land redistributed in favor of citizens.Established use of land in return for payment.

The land reform in Russia started in 1990 was not implemented due to the lack of funding. In the framework of the Federal target program, the land reform has been provided with a significant amount of work in 1999 - 2002, which was also not performed due to lack of funding. Since 2002 the development of documents started to form lists of the land for which the Russian Federation, subjects of the Russian Federation and municipal ownership have the right of ownership for the purpose of state cadastral registration of these sites for the demarcation of state land ownership (Волков, 2007).

In reality the land reform in Russia only exacerbated the economic crisis, led to the ruin of many agricultural enterprises and the reduction of sown areas and decrease in soil fertility. Russia lost 1/3 of its internal market. Food production limit led to the absence of reserves of productive land, progressive soil degradation, increasing bends of productive land for non-agricultural purposes, the increasing cost of energy and fertilizers, deficiency of fresh water. Agriculture has become more and more energy intensive due to application of fertilizers, pesticides, etc. A part of arable land (20 - 40%) has overgrown with shrubs and is out of use.

The focus on the development of farming in Russia was not justified. The main areas of the land belonged to the state and municipalities owners. Peasants showed great interest in the field of family farming (private farms), getting help from the main existing collective farms ((land allotments, food, machinery, fertilizers, seeds, etc.).

Unlike the participants of the market relations and efforts to achieve maximum efficiency, owners of private farms avoided self-production keeping in mind high risks and uncertainty of the agricultural market. The main purpose of private farms became ensuring the social protection.

Results of nearly 15 years of the reform have revealed its low efficiency in Russia. The area of farmland decreased by 14% (30.5 million hectares) (Fig.1.), production in all categories of farms - 40% (90 million rubles in 1991 prices) (Индикаторы рынка земли, 2013).

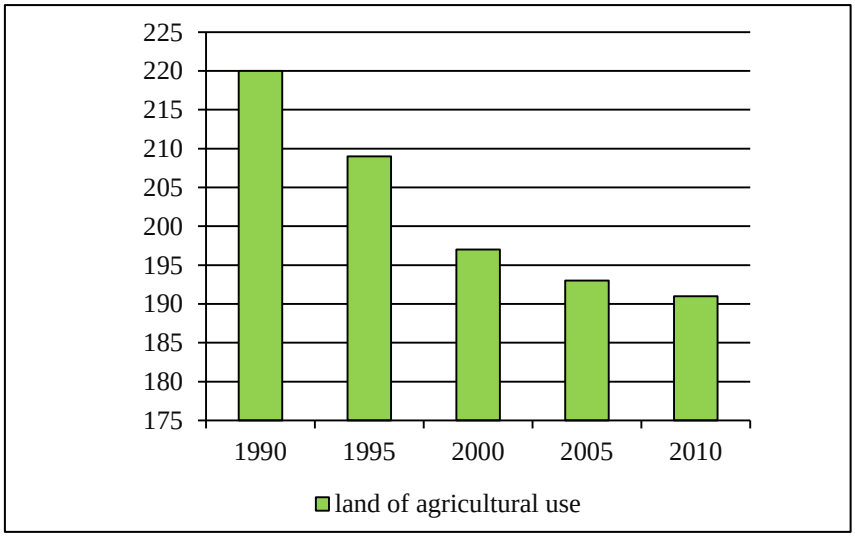

Fig.1. Changes of land of agricultural use in Russia during the years of the reform, million hectares.

As regards Latvia, year after year the fields of Latvia became deserted not only of people, but also of the farms. Every year the number of farms have been decreasing by several thousand in Latvia (Desmit gadu laikā…,2014). If in 2003 there were about 133,000 farms, now there are only 83,000. This is demonstrated by the data of the agricultural land use changes (Table 2.). In the period of the last hundred years agricultural land use has decreased by more than 1,000 hectares in Latvia.

Table 2.

Changes of land of agricultural use in Latvia, thousands hectares

	1913	**1935**	**1989**	**2000**	**01.01.2014.**
Total Land of agricultural use	3,633.8	3,770.5	2,568.7	2,486.0	2,376.7
including:					
arable land and orchards	1,729.6	2,113.7	1,721.0	1,880.3	1,726.6
meadows	910.2	905.3	236.0	233.8	231.8
pastures	994.0	751.5	611.7	371.9	418.3

Agriculture Organization of the Cooperation Council is concerned that in the near future even 60,000 farms could suspend their activities.

There are several reasons for reduction of the number of agricultural farms - small farms are joined to the large farms, people leave homesteads. Small and medium-sized farmers are worried about this development and consider that soon smaller rural municipalities will have only two or three large farms and fields will become abandoned land.

Accidental people registered as farmers, having large areas of land with agriculture machinery and equipment. Sometimes the means of production and land were obtained by deceit and "for free", afterwards being sold with great profit; agricultural land was used for building cottages.

The efficiency of the use of land and the productivity of labour in agriculture of European countries is 5 - 7 times higher than its level of Russia. Experts consider that the land resources in Russia are undervalued at least by 3-5 times. Researchers of the Agricultural Academy of Russia has estimated that the development of agricultural production in Russia has been thrown back: the number of cattle - more than a quarter of a century back, the land productivity - 25-30 years back, machinery and equipment - almost half a century back (Петриков, 1998).

General Guidelines of the Development of Agricultural Enterprises from 2014 till 2020 in Latvia are as follows (Lauku attīstības politika, 2014): increase of income from efficient production, increase of value-added and market-oriented products, small and medium-sized farms' support (cooperation, education, niche products, employment outside the agriculture), the support of family farms, which are able to earn and provide for their family, each hectare of of agriculture land, forest and private waters could be used for value creation, development of science and education.

Conclusions and proposals

1. 15 years have shown that the proposed models have not been implemented in Russia ignoring the objective realities, the absence of material, organizational and financial resources, the proper development of agricultural science.
2. The emphasis on the development of farms has not justified itself.
3. In Russia, collective farms in active cooperation with private farms have become the main producers of agricultural products.
4. The land reform envisaged the return of the agricultural land to its former owners or their heirs rather than the cultivation of agricultural land and development of agricultural enterprises.

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Information about authors

Vivita Baumane, Dr.oec., associate professor, Latvia University of Agriculture, Faculty of Rural Engineering, Department of Land Management and Geodesy. Street Akademijas 19, Jelgava, Latvia, LV-3001, +37163026152, vivita.baumane@llu.lv , Fields of interest – agrarian economics, land use, land degradation, assessment of real property, market of real property.

Olga Pasko, professor, Tomsk Polytechnic University, Institute of Natural Resources, Department of Geology and Land Management, Lenin Avenue 30, Tomsk, Russia, 634050, +73822563605, helgapas@mail.ru, Fields of interest - rational and efficient land use resources, land reform, land management.

CONSULTING EDUCATION IN MODERN LAND USE PLANNING

Tetyana Kalna-Dubinyuk[1], Alexander Isachenko[2],
[1]National University of Life and Environmental Sciences of Ukraine, Kyiv
[2] State University of Land Use Planning, the Russian Federation, Moscow

Abstract
Consulting is a catalyst for scientific and technological progress in agriculture, promotes the dissemination of new knowledge, and is quite reasonable and necessary in the current socio and economic conditions. Organization of a system of land use planning - one of the main areas of regulation of land relations in the ongoing land reform. Training of specialists in the field of land use planning should include consulting and component for diffusion of innovation in achieving sustainable development of territories and effective use of agricultural land. The article concentrates on experience in consulting education at the National University of Life and Environmental Sciences of Ukraine and its using based State University of Land Use Planning in Moscow.
Keywords: training, consulting, education, land use planning.

Introduction

Universities today, as the institutional component of society, are the main carriers of innovative development of the nation. Today agriculture require high-level professionals who have not only expertise, but also are able to make strategic and tactical innovative solutions, identify promising scientific developments and implement them in land use planning. To do this we need to develop information and consulting activity that is associated with the preparation of expert consultants in this area. In Ukraine consultant's education organizes by universities and consists of basic and advanced training programs. To ensure the quality of consultants to apply scientific and methodical approach, the main components of which are: diagnosis - definition of training needs, planning - definition of training programs and basic disciplines; motivation - to create learning environment with pleasure; methodical - choice of best practices and training tools; resource - teachers and materials; result - abstracts, graduation work. Distributed distance learning system, video films are being developed interactive consulting system and electronic consulting system (e-Extension).

The purpose and objectives of the research is to show the role of consulting education, its characteristics and prospects for the development of land use planning.
Considerable contribution to the understanding of the theory and its consulting and educational programs have made many foreign and domestic scientists, including Calvert Makkhem, Milan Courbet, William Riviera, Rolker Hoffman, Van Den Ben, Stanley Johnson, R.K. Yuksvyarov, A.P. Posadsky, E.A. Utkin, V. M. Koshelev, M.F. Kropyvko, N.M. Borodina, etc.
However, consulting education requires further implementation of the program's training in various specialists including land use planning.
The theoretical and methodological background of the research constitute the dialectical method of cognition, systematic approach to the study of land use planning consulting processes and special methods such as historical and logical - the study of the evolution of the consulting business continuity solution and its problems; abstract and logical - for theoretical synthesis and report writing.

Methodology of research and materials

Consulting is a process of intellectual activity of professional consultant that generates recommendations for making science-based decisions regarding the management and operation of an agricultural enterprise. Different countries have their name of consulting services and legal definition. In Ukraine consulting service in agriculture received the name as advisory service - according to the Law of Ukraine "On Agricultural Advisory Services", adopted on June 17, 2004.
In world practice, agricultural advisory system formed usually with the support of the state as one of the key mechanisms to implement the state agricultural policy in place that provides the link between science, education and industry in innovation, the dissemination of agricultural knowledge and information.
The study showed that the development of land use planning requires expert advisors and advisors who have professional training. Inclusion a consulting education in the program for training land users

based on a generalization and systematization of modern international experience in developing joint training programs and in-depth practical training based on advanced domestic and foreign enterprises.
The Law of Ukraine «On Agricultural Advisory Services» refers to the training of advisors and expert advisors - consultants. The Law stresses that training consultants consists of learning the basic training program and training at higher education institutions is carried out on the orders of the central executive authority on agricultural policy, consulting services, self-regulatory organizations, etc.
National University of Life and Environmental Sciences of Ukraine became one of the first agricultural institutions of higher education, which has been working in the direction of education, research and consulting (extension). It was established the Department of Extension, developed training programs for Bachelors and Masters in extension, training agricultural advisers and expert – advisers - consultants. (Kalna-Dubinyuk, 2008).
Thus, the Department has developed new courses in the core disciplines : "Fundamentals of Agricultural Consulting ", " Consulting Management", "Organization of Information and Advisory Activities " , as well as distance learning - distance learning course "Agricultural Consulting " - the site www.dorada.org.ua, which is rooted in the educational process of agricultural universities in Ukraine . (Kalna-Dubinyuk , 2011) . Specialists of the Extension Department has received special training in top foreign universities and consulting services, participated in many conferences, seminars and trainings on consulting. The result was published model curricula for all agricultural educational institutions of Ukraine on: «Fundamentals of Agricultural Consulting ", "Consulting Management", Organization of Information and Advisory Activities «and tutorials to them. (Kalna-Dubinyuk, 2005).
Students are offered with original methods and techniques of economic analysis and advice to agricultural producers using techniques SWOT - analysis, Gross - margin, partial budgets, financial statement analysis, and investment analysis. Was opened a new Department of specialization - "Information and Consulting Activity in the APC» for the Masters "Management of Organizations". There were introduced new courses such as " Organization of Adult Education", "Business Ethics", "PR - consulting", "Record Keeping in the Consulting Activity", "Planning Information and Consultation Programs in the Countryside", "Modern Methods of Investigation" and etc. Program provides Workshop for six weeks on the basis of existing consulting services of Ukraine or abroad.
Innovative area of consulting was the opening of Ministry of Education and Science of Ukraine (August 2010) of a new specialty for the Masters "Doradnitstvo" in specific categories for all directions of Bachelors. It involves specialization masters on topical issues of agriculture and land use planning and geodesic support inventories. So, already at the Extension Department of the University there are specialization: "Information and Consulting Activities in Agriculture", "Green Tourism" and will be opened in the future of other areas such as “Architecture and Landscape Design, “Organic Production”, “Geodetic Providing Land Use Planning and Inventories, etc. (Kalna- Dubinyuk, 2011).
For distance learning, which is spreading rapidly in the consulting education, it is necessary to use web- technology and the Internet. So, scientists and specialists from the National University of Life and Environmental Sciences of Ukraine develops Web- portal "The Agricultural Sector of Ukraine" (www.agroua.net) as a centralized universal information resource to meet the information needs of agricultural sector. At the Extension Department of the University developed an interactive consulting system "CONKA", which helps consultants generate evidence - based solutions for clients. The purpose of the system is to use it for agricultural companies and advisors, as well as a wide range of users: from business leaders and companies to individual entrepreneurs develop their business in terms of international standards and certification.

Discussions and results

Extremely important for active learning to create visual material, prepare textbooks and manuals on counseling, create films on various aspects of agricultural extension.
Since April 2006, the Extension Department has been actively working on the creation of a series of scientific and popular films : "The Development of Consulting Service in Ukraine": "Consulting Programs Development in the Countryside", "Consulting Programs for Children and Youth", "Development Consulting Education", "Consulting Programs for Agribusiness and Environment". Each video lasting 15-20 minutes. The purpose of these films was:
- "Consulting Programs Development in the Countryside" - show models that are designed and implemented consulting service, organized as a specific solution or a separate set of problems of socio and economic development of rural areas;

- “Consulting Programs for Children and Youth " - to show the social status of children as full members of society, the discovery and development of creative abilities of children and youth; promotion of healthy lifestyles, the formation of youth knowing that thanks to his professional growth they carry a significant contribution to the development of society, the problems of youth residing in rural areas;
- "Development Consulting Education” - training future managers and organizers of agricultural consulting for modernization of the agricultural sector of the state and other sectors of the economy;
- "Consulting Programs for Agribusiness and Environment” - to promote the development of rural infrastructure, self-employment of the rural population, the development of respect for the beauty of his native land, the existing cultural and historical heritage of the Ukrainian people , the environment.
Thus, all the basic information about the development and counseling work in Ukraine is shown in these four films.
Professional training and development of agricultural consultants and experts consultants conducted on training commissioned Ministry of Agrarian Policy and Food Production of Ukraine, consulting services and their National Association (Kalna- Dubinyuk, 2008). The result has the qualifying exams with issuing qualification certificates agricultural consultants and expert consultants, as well as certificates to carry out consulting activities - consulting services - members of the National Association of Agricultural Advisory Services in Ukraine. Created and maintained on the Ministry of Agrarian Policy and Food Production of Ukraine registry agricultural consultants and experts, consultants and consulting services.
In a market environment, a lot of attention is paid to training activities and business schools, which are becoming increasingly important in Ukraine. The purpose of the business schools - providing complex knowledge on topical issues of production, promotes the early introduction of them into practice. Today, business schools are becoming popular for rural green tourism, organic production, fish farming, beekeeping, school and improve soil fertility on agricultural service cooperatives, school of landscape design, etc., which she founded and conducted by the Extension Department of the National University of Life and Environmental Sciences Ukraine (Kalna-Dubinyuk, 2010). Each school is held together with the association partner, has developed a program of studies, which includes all theoretical and practical aspects of the school. Classes are taught by experienced educators and practitioners include lectures and practical work on the basis of successful farms (enterprises), as well as the presentation used the listeners themselves. After school, students are tested and certified.
The department conducts school - workshops for teachers of agricultural universities in Ukraine to introduce consulting education into the educational process. A new International Training and Research Electronic Center (e - Extension) creates in the structure of the National Ukraine of Life and Environmental Sciences of Ukraine to respond quickly to the needs of the time and sharing of best practices consulting organizations of the world, to upgrade the skills of consultants and experts. The structure of this electronic system includes government agencies, academic institutions and educational institutions, extension services, private businesses, community associations and international projects. Its core is the union of practitioners in the fields of business, for which an electronic platform is organized (Kalna-Dubinyuk, 2013).
Under the conditions of Ukraine and Russia in the development of market relations in land use planning consulting activities is becoming increasingly important. It is based on the use of qualified professionals and advanced domestic and foreign experience. Therefore, it is important to improving training programs in land use planning activities. We believe that with the current requirements and trends for the successful functioning of the services of land use planning of our countries should gradually spread implementation consulting in daily activities, especially in the Russian Federation, this activity is still underdeveloped.
Such intentions are at the State University of Land Use Planning (Moscow), where there is essentially 235 years there has been a successful training, now sought in land management, land and urban cadaster, land law, real estate valuation, surveying, environmental, ecology and nature, architecture and design, receiving skills mapping, territory management, competent real estate cadaster, land use planning organize their records and registration. (Volkov, Isachenko, 2012).
In recent years, developing cooperation with universities in CIS countries, Ukraine and the Republic of Belarus to exchange of best practices and achievements.
Through websites and ads identifies specific wishes of businesses and individuals. By way of personal contact with customers, using remote sensing methods and modern communications - clearly

examines topical issues related to the various aspects of land use planning. (Kalna-Dubinyuk, Isachenko, 2013).
In particular, developing counseling following subjects research conducted by staff of the Department of Land Use Planning" of the State University of Land Use Planning": - Land management software agricultural production, theory and methods of land use planning in terms of agricultural lands, the planning of sustainable use and protection of lands of the Russian Federation, municipalities, land under land degradation , land protected areas, project development of land use and protection technology to create digital maps for land use planning and many others.
At the Department of Land Management and several other graduate departments GUZ successfully work known in Russia and abroad, scientists who are able to provide high quality and authoritative advice on land and inventories, it is clear the rising demand for such services is practically significant. We believe that the development of cooperation in the application of consulting education programs at universities will successfully move to improve land use planning and training activities.
Results of studies conducted with including the consulting component in different areas of land management programs indicate their demand (Semochkin, Isachenko, 2013).
At the Department of Land Use Planning and several other graduate departments GUZ successfully work known in Russia and abroad, scientists who are able to provide high quality and authoritative advice on land and inventories, it is clear the rising demand for such services is practically significant. We believe that the development of cooperation in the application consulting education programs in universities of Russia will successfully move to improve land use planning and training activities.

Conclusions and proposals

In a market environment, business success reaches those who in addition to technical knowledge in the chosen specialty can master consulting activities - methods and techniques of information transmission of new knowledge and innovation. Development of existing consulting education in Ukraine provides for the use of advanced information technologies and systems, using the best international practices. Proposed Ukrainian experience in training of counselors at the National University of Life and Environmental Sciences of Ukraine, the use of research results in consulting of the State University of Land Use Planning will be useful for training in the field of geodetic support of land and inventories.

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Information about authors

Kalna-Dubinyuk Tetyana, Professor in Economics, Head of Extension Department, National University of Life and Environmental Sciences of Ukraine Expert Advisor of Ukraine, 15, Geroyiv Oborony st., Kyiv, 03041, Ukraine, Office: (+38-044) 527-8061, Fax: (+38-044)527-8061,mob.+38-097-590-11-83, e-mail: tatiankd@yahoo.com
Isachenko Alexander, PhD, Associate Professor, Department of Land Use Planning, State University of Land Use Planning (Moscow), the Russian Federation, Corresponding Member of the Russian Academy of Natural Sciences (RANS), Honorary Doctor of the Institute of Agroecology and Environmental of National Academy of Agricultural Sciences (NAAS) Expert Advisor of Ukraine on Land. 105064, Moscow, ul. Kazakov, 15, tel.: 8-916-831-96-11 mob. 8-499-261-20-51 - slave. e-mail: isachenk0@bk.ru

EUROPEAN VERTICAL REFERENCE SYSTEM IN BALTIC COUNTRIES

Armands Celms, Inese Bimane, Ilona Reke
Latvia University of Agriculture

Abstract
At the moment all three Baltic countries – Estonia, Latvia and Lithuania – use Baltic Normal Height System 1977 as a national height system. But the European Union regulations declared the European Vertical Reference System as a national height system. For height transformation there is a transformation formula for each European country. After calculations it is seen that height difference between Baltic Normal Height System 1977 and the European Vertical Reference System depends on point location in the territory (coordinates). This unequal height difference between both height systems will cause unequal height values on border connection points between the Baltic countries.
Key words: European Vertical Reference System, transformation formula, border connection points.

Introduction

Levelling network is a national height system forming element. Levelling network ensures the realization of various functions in the national economy. Using Class I leveling results for any kind of transformations, it is necessary to know the accuracy of established levelling network (Celms et al., 2013). At the moment all three Baltic countries – Estonia, Latvia and Lithuania – use Baltic Normal Height System 1977 as a national height system. In Latvia it is determined by the Cabinet of Ministers. But the community of surveyors and land managers consider that the existing height data are out of date; vertical movements need a new height system. The Latvia Geospatial Information Agency determined that from the 1st of August, 2014 Latvia will use the European Vertical Reference System as a national height system. The use of the European Vertical Reference System in each European Union member state is determined under Directive 2007/2/EC of the European Parliament and of the Council as of 14 March 2007, establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). (Directive 2007/2/EC of …, [b.g.])

Methodology of research and materials

The Federal Agency for Cartography and Geodesy of Germany and Reference Frame Sub-Commission for Europe have developed a transformation formula for each European country for the purpose of height transformation from existing Baltic Normal Height System 1977 to the European Vertical Height System:

$$H_{(II)} = H_{(I)} + a_1 + a_2 \times M_0 \times (LAT - LAT_0) + a_3 \times N_0 \times (LON - LON_0) \times \cos(LAT) \quad (1)$$

Where: $H_{(I)}$: height in the source system [m];
$H_{(II)}$: height in the target system [m];
M_o: radius of curvature in the meridian of GRS80 [m] in P_o;
N_o: radius of curvature perpendicular to the meridian of GRS80 [m] in P_o;
LAT: latitude in ETRS89 [radian];
LON: longitude in ETRS89 [radian];
$P_o(LAT_o,LON_o)$: Reference point of the transformation;
a_1...vertical translation [m];
a_2...slope in the direction of the meridian [radian];
a_3...slope in the direction perpendicular to the meridian [radian] (Description of national…, [b.g.]).

Values of transformation formula for Latvia are:

- M_o = 63840416.7 m;
- N_o = 6393195.1 m;
- LAT_o = 56°58’ = 0.99426 radian;
- LON_o = 24°53’= 0.43430 radian;
- a_1 = 0.15374 m;
- a_2 = 0.01558 sec
- a_3 = 0.01174 sec (Valsts augstumu izejas …, 2009).

The transformation formula defines a transformation point in every country. The transformation point in Latvia is not the same as the geographical centre or the centre of gravity of Latvia as it is shown in Figure 1.

Fig. 1. Transformation point, the geographical centre and the centre of gravity of Latvia.

The geographical centre is a point between extreme North – South and West – East points. In Latvia the coordinates of geographical centre are 56° 52’ 48.5” North 24° 36’ 22.4 East, but the coordinates of the centre of gravity – 56° 52’ 51.2” North and 24° 59’ 01.9” East.
According to the transformation formula the height difference between Baltic Normal Height System 1977 and the European Vertical Reference System depends on transformation point location is not equal but depends on transformation point location in the country and the distance to a transformation point. All other values of transformation formula are constant.
To determine the height difference between both height systems for each point in the territory, the following equation is obtained from the transformation formula:

$$H_{(II)} = H_{(I)} + a_1 + a_2 \times M_0 \times (LAT - LAT_0) + a_3 \times N_0 \times (LON - LON_0) \times \cos(LAT) \quad (2)$$

$$H_{(II)} - H_{(I)} = 0.15374 + 0.01558 \times 63840416.7 \times (LAT - 0.99426) + 0.01174 \times 6393195.1 \times (LON - 0.43430) \times \cos(LAT) \quad (3)$$

Assuming the height difference $H_{(II)} - H_{(I)}$ as a constant value gets the curve – the point set with the same height difference. Fig. 2 and Fig. 3 show the curve if $H_{(II)} - H_{(I)} = a_1 =$ 0.15374 m.

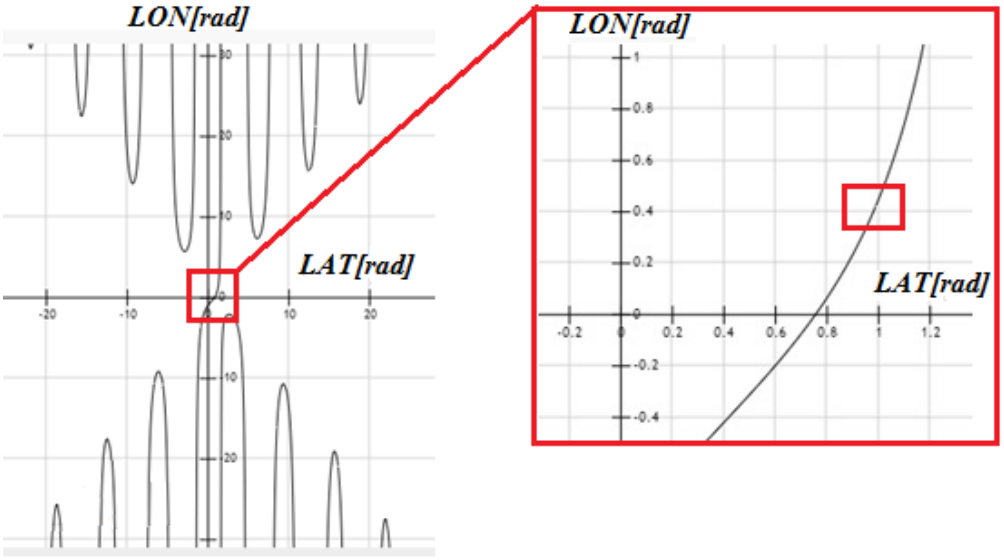

Fig. 2. Curve of the transformation formula if $H_{(II)} - H_{(I)} = a_1 = 0.15374$ m.

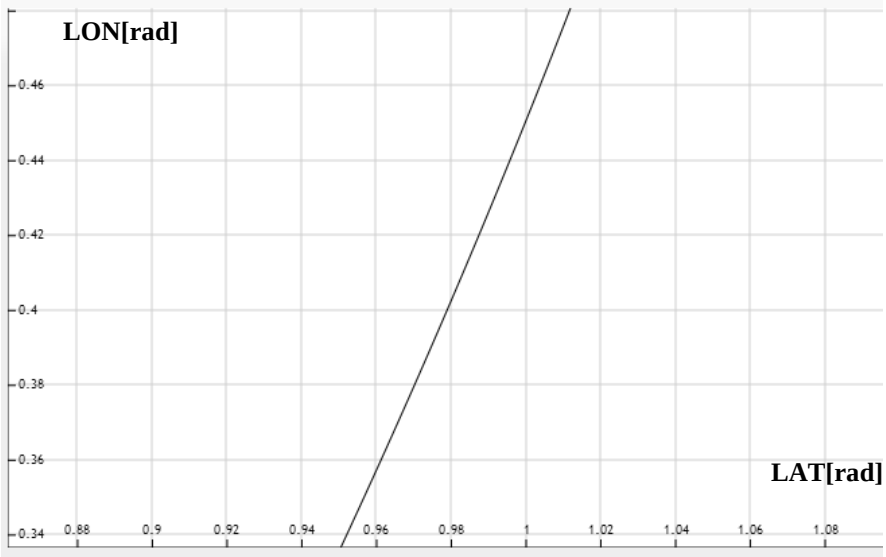

Fig. 3. Part of the curve of the transformation formula if $H_{(II)} - H_{(I)} = a_1 = 0.15374$ m for geographical coordinates appropriate for territory of Latvia.

According to transformation formula calculations in Latvia the difference between Baltic Normal Height System 1977 and the European Vertical Reference System will be 135 mm in the south-eastern part of Latvia and will increase to 169 mm in the north-western part (see Fig. 4). This could make an additional error for height determination between points.

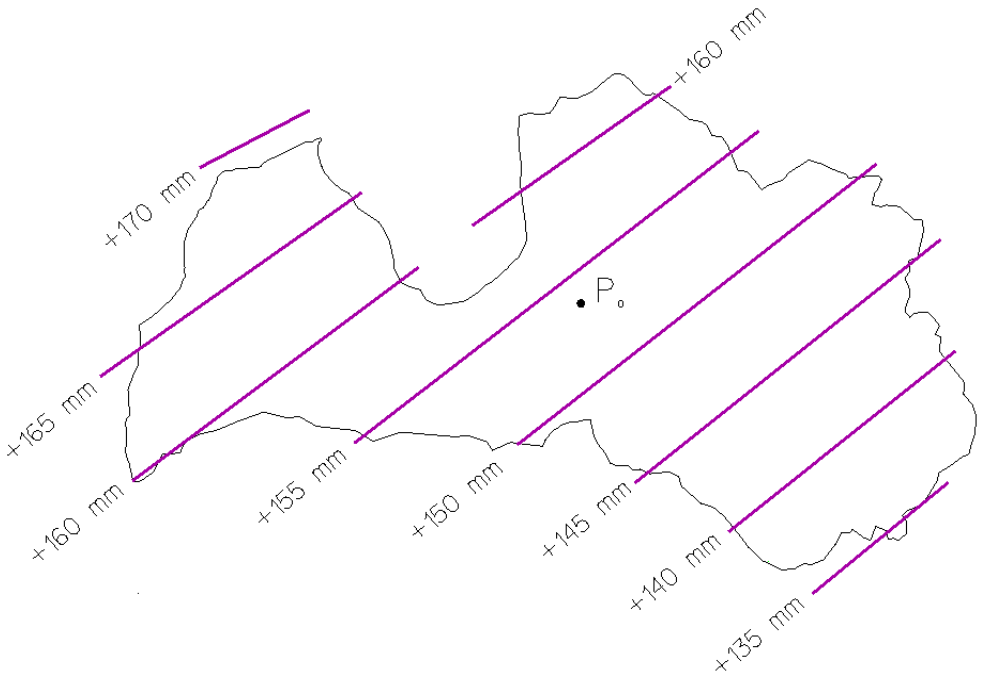

Fig. 4. The difference between height systems in Latvia and transformation point $P_{0.}$

Discussions and results

Figure 5 shows the difference between both height systems in millimetres and the location of the transformation point in all three Baltic countries.

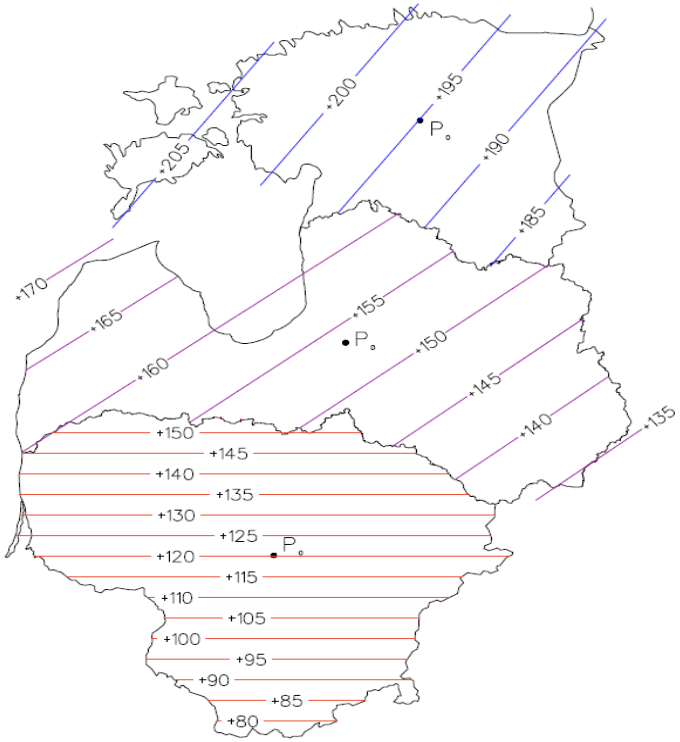

Fig. 5. The difference between height systems and transformation point P_0 in Baltic countries.

Fig. 5 shows that in Lithuania the difference between height systems will be from 80 mm in the south part until 150 mm in the north part of the country. In Estonia – from 185 mm in the south-east part until 207 mm in the north-west part of the country. The European Vertical Reference System will cause unequal height values at the connection points on the border: the height difference of same point in Latvian and Estonian or Latvian and Lithuanian height system will be until 33 mm on the state border (Fig. 6.).

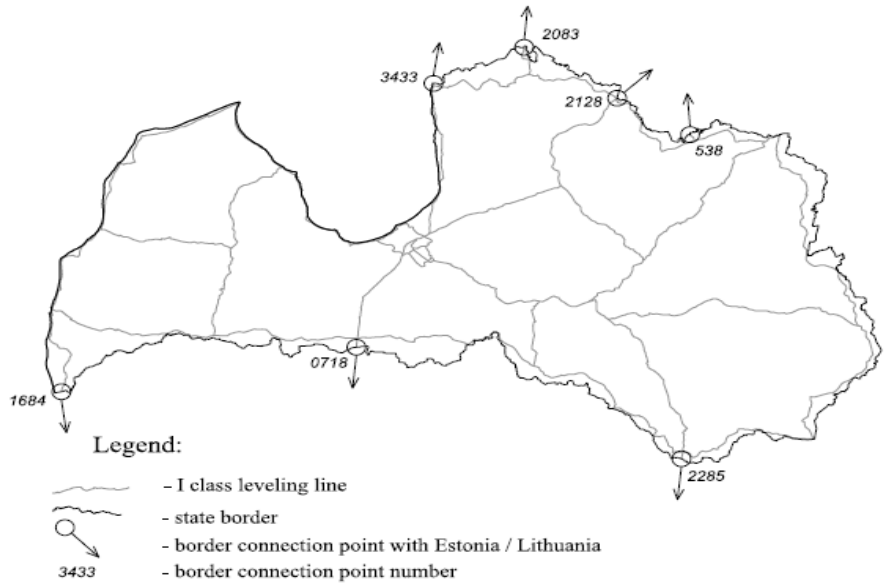

Fig. 6. Border connection points with Estonia and Lithuania.

Table 1 shows the height difference in the border connection points. On the border of Latvia – Estonia the height difference in the European Vertical Reference system in both countries will be 32 to 33.9 millimetres, but on the border of Latvia – Lithuania the connection point heights in Latvia and Lithuania in the European Vertical Reference System will be -0.5 mm to 19.6 mm. So the same point height on the border will be different in each country in the European Vertical Reference System. There will be no more height connection between the Baltic countries.

Table 1

Height difference in border connection points

	Point No.	**Point height, m (BAS77)**	**Height difference between BAS77 and EVRS in Latvia, m**	**Height difference between BAS77 and EVRS in Estonia/Lithuania, m**	**Difference between heights of EVRS in Latvia and Estonia/Lithuania, mm**
LV-EE	3433	3.21	0.163	0.197	**-33.9**
	2083	72.37	0.162	0.194	**-32.0**
	2128	50.93	0.157	0.190	**-33.3**
	538	78.64	0.153	0.186	**-33.4**
LV-LT	1684	11.01	0.160	0.140	**19.6**
	718	96.4	0.160	0.160	**-0.5**
	2285	138.9	0.137	0.130	**7.4**

Figure 7 and Figure 8 show the height differences after using the European Vertical Reference System along the whole borderline Latvia – Estonia and Latvia – Lithuania. As it is seen in Figure 7, direction of height difference between Baltic Normal Height System 1977 and the European Vertical Reference System has an equal increase in Latvia and Estonia: from south-east to north-west of the country. Therefore the height difference between both countries using the European Vertical Height System along the whole borderline is equal –33 millimetres on average (Fig.7).

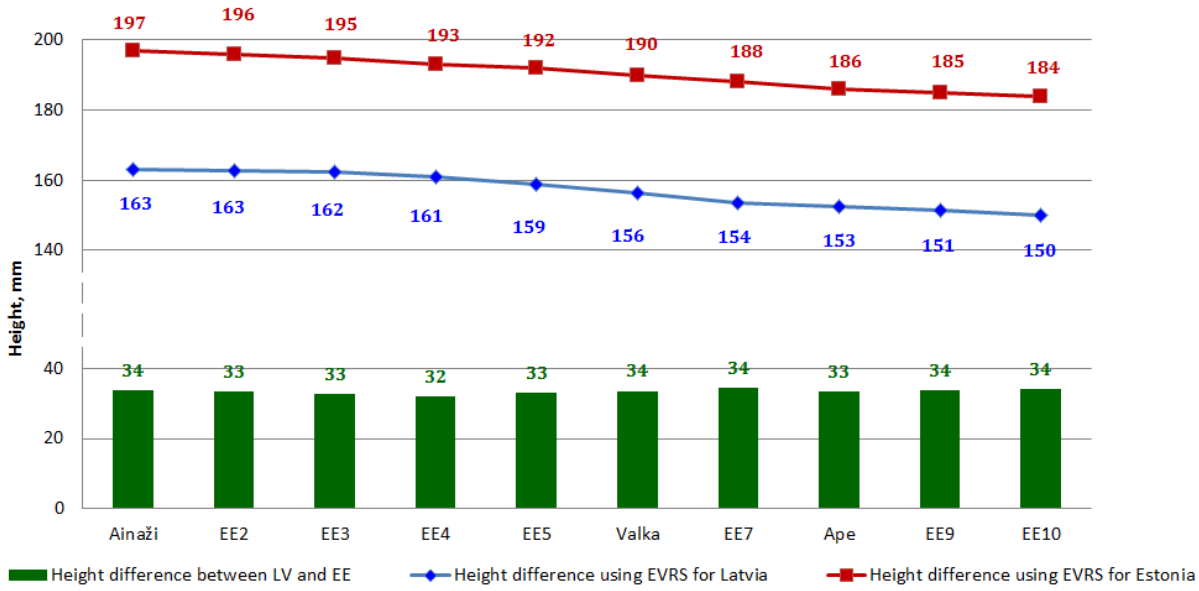

Fig. 7. Height difference between Baltic Normal Height System 1977 and European Vertical Reference System on border line Latvia – Estonia.

But the direction of height difference between Baltic Normal Height System 1977 and the European Vertical Reference System does not have an equal increase in Latvia and Lithuania. In Latvia it increases from south-east to north-west of the country but in Lithuania – from south to north of the country. Therefore the height difference between both countries using the European Vertical Height System along the whole borderline is different: 20 to -5 millimetres (Fig.8). There are 2 points on the borderline with the same height in Latvia and Lithuania using the European Vertical Reference System.

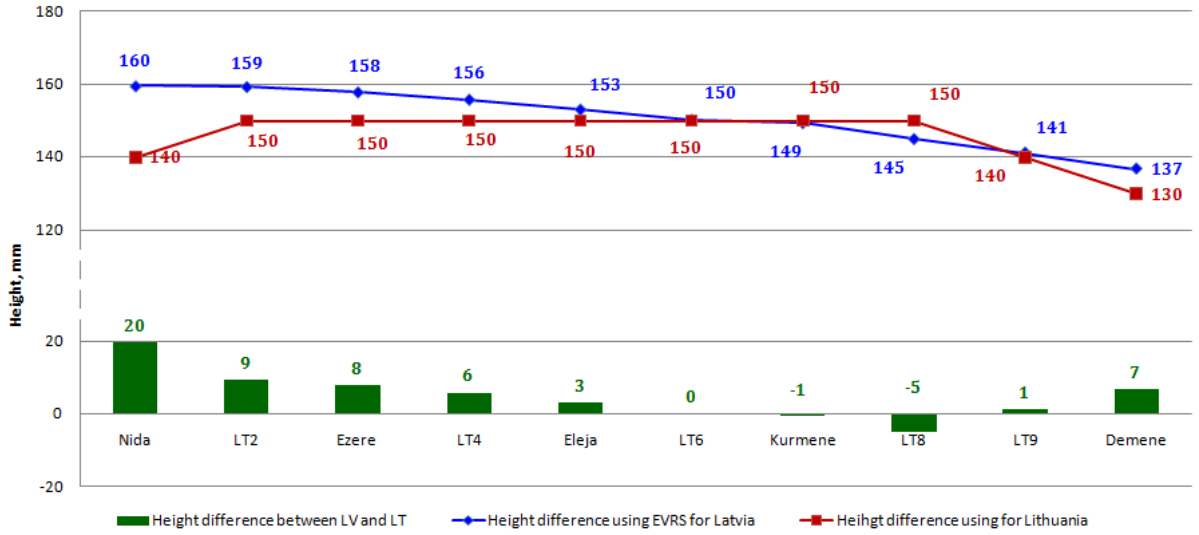

Fig. 8. Height difference between Baltic Normal Height System 1977 and European Vertical Reference System on border line Latvia – Lithuania.

The height transformation to the European Vertical Reference System will cause many changes and it is necessary to study and evaluate the system before using it.

Conclusions and proposals

1. The differences between Latvian - Estonian and Latvian - Lithuanian planned EVRS height systems is in the range from -33.9 to +16.9 mm.
2. United EVRS height system for the common Baltic space is advisable.

3. The existing height system transformation to the European Vertical Reference System in the Baltic countries will reject the possibility of the direct comparison of the Earth's vertical movement dynamics and comparison of the prior levelling results.
4. It is desirable to give height values for each current geodetic sign in Baltic Normal Height System 1977 after the implementation of the EVRS height system.

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Information about authors

Armands Celms, Mg.sc.ing., lector, Latvia University of Agriculture, Faculty of Rural Engineering, Department of Land Management and Geodesy. 19 Akademijas Street, Jelgava, Latvia, LV-3001, +37163024618, armands.celms@llu.lv Fields of interest – precise levelling, vertical movements of the Earth's crust.

Inese Bimane, Dr.paed., assistant professor, Latvia University of Agriculture, Faculty of Rural Engineering, Department of Land Management and Geodesy. 19 Akademijas Street, Jelgava, Latvia, LV-3001, +37163024618, inese.bimane@llu.lv Fields of interest – precise levelling.

Ilona Reke, Bc.sc.ing., Master student, Latvia University of Agriculture, Faculty of Rural Engineering, Department of Land Management and Geodesy.

IMPROVEMENT OF THE SYSTEM OF LAND PARCELS REGISTRATION

Lev Perovych
University of Life Sciences in Lublin, Poland

Abstract
The development of GIS technologies, of Earth remote sensing methods, improvement of the legal basis, as well as differences in approaches of creation and functioning of the cadastral systems puts on the agenda the task of using a unified methodological approach for the creation of the cadastral systems. It is particularly relevant during the period of integration and globalization of economic, sociopolitical, scientific and cultural, educational and other programs of different countries and, especially, of the countries of the European Union. The purpose of this research is to attempt to improve the structure of cadastral system with regard to land parcels registration outlining the main directions of scientific and practical research meant for the modernization of the cadastre. The results of the research are suggestions and recommendations about the possibility of creating a unified register of cadastral objects, land parcels in particular, as well as the list of scientific tasks aimed at the modernization and improvement of the cadastral system. The conclusions show that the cadastre should be regarded as the state informational and registration system of geospatial position of the objects, their quantitative and qualitative assessment and legal status at this stage of development of technical, techno-logical and legal trends. In a scientific sense, the cadastre is a branch of science which studies the patterns and principles of formation, functioning and preservation of cadastral objects, information about them and their register.
Key words: cadastre, register, improvement.

Introduction

The development of socio-economic relations leads to the necessity of rethinking the value and the place of the cadastre in the globalized economic processes. The development of technical means and, in particular, GIS technologies and remote sensing methods detect new opportunities and properties of cadastral systems which reveal their new features aimed at resolving a number of tasks which previously were difficult to solve or they were solved in other systems.

One of the important documents, giving a definition of the cadastre at a modern level, is found in the famous publication 'Cadastre 2014: A vision for Future Cadastral System', in which the cadastre is defined as a "methodically arranged public inventory of data concerning all legal land objects in a certain country or district, based on a survey of their boundaries" (Kaufmann, Steudler, 2001). The given definition identifies the objects of land recording where the connection *object – right* is accentuated. On the other hand, the definition of land registration is given as a process of official accounting of land rights through the appropriate legal documents or titles accentuating the connection *right – object*.

There are two registers in most countries: the first one includes geometrical, physical, economic and other characteristics of the cadastral objects, the other one – the rights to the cadastral objects. In general, the first register is stored in the organization that keeps records, collects and systematizes data about the cadastral objects and it is called the cadastral register (INSPIRE data specification, 2010), the second register – in the structural subdivisions of the legal institutions. Hence the problem of researching the possibility of two registers' integration into a unified department that would make it possible to significantly reduce the material, financial and physical costs and to eliminate the bureaucratic procedure of providing the customers with documents about property ownership. The first register has a "technical" character and the second – the legal character. An important prospect is to provide the first register with more legal character in terms of the protection of property rights.

And, finally, different viewpoints regarding the problem of the cadastre development are expedient as they allow to work out a uniform methodological approach concerning the formation and functioning of the cadastral systems which will promote the legal protection of the interests of holders of cadastral objects, the creation of the globalized real estate market improving the investment climate.

Methodology of research and materials

The problem of the integration of two registers is reflected in the article (Wouters, 2013). The author holds the view that the integration of two registers would provide better quality, better and cheaper service, more efficient and easier to run system.

Since 2010 in Finland all cadastral, cartographic and respective information has been recorded in the unified integral database conducted by the National Land Survey of Finland (Myllymaki, Pykala, 2011). The data about the ownership or right-of-use of the land, transactions, two-dimensional geometry of the land parcels and their value are included in the cadastre. The National Land Survey of Finland has been registering titles and mortgages, but the database is separated from other registers.

The final cadastral document is a cadastral plan, which, in most cases, is an image of a cadastral object on the plan at a certain scale. In addition, it is necessary to specify the inventory number of the land parcel and its area, coordinates of the points of boundaries, signatures of all adjacent landowners and land users, land explication on the cadastral plan (Fig. 1).

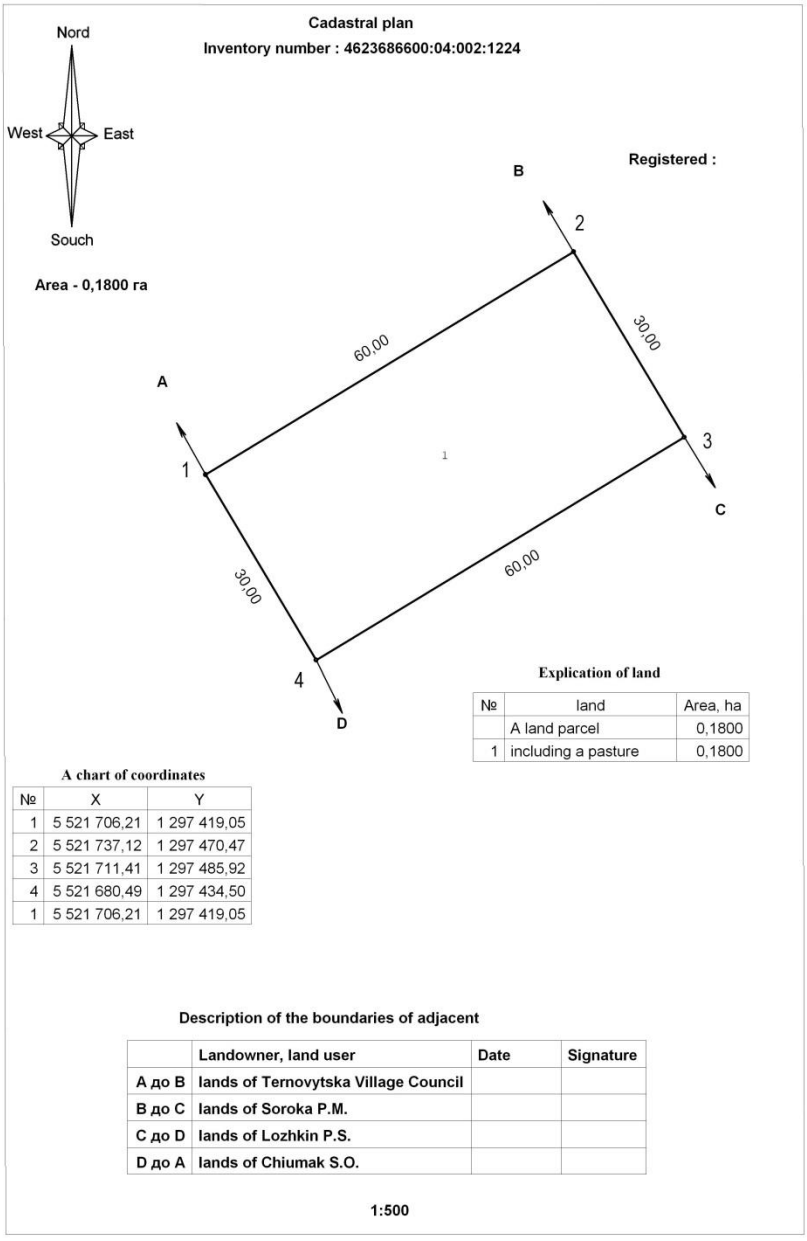

Fig.1. The cadastral plan of the land parcel.

A cadastral plan with such information has elements not only of the technical (area, coordinates, location), but also of the legal document because the boundaries of the land parcel set in situ are fixed by the official signatures of the adjacent landowners. Consequently, confirmation of the signatures of adjacent landowners regarding the ownership of the land plot of a specified owner legally or in the legal field of the state by an authorized person

entails the legal consequences about the definition of ownership of the given land parcel. Thus, registration of ownership (title) or mortgage can take place directly in the land (cadastral) services.
The information which is presented on this cadastral plan allows to duplicate the identification of the land parcel. In the first case, the inventory cadastral number allows to publish the location of the land parcel in the system of administrative-territorial structure of the state, and in the second one – to determine the location of the boundary markers of the land parcels in selected reference coordinate system.

Discussions and results

Overall, three styles of cadastral systems are used in the world practice: French/Latin, German, Torrens/English (Williamson et.al., 2010). All the given above cadastral systems do not provide the protection (inviolability) of the land parcel boundaries. The Torrens and German cadastral systems guarantee the titles (ownership rights) for the land parcels. At the same time the Torrens cadastral registration system is integrated into the land registration process, and the German cadastral system gives the priority to the land registration. In the French system the cadastral registration takes place after the land registration.
Returning to the protection of the ownership rights, it should be noted that the protection involves the inviolability of land parcel boundaries identified in any physical point of time in relation to the initial one being fixed in legal documents. In case of violation of this legal norm the protection of the ownership rights on the holistic land parcel is resolved in court, where the sides interested in resolving the conflict are active participants in the judicial process. The solution of land and property disputes in such a way concerning the inviolability of the land parcel boundaries is based sometimes on the factor of human subjectivity which leads to the adoption of illegal decisions.
In this case, the most reliable and unprejudiced method for the establishment of the reliability of the position of land parcel boundaries can be the method of technical expertise which allows on the basis of comparison of the results of measurements of terrestrial cadastral control or remote sensing in relation to the initial to restore and to set the land parcel boundaries with predetermined accuracy at any physical moment of the time. The solution of this problem from a technical point of view does not represent any difficulties. Hence we can conclude that the cadastre can play an important role in the realization of protection of ownership rights to the land parcels.
Thus it is possible to formulate the generally accepted definition of the cadastre: *cadastre is a state informational and registration system of geospatial position of cadastral objects, their quantitative and qualitative parameters and legal status.* This definition legitimizes the cadastre as a legal category in socio-industrial relations, which has a defining status during the adoption of various management decisions, controlling over compliance with the rights and duties by the subjects of cadastral objects and stakeholders.
From a scientific point of view, the author believes that the cadastre should be considered as the science which studies the principles and patterns of formation, functioning and preservation of the system of cadastral objects and information about them, which is coupled with interconnections of the geospatial basis, natural, environmental, socio-economic and legal factors.
Cadastral science should be directed to ensure:

- the science-based territorial cadastral zoning of territories both inside the settlements and outside of them;
- development of the classifiers of lands of different categories, their intended usage, restrictions and encumbrances regarding the use of cadastral objects;
- development of methods and technologies for improving the organizational and legal norms of functioning of the cadastre system;
- improving of registration system of cadastral objects and the rights on them;
- modelling and forecasting the prospects for development of cadastral systems;

- modernization and wide integration of interconnections between the various styles of cadastres and more.

Directions of studying the cadastre, which are outlined above, definitely do not exhaust sets of all scientific research in the cadastral science.

Conclusions and proposals

Cadastral and land registration of land parcels should be combined into a unified register in departments which deal with the organization and coordination of conducting of cadastral works.

Modern technologies of cadastral works allow to carry out the technical expertise of inviolability of land parcel boundaries, which can be an effective mechanism of protection of property ownership rights.

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Information about author

Lev Perovych Professor, Doctor of Technical Sciences, University of Life Sciences in Lublin, Poland, 8(032)2582631, e-mail: tania-martunyk@mail.ru

LAND MANAGEMENT AGAINST LAND/REAL ESTATE DEGRADATION

Alexander Pomelov
Belarussian Research Institute on Land Management, Geodesy and Cartography

Abstract
The article concentrates on problems of land/real estate degradation in Belarus, as well as on the ways of solving them by means of land management. The analysis of various documents resulted in the conclusion that there is a lack of a unified conceptual and terminological framework with regard to the following terms and concepts: "degradation", "land degradation", "degraded lands", "land conservation/protection", "real estate degradation" and others. The concepts of "land parcel" and "real estate unit" are compared. As an effective tool for combating degradation of land and real estate the article offers more efficient use of land management system developed for this purpose, as well as other legislative, institutional, organizational and technological measures.
Keywords: land management, land degradation, real estate.

Introduction

Since 2001, the Republic of Belarus is a party to the United Nations Convention to Combat Desertification/Land Degradation (UNCCD, 1994). The problem has become increasingly referred to in legislation acts, regulations, government programs, plans, strategies and national reports on implementation of the UNCCD, for example (Natsionalnyy doklad, 2006; Strategiya realizatsii, 2010, etc.). According to the international expert's view, the effectiveness of their realization is constrained by limitation and dispersion of funding and the lack of proper coordination between them (UNDP, 2006).

Unfortunately, despite accession of the country to the UNCCD, no important scientific research has been carried out in the field of combating land degradation. Moreover, available important results in the considered area, for example (Nkonya et.al., 2011, Poulsen, 2013) are not studied in Belarus.

The author holds the view that the main reasons for the inefficiency of combating land degradation in Belarus are the following: the first is underestimating of the importance of the problem by governmental authorities and by the population, the second is the lack of clear and viable mechanism for its solving (Pomelov A., 2013).

Underestimation of land degradation problems is associated with the lack of public information and skilled personnel in this area, as well as with non-critical proportion of degraded lands and the level of their degradation. Besides, the environmental issues in Belarus traditionally placed after socio-economic ones, largely because of still inexistent criteria for their comparison.

The absence of an effective mechanism for solving land degradation problem is evident due to the fact that national legislation places a variety of land use restrictions aimed at protecting and improving of land, but in practice they are not respected.

Due to the urgency of the outlined problem the author draws attention to land management as an efficient tool of land use regulation mechanism, aimed at combating land degradation.

Methodology of research and materials

The study is based on reporting and planning documents concerned with the implementation of the UNCCD by the Republic of Belarus, as well as current information of land monitoring and land cadastre as of January 1, 2014 (GZK, 2014) as the data source. The results of previous studies of the author (Pomelov A., 2006, 2013), theoretical and practical experience of land management in Belarus are used in the article as well.

During the studies the basic scientific methods are applied, such as: empirical, for example, observation and comparison, and theoretical, for example, analysis and induction. In particular, observation and comparison were carried out in the case of dynamics in land resources state change in time and space, including land degradation processes. The analysis is carried out by comparing the concepts of "land parcel" and "real estate unit." The induction method allows the results of studies concerning certain types of land degradation to be extrapolated to the entire problem.

Discussions and results

The main purpose of the state land policy in Belarus is increasing efficiency (effectivization) of land use and land protection (Natsionalnyy doklad …, 2011). According to land legislation "protection of land" is a system of measures directed to prevention of land degradation, restoration of degraded lands (Kodeks o zemle, 2008).

However, the analysis of national legislation where "land degradation" is mentioned has unexpectedly showed that a uniform understanding of this concept does not exist yet (Pomelov A., 2006, 2013).

The word "degradation" is known to be of Latin origin and means deterioration or loss of original useful properties that is, deterioration in quality, and in this regard, the shift to a lower quality level (in accordance with the gradation system).

The term "quality" is most often used in two meanings: as a set of properties responsible for the ability to satisfy certain requirements in accordance with a purpose of a thing, product, service, goods, etc., and as a set of attributes, properties and characteristics distinguishing one object or phenomenon from others.

In our opinion, the first meaning is viable to be used in relation to degradation as to the process and the second one – as to its result, assuming that as a result of degradation process the quality takes discrete values, and determines new properties of the object and its shift to other lower gradation level.

It is important to consider the processes of degradation within the framework of a certain designated purpose of the object. Theoretically it is possible to consider one and the same process as degradation, and as improvement depending on a designated purpose of the object. Besides, determination of the fact of degradation suggests a comparison of the actual state of an object with the original, documented one. In other words, degradation is a relative phenomenon.

In view of the foregoing the author gives the following definitions which are included in the national land legislation. Land degradation – land quality decreasing process which is the result of harmful anthropogenesis and (or) natural effects; degraded lands – lands that lost their original useful properties as a result of degradation coming to the state excluding the possibility of their effective use according to the initial purpose (Kodeks o zemle, 2008).

At the same time not everything is clear with the term "land". According to UNCCD introduction the term "land" means «the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system». The term "land degradation" means «reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: soil erosion caused by wind and / or water; deterioration of the physical, chemical and biological or economic properties of soil; and long-term loss of natural vegetation» (UNCCD, 1994).

In accordance with the land legislation of Belarus soil is a component part of land. But land (lands, land resources, land fund) includes all earth's surface within the state boundaries. Thus, all the lands in all their diversity according to a designated purpose, condition, land-use regime, legal status, etc. in the author's view can be the subjects to degradation.

Characteristics of land is important for understanding of the essence of degradation processes, selecting criteria of their allocation and evaluation, as well as for justification of ways and taken measures for combating degradation.

Previous studies of land degradation problems and their classification in Belarus proposed taking into account legal land degradation as well (Pomelov A., 2006, 2013), in cases when violation of rights to land prevents from using land parcels effectively according to their purposes. It must be admitted that such kind of presentation of land degradation problem appeared to be unexpected for many Belarusian specialists.

In the present article, the studies are continued, including dealing with a problem of reasonability of expanding the concept of "land degradation" to the concept of "land/real estate degradation".

It is determined by the Civil Code of the Republic of Belarus that real estate includes land parcels, sites of the subsoil, isolated water objects and everything that is inseparable from land and that is impossible to move without causing incommensurate detriment to their designated purpose in particular forests, long-term plantings, buildings, constructions. The Land Code determines a land parcel as a part of the earth's surface, having the boundary and designated purpose and being regarded in close connection with capital (permanent) structures (buildings, constructions) located on it.

Thus, deriving from civil and land legislation (and registration legislation) the following important consequences are taking place: a) real estate property appears to be not land as a whole, but a land parcel, b) land parcel is primary in relation to other real estate properties (units), c) the concepts of "land parcel" and “real estate unit" are identical.

This approach is approved of by legislation of some developed countries. For example, Article 1 of the Land Code of Sweden says "Real Estate is Land. It is divided into real estate units” (Swedish Land Legislation, 1998). In the UNECE Guidelines (1996) it is stated that «Land: the surface of the Earth, the materials beneath, the air above and all things fixed to the soil».

In the land legislation of Belarus the concept "real estate unit" is not used. But the purpose of a land parcel provided for allocation of any object, for example, of a capital structure (building, construction) is predetermined, as a rule, by the purpose of the object. And there is a unified classification of purposes of land parcels, buildings and constructions existing in Belarus (Postanovlenie Komzema …, 2004). Therefore if a certain building cannot be used according to its initial purpose because of essential decrease in quality or other causes, it implies not only degradation of the building itself, but of the land parcel under it as well.

It can be found in many examples in different countries (30 fotografiy …, 2014) which can be carried to degraded real estate units. Figure 1 is depicts an object in Namibia, where in September 2013 a major event of UNCCD was held (K-11). The figure shows that in Africa during the process of desertification not only fertile soil was covered with sand, but buildings as well. The same example for Belarus is the former restaurant "Zaslavl" located near the city of Minsk (Fig. 2).

Fig. 1. City-phantom Kolmanskop, Namibia (30 fotografiy …, 2014).

Fig. 2. Zaslavl restaurant about Minsk, Belarus.

The author considers that the term "degradation" should integrate various causes and consequences of a quality reducing process of the object. This would let study the problem and the ways of its solving

somehow consistently and all around. For example, for conditions of Belarus 18 types of land degradation were distinguished (Natsionalnyy doklad …, 2006).
The expanded understanding of the terms "land, lands" as a set of land parcels/real estate units will allow to analyze the problems of degradation in more details and to prove the ways of combating it differentially according to designated purposes, state and land-use regime. In this connection it should be assumed that in various situations (for various lands) different approaches are required for combating degradation.
On the other hand, it would allow to involve the certain already developed instruments of regulation of land/property use for combating degradation, such as: physical and legal, economic and ecological, etc. It is referred to the land cadastre maintaining, real estate registry, valuation and taxation, market development, improvement of investment climate, etc.
As stated above, one of the reasons for the lack of effectiveness while implementing of the UNCCD in Belarus is the absence of a viable mechanism which should include planning, development of legal base, optimization of the responsible authorities system, organization of works, information support, control and motivation, etc. Moreover, all the listed above elements must work integrated as a single set.
For example, the experience in Belarus has shown that establishing by any regulatory legal act of certain environmental land use restrictions aimed at combating land degradation is not sufficient. It is necessary to bring them to a particular land user through the system of land cadastre, state registration, allocation of land parcels and title documents. It is not enough to develop a project on preventing degradation and restoring of degraded lands, it is necessary to apply economic and legal mechanism that would motivate a land-user to spend funds for implementation of this project.
It is obvious that some features of Belarus as, for example, the prevalence of state land property, backwardness of land market, etc., predetermine special ways of combating land degradation. At the same time general universal approaches are possible as well.
First of all the attention is wanted to be paid to the system of «zemleustroistva» which is considered to be the main element of land use regulation mechanism for realization of land policy in Belarus (Natsionalnyy doklad …, 2011).
There is no direct translation of the Russian term «zemleustroistvo» into English. In the author's opinion, it is closest in its meaning to the concept of "Land Development", though the concepts like "Land Management", "Land Administration", "Land Organization", "Land Use Planning", "Surveying" etc. are more often used. Land Management (Land Development) represents a complex of legal, economic and technical measures directed (in a broad sense) to the improvement of lands in order to increase their quality. In other words, combating land/real estate degradation is the direct purpose of land management/development.
The content of land management/development in Belarus is established by the land legislation (Kodeks o zemle, 2008). It can be divided into four parts – directions of land management/development activity (set of types of the land management/development works). They are: 1) information support, 2) land use planning, 3) redistribution of lands, 4) other works (Pomelov A., 2013).
1. Information support – work, first of all, connected with collecting, processing, storage and use of data, including spatially distributed, that are necessary for development and justification of certain administrative decisions in the field of use and protection of lands.
In Belarus to such works are referred: aerogeodetic works, creation and operation (maintaining, updating) of land information systems (LIS) and geoportal, soil and geobotanical inspection of lands, cadastral assessment of lands, inventory of lands, state land cadastre maintaining (updating), etc. Thus it should be noted that according to the legislation of Belarus the register of real estate, rights for it and transactions with it (the real estate register) is a component part of the State Land Cadastre.
The existence of information and registration system described above is of great importance for combating land/real estate degradation. It is a source of actual and reliable information about physical and legal condition of an object. Only a comparison of the actual situation with the basic data recorded for a certain date in the state land cadastre allows to draw a conclusion about degradation and to take appropriate measures.
Actual and perspective problem of information support for land management/development is integration of information about already degraded and degrading objects into the system of account/registration of lands and real estate. Besides, their identification, mapping, classification,

analysis and assessment require introduction of modern technologies based on using of the remote sensing data of the Earth (RSDE).

2. Land use planning – work connected with development, justification and implementation of schemes and projects of land management/development and other land use planning documentation defining the prospects of organization and land arrangement in time and space. Results of land use planning directly depend on the issues information support efficiency, on sufficiency and reliability of basic data.

Now in Belarus there are some systems of spatial planning applying for complexity, though, in fact, being sectorial. In the author's opinion, combating land/real estate degradation problems are more successfully resolved in schemes of land management/development of administrative regions and in projects of separate land parcels management/development. It is confirmed from the side of UNDP in Republic of Belarus and GEF, by their high appreciation of the work results as well as by their co-financing the development of the schemes and projects described above.

At the same time solving of a number of actual problems in Belarus, including increase of efficiency of combating land/real estate degradation, requires creation of more perfect system of spatial planning. On a sample of some developed countries of the world it should have not a sectorial, but really a uniform complex character and function under the control of local authorities.

3. Redistribution of lands – work connected with the following issues: final land allocation, placement of objects of different functions, change of designated purposes of land parcels, their transfer to property (privatizations) or alienation for the state needs, identification and restoration of the boundaries of administrative-territorial and territorial units and of land parcels, the solution of land disputes, etc.

Redistribution of lands is a decisive stage defining the destiny of land parcels/real estate unites for a foreseeable prospect. It is capable to make fatal impact on land/real estate degradation processes, either to stop them or to create conditions for emergence and distribution. Therefore it is very important to carry out redistribution of lands according to strategy and tactics of land use that would be reasonable from economic, ecological, social and other points of view in complex and accepted at a stage of land use planning. It must be admitted that, in Belarus it does not take place nowadays retaining problems, including those partially connected with combating land/real estate degradation.

4. Other land management/development works – work connected with scientific researches, development and deployment of modern technologies, modernization of the hardware-software complex necessary for implementation of other land management/development actions. In our opinion, administrative and educational activity in the field of land management/development is also necessary to be referred to this direction.

As a whole, in order to increase the efficiency of combating land/real estate degradation in Belarus, the following measures, including using means of land management/development, are required.

A. To develop regulatory legal base in the field of protection and use of land/real estate, and primarily, to develop projects and to adopt the Laws "About Protection of Lands/soils" and "About Spatial Planning", as well as "The uniform qualifier of ecological requirements and land use restrictions", to make the appropriate changes and additions into some legislative acts (Land Code, Law on environmental protection, Code on Administrative Offenses, Criminal Code, etc.), to develop a series of technical regulations.

B. To optimize an organization and function chart of governmental authorities interaction. To increase powers (competence) of the Ministry of Natural Resources and Environmental Protection, the body responsible for implementing of UNCCD in Belarus, and of its territorial bodies. Unfortunately, now they have no real leverage over land users. Land management/development services of local executive committees as well as the public and land users are necessary to be more extensively involved in combating land/real estate degradation.

C. It is essential to increase effectiveness of the state control over use and protection of land/real estate. Combating land/real estate degradation is one of the main objectives of such control. For this purpose it is necessary to recreate legal and regulatory framework, to create specially authorized body, to pass to essentially new technologies of identification, mapping, classification and evaluation of degradation processes using objective documented RSDE (Pomelov A., 2012).

D. To provide further development of the system of state land cadastre (GZK) and state registration of real estate, rights for it and transactions with it. Main propositions on improving the register of land resources of the Republic of Belarus (considered to be the main component of GZK) are the following: essential simplification and content reduction, including classifications of lands by types; full

transition to using RSDE, geoinformation and web technologies; redistribution of functions between the organizations subordinated to the State Property Committee for land management and land use planning services of local executive committees.

E. Implementation of economic and market methods (of land use regulation). Implementation of these methods assumes:

-formation of real estate units on the basis of the land parcels through the whole territory of the country, irrespective of its purpose, state and land-use regime, form of ownership and type of the rights for it, etc.;

-mass account/registration of these real estate units with using modern technologies, allowing to reduce expenses of time and funds for this process;

-mass assessment of market/cadastral value of real estate units using simple models based on available information, received, generally by their accounting/registration;

-introduction of a uniform real estate tax from its market/cadastral value with differentiation of a tax rate only in connection with its various purposes;

-abandoning the practice of exemptions from payments for land/property, introducing all sorts of privileges and preferences;

-receipt of funds from payments for earth/real estate to local budgets;

-intended use of a part of the funds received from payments for land/property for its improvement, protection, land management/development, including updating of land use planning documents, urban planning and other documents defining the prospects of land development (Pomelov A., 2013).

Conclusions and proposals

1. After the accession of Belarus to UNCCD combating land degradation started to be paid more attention to, but real results are very modest.
2. First of all, for increasing of the work efficiency it is necessary to define unambiguously the concept of the term "land degradation", the object and mechanisms of combating it,
3. According to the research results of the stated problem in Belarus the term "degradation" is proposed to be used when speaking about integration of various quality decreasing processes, occurring to different causes and having different consequences.
4. All kinds of degradation processes should be considered within the framework of a designated purpose of an object. And to each object of degradation a particular approach is needed.
5. Lands not only as the Earth surface, but as a set of land parcels/real estate units should be considered the object of degradation combating.
6. Along with already existing categories of degradation (physical, chemical, biological, economic, etc.) it is proposed to suggest the problem of legal degradation of land parcels/real estate units for consideration.
7. Under the conditions of Belarus, land management/development is considered to be an effective instrument of combating land/real estate degradation. And, in general, mechanism of land use regulation is directed exactly to this purpose.
8. Each of land management/development components (information support, land use planning, redistribution of lands) carries out a particular function in preventing land/real estate degradation and its restoring.
9. At the same time effective combating land/real estate degradation is impossible without realization of a complex of viable measures of legislative, institutional, organizational character. First of all active participation of the interested (motivated) local governing bodies and self-government, of the public and land users is demanded in this process.

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Information about author

Alexander Pomelov, PhD, ass. prof., director of Belarussian Research Institute on Land Management, Geodesy and Cartography. 86/3 Kazinets str. Minsk 220108 BELARUS, +375 29 6102730, e-mail: pomelov@mail.bn.by.
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METEOROLOGY MONITORING OF THE PRECIPITABLE WATER VAPOR DISTRIBUTION IN THE ATMOSPHERE BASED ON OPERATIONAL GNSS DATA PROCESSING AT REFERENCE STATION NETWORK ZAKPOS

S.Savchuk[1], N.Kablak[2], I.Kalynych[2], O. Reity[2]
[1]Lviv Polytechnic National University, [2]Uzhgorod National University

Abstract
Remote monitoring of the atmosphere is designed to obtain information about the state of the atmosphere. The principle of the remote monitoring system of the atmosphere is based on the registration and processing of spacecraft radio signals of the Global Navigation Satellite Systems (GNSS). The wet tropospheric delay component of the electromagnetic signal ($\Delta\rho_w^{tropo}$), which is derived from the GNSS observations data analysis, is used to calculate the water vapour content in the atmosphere. It is well known, that this parameter is critical to meteorologists, because the water vapour content in the atmosphere is a key parameter in the construction of numerical weather modelling. In this article the IWV - Integrated Water Vapour has been estimated and the expected accuracy of its determination on the basis of the operational GNSS data processing from reference station network ZAKPOS and the results of aerologic sensing of the atmosphere are given.
Key words: GNSS observations, tropospheric delay, water vapour.

Introduction

The principle of the remote monitoring system of the atmosphere is based on the registration and processing of spacecraft radio signals of the Global Navigation Satellite Systems (GNSS). The distribution of radio signals from navigation satellites to ground receivers through the atmosphere is accompanied by a propagation rate decrease. This is due to the presence of nitrogen, oxygen, carbon dioxide molecules and water vapour in the atmosphere. Under the influence of external radio waves, these molecules are polarized and provide additional electrical currents in the atmosphere. As a result, the total current is different from the currents in vacuum, which leads to decreases of phase velocity of the radio waves that directly depends on the concentration of molecules. Therefore, measurements of additional delay of signal passing in the atmosphere provide information on the integrated properties of the atmosphere along the propagation path of signal. When processing observational data from space vehicles, one gets additional information in the form of files of radio signal atmospheric delays that are registered by GNSS-receivers. Due to strong correlation between water vapour in the atmosphere and tropospheric delay of GNSS-signal propagation, one can estimate the IPWV - Integrated Precipitable Water Vapour in the atmosphere based on GNSS measurements.
The first has been created in Ukrainian network of active reference stations ZAKPOS / UA-EUPOS in Transcarpathia (Savchuk S. et al., 2008). Currently, there is an intensive ongoing research to identify and take into account the errors affecting GNSS observations in the network of active reference stations, including the investigation of lower atmosphere influence (tropospheric delays of the electromagnetic signal). Tropospheric delay errors in GNSS-measurements influence primarily the overall scale of geodetic measurements, the determination accuracy of the height point above the sea level and horizontal coordinates of the observation points. The wet tropospheric delay component of the electromagnetic signal allows to determine the amount of water vapour in the atmosphere that can be used for the purposes of meteorology.
In this article the concept of exploration of the existing infrastructure of the national network of active reference GNSS-stations for remote sensing of the atmosphere to determine the content of water vapour in the atmosphere as one of the main weather creating factors is presented. The accuracy of the integrated water vapour in the atmosphere (IWV) based on GNSS observations is estimated.

Analysis of recent research and publications on this issue

Currently, the troposphere exploration using GNSS - monitoring is aimed at deeper understanding of weather and climate processes, and ultimately, improving weather forecasting (J. Bosy et al., 2011).
Weather forecasting is largely dependent on the atmospheric circulation data, in which the physical processes of dynamic mass and energy mixing (including radiation, etc.) must be known. The atmosphere is unstable in both vertical and horizontal direction. The troposphere dynamics is

considerably complicated due to fast changes of water vapour phases. The structure of the humidity field is reasonably complex and depends on many different processes in the atmosphere, so it is characterized by regular and random changes in the spatial and temporal scales. Large-scale inhomogeneities of the humidity field reach hundreds or thousands of meters. There are also small-scale humidity field inhomogeneities with dimensions from hundreds of meters to millimetres. Numerical characteristics of water vapour are used in operational meteorology for short-term weather forecasts (the distance between stations to 70 km) and for numerical weather prediction in climate applications for the whole region (the distance between stations > 100 km).

Operational weather forecast is usually based on relative humidity observations, along with pressure and temperature, determined by radiosondes and ground meteorological devices. Radiosondes are launched twice a day and determine the profiles of changes in atmospheric pressure (P, mbar), temperature (T, ˚C) and relative humidity (W, %) with height in the atmosphere. One of the main disadvantages of the radiosondes is the relatively low accuracy of the sensors as a result of contamination during their launch. On the other hand the amount of water vapour can be determined by radiometers. This tool generally provides very accurate data, but its measurements are unreliable during rainfalls, and this device is expensive. Radiosondes and ground or space water vapour radiometers are located at considerable distances from each other, and the measuring discretisation is low. For these measuring methods the vertical resolution determination of water vapour content in the atmosphere is sufficient, but spatial and temporal data distribution in these measurements is very loose and depends on weather conditions.

At the end of the last century a new method for evaluating and determining the integrated water vapour in the atmosphere (IWV) based on GNSS observations was developed. The method is based on the assessment of tropospheric delays ($\Delta\rho^{tropo}$) in the GNSS satellite signals. Preeminently $\Delta\rho^{tropo}$ can be directly related to the water vapour amount in the atmosphere and thus, it is a product that is essential for meteorologists. The advantage of this method is the possibility of its continuous implementation within the existing GNSS infrastructure (active reference station network with an exclusive control centre) and the fact that the derived water vapour estimates from the GNSS measurements do not depend on the rainfall and the presence of clouds.

Depending on the geographical location of the reference GNSS stations presently it is possible to study the detailed spatial and temporal distribution of water vapour in the atmosphere. Using GNSS allows long-term regional and global monitoring of the water vapour content in the atmosphere.

The tropospheric delay $\Delta\rho^{tropo}$ consists of two components: hydrostatic delay $\Delta\rho_d^{tropo}$ that depends on the state of the dry component of the atmosphere and the wet delay $\Delta\rho_w^{tropo}$ depending on humidity. These data values are $\Delta\rho_d^{tropo}$ - meters, $\Delta\rho_w^{tropo}$ - decimetres, IWV - millimetres. The IWV values vary from 0 to 40 mm and above. The error of 0.5 hectopascals corresponds to 0.2 mm for IWV and is acceptable for numerical weather prediction. The quality of results depends on the availability of meteorological estimations on the ground (Kablak N. et al., 2004).

Today, a number of meteorological projects have been completed: COST-71 "Exploitation of Ground-Based GPS for Operational Numerical Weather Prediction and Climate Applications" (1998-2003), TOUGH "Targeting Optimal Use of GPS Humidity Measurements in Meteorology" (2003-2006) and others. Currently an ongoing project in Central Europe, within which the zenith tropospheric delays in the regional network of GNSS stations are defined in near-real time, is E-GVAP. Its main analysis centre is located at the Royal Observatory of Belgium (ROB) (http://egvap.dmi.dk). The network currently has about 160 stations: most of them belong to the permanent network of EPN EUREF (*http://www.epncb.oma.be)* and the International GNSS Service IGS (http://igscb.jpl.nasa.gov). The continuity of water vapour determination on large areas allows to define and predict the dynamics of water vapour, and hence the rainfall in real time. Western part of Ukraine (Transcarpathian region) borders with Hungary, Slovakia, Romania and Poland. In the territory of those countries there are active reference station networks: SKPOS - Slovakia, GNSSNET.hu - Hungary, ROMPOS - Romania, ASG-EUPOS - Poland. Taking into account the geographical position of Ukraine (Transcarpathian region), and thus the station network ZAKPOS/UA-EUPOS, and cross-border cooperation with European countries, we can have accurate and frequent sample of IWV values on large areas, which allows us to define and predict the dynamics of water vapour in real time. Due to these statements the present research is caused.

Objective

The aim of this work is to evaluate the accuracy of the precipitable water vapour on the basis of operational GNSS data processing from reference station network ZAKPOS/UA-EUPOS for the purposes of meteorology.

The basic material

10% of the total tropospheric delay is the wet component of the tropospheric delay. The amplitude of the micro vibrations of the water vapour partial pressure has a random nature and can reach several millibars just in 10-20 seconds. The scale factor of partial pressure, which determines the height h_e, where e is reduced 2.72 times, varies widely – from 0.9 to 4.0 km. Within significant temperature inversion the height h_e reaches maximum values ($h_e \sim 4$ km). So the air humidity is difficult to model. And for accurate weather forecasting, one needs information of exclusive quality with high spatial and temporal distribution.

The equation for the phase method of observation is of the form (Hofmann-Wellenhof B.et al., 1997):

$$\Phi = \rho_R^S + \Delta\rho^{ion} + \Delta\rho^{tropo} - \Delta\rho^{rel} + c\cdot\Delta t^S - c\cdot\Delta t_R + \lambda N - \nu_R^S, \quad (1)$$

where ρ_R^S is the distance between the position of the GPS-satellite in the t^s era (GPS) and the GPS-receiver position in the t_R era (GPS); $\Delta\rho^{ion}$ is the ionospheric delay; $\Delta\rho^{tropo}$ is the tropospheric delay; $\Delta\rho^{rel}$ is a relativistic correction; ν_R^S is the noise measurement plus not modelling effects; c is the speed of light; N is the number of whole cycles; λ is the wavelength; $\Delta t^S, \Delta t_R$ are the satellite and receiver clock errors with respect to GNSS time system, respectively.

The phase of carrier frequency can be measured with an accuracy above 0.01 cycle, which corresponds to millimetre accuracy of the coordinates determination.

The total tropospheric delay can also be determined by means of aerologic sensing of the atmosphere using the formula (Mendes V.B. 1999):

$$\Delta\rho^{tropo} = \Delta\rho_d^{tropo} + \Delta\rho_w^{tropo} = 10^{-6}\cdot\int N_d^{tropo}dh + 10^{-6}\cdot\int N_w^{tropo}dh \quad (2)$$

where $N_d^{tropo} = K_1\left(\frac{P_d}{T}\right)Z_d^{-1}$ are the coefficients of dry air refraction; $N_w^{tropo} = \left[K_2\left(\frac{e}{T}\right) + K_3\left(\frac{e}{T^2}\right)\right]Z_w^{-1}$ are the coefficients of wet air refraction; P_d is dry air pressure, mbar; e is partial pressure of water vapour, mbar; T is temperature, K_1 is the coefficient characterizing the polarization of dry air molecules, $K\cdot$ mbar $^{-1}$; K_2 is the coefficient taking into account the polarization of water molecules, K·mbar^{-1}; K_3 is the coefficient reflecting the effect of changing the electrical orientation of polar water molecules, 10^5 K^2·mbar^{-1}.

Using the Mendeleev-Clapeyron equation we obtain:

$$N = K_1R_d\rho + \left[K_2'\left(\frac{e}{T}\right) + K_3\left(\frac{e}{T^2}\right)\right]Z_w^{-1} \quad (3)$$

where

$$K_2' = K_2 - K_1\left(\frac{R_d}{R_w}\right) = K_2 - K_1\frac{\mu_w}{\mu_d},$$

R_d = 287,06 J·kg^{-1}· K^{-1} is the specific gas constant of dry air, R_w = 461,525 J·kg^{-1}· K^{-1} is the specific gas constant of water vapour, ρ is the overall air density, μ_d and μ_w is the molecular mass of dry air and water vapour, respectively.

The delay due to the influence of hydrostatic component of the atmosphere in the zenith direction is

$$\Delta\rho_d^{\ z} = 10^{-6}K_1R_d\int_{h_0}^{h}\rho dh. \quad (4)$$

Atmospheric delay caused by the influence of water vapour in the zenith:

$$\Delta\rho_w^z = 10^{-6}\int_{h_0}^{h_{\max}}\left[K_2'\left(\frac{e}{T}\right)+K_3\left(\frac{e}{T^2}\right)\right]Z_w^{-1}dh \tag{5}$$

Using the value of the wet tropospheric delay, obtained in the GNSS observations processing, the integrated water vapour (IWV) as the total mass of water vapour in the column of air from the surface of the Earth to the end of atmosphere having the cross section of 1 m^2 can be determined by the formula:

$$IWV = \frac{\Delta\rho_w^{tropo}}{\xi}, \tag{6}$$

where

$$\xi = 10^{-6}R_w\left[K_2' + \frac{K_3}{T_m}\right].$$

In the last formula, the average temperature T_m can be determined by means of the relation (T.A. Herring et al,1992)

$$T_m = \frac{\int_{h_0}^{h_{\max}}\frac{e}{T}Z_w^{-1}dh}{\int_{h_0}^{h_{\max}}\frac{e}{T^2}Z_w^{-1}dh} \tag{7}$$

From the gas equation of state we obtain:

$$\left(\frac{e}{T}\right)Z_w^{-1} = \rho_w R_w$$

where ρ_w is water vapour density. Then the wet delay component will be:

$$\Delta\rho_w^{tropo} = 10^{-6}R_w\left[K_2' + \frac{K_3}{T_m}\right]\int_{h_0}^{h_{\max}}\rho_w dh. \tag{8}$$

The IWV value can be easily converted into units of length if we divide it by water density ($\rho(H_2O) \cong 10^3$ kg·m^{-3}). Then it is interpreted as the height (in mm) of water column of 1 m^2 cross section, derived from the condensed steam. It can be called a precipitable water vapour or just precipitable water (*PW*):

$$PW = \frac{1}{\rho_{H_2O}}\int_{h_0}^{h_{\max}}\rho_w dh. \tag{9}$$

It is obvious that 1 kg·m^{-2} of *IWV* corresponds to 1 mm of *PW*.
The IPWV value is calculated from the relation

$$IPWV = \frac{IWV}{\rho_w}. \tag{10}$$

Thus, for the transition from $\Delta\rho_w^{tropo}$ to the precipitable water vapour it is necessary to know the average temperature of the atmosphere above this point. The average temperature depends on the surface temperature with the correlation coefficient close to unity. For this purpose one needs to build a regression relation of the average temperature T_m and the Earth's surface temperature T_0 at the points of observation.

Experimental research

The value of the precipitable water vapour *IWV* (6) is definitely determined by $\Delta\rho_w^{tropo}$, which can be calculated by different methods:

- from GPS observations with the removal of the hydrostatic component;
- basing on aerologic sensing of the atmosphere;
- modelling representations using ground values of meteorological parameters.

Synchronous meteorological parameter measurements on the Earth's surface were used for the research, as well as aerologic sensing data of the atmosphere and delay values from network processing ZAKPOS during the year.

To estimate the errors of *IWV* determination we take into account the formulas (6), (7) and (8). The wet delay $\Delta\rho_w^{tropo}$ is determined by extracting from the total tropospheric delay $\Delta\rho^{tropo}$, obtained from GNSS measurements, and using the hydrostatic component of the atmospheric delay $\Delta\rho_{m,d}$ determined from the model:

$$\Delta\rho_w^{tropo} = \Delta\rho^{tropo} - \Delta\rho_{m,d} . \quad (11)$$

In most cases when processing GNSS data the Saastamoinen Model (Saastamoinen I.I., 1973) is used to calculate the hydrostatic component of the tropospheric correction $\Delta\rho_{d,c}$. According to the Saastamoinen Model the hydrostatic component of the tropospheric delay is calculated from the measured values of ground pressure at each station for which we know the latitude and altitude above sea level.

To explore the accuracy of *IWV* determination, the results of aerologic sensing of the atmosphere at UT=0^h i UT=12^h hours during the year in Uzhgorod were used. Based on these results the total delay $\Delta\rho_{aer}^{tropo}$ and separately the hydrostatic $\Delta\rho_{a,d}$ and wet $\Delta\rho_{a,w}$ components of the tropospheric delays were calculated. For the same time points the $\Delta\rho_m^{tropo}$, $\Delta\rho_{m,d}$ and $\Delta\rho_{m,w}$ were calculated based on ground meteorological parameters (temperature *T*, pressure *P*, humidity *W*) using the Saastamoinen Model and local model, as well as absolute tropospheric delays $\Delta\rho^{tropo}$ derived from GNSS observations on the same time points were found.

In the radio range, temperature inversions have a great influence on the tropospheric delay value, which cause the growth of the partial pressure of the atmosphere that affects the value of $\Delta\rho_{aer}^{tropo}$ and $\Delta\rho^{tropo}$. Modelling representations of tropospheric delays $\Delta\rho_m^{tropo}$ do not include the vertical distribution of meteorological parameters in the atmosphere, where temperature inversions are often observed. According to the sensing data of the atmosphere in Uzhgorod, there was explored that in 3 km height of the atmosphere, temperature inversions are observed in 73-97% of cases. Inversions in the layer of (8 – 18) km (upper layer) are observed in 20-40% of cases. Particularly strong inversions were observed at night in winter, mainly due to radiation inversions. The distribution of water vapour at different altitudes has irregular changes. There is no correlation between ground humidity values and its changes with heights. The average contribution of temperature inversions to the atmospheric delay ranges from 29 mm to 64 mm, humidity inversions: from 3 mm to 15 mm. Thus, the difference ($\Delta\rho_{aer}^{tropo} - \Delta\rho_m^{tropo}$) can reach 5-6 cm.

The $\Delta\rho_{aer}^{tropo}$ value cannot be considered completely accurate. The number of levels, on which the aerologic parameters were measured, depends on the frequency of the radiosonde query and the h_{ul} height of the upper limit of measurements. h_{ul} ranges from 5 to 20 km. The number of levels at one sensing ranges from 15 to 90. The measurement accuracy of aerologic parameters depends on the radiosonde type. In our case it is: $\Delta P = \pm$ 1 mbar, $\Delta t = \pm$ 0.8 ^{0}C and $\Delta W = \pm$ 5%. This allows us to determine the refractive index of air with an error of $1 \cdot 10^{-6}$·. The error of $\Delta\rho_{aer}^{tropo}$ in the zenith, caused by measurement errors of the meteorological parameters, varies from 0.006 to 0.012 m.

To explore the accuracy of modelling representation $\Delta\rho_{m,d}$, the hydrostatic delay was calculated by the Saastamoinen Model ($\Delta\rho_{d,S}$), by a local model ($\Delta\rho_{d,l}$), which takes into account the regional, local and topographical features of observation points (Kablak N. 2011), and by aerologic sensing of the atmosphere ($\Delta\rho_{d,aer}$). The estimations of differences between them are given in the following table:

	Averaged values, m	Standard deviation, m
$\lvert\Delta\rho_{d,aer} - \Delta\rho_{d,l}\rvert$	0.0028	0.0048
$\lvert\Delta\rho_{d,aer} - \Delta\rho_{d,S}\rvert$	0.0092	0.0086

The $\Delta\rho_{d,l}$ value calculated by the local model is better consistent with the values calculated on the basis of aerologic sensing $\Delta\rho_{d,aer}$ than $\Delta\rho_{d,S}$. Only in 9 cases out of 56 $|\Delta\rho_{d,aer} - \Delta\rho_{d,l}|$ is greater than $|\Delta\rho_{d,aer} - \Delta\rho_{d,S}|$.

Thus, we can assert that the created local model of hydrostatic delay determination in Uzhgorod is better consistent with $\Delta\rho_{d,aer}$ than the Saastamoinen Model.

The differences of $\Delta\rho_{m,d}$ average values determined by two methods (by aerologic sensing data and by Saastmoinen model) reach 1 cm. This corresponds to the IWV difference - 1.5 mm. In some cases, when the $\Delta\rho_d$ determination accuracy by modelling representations is 3-4 cm, the precipitable water vapour will be determined with an error of 5-6 mm. Therefore, to improve the accuracy of the precipitable water vapour (*IWV*) determination on the basis of the operational GNSS data processing it is reasonable to use local modelling representations for the hydrostatic component of the tropospheric delay.

From the GNSS measurements we have the total tropospheric delay $\Delta\rho^{tropo}$. If the GNSS measurements were carried out only in the zenith direction (the satellite for this point is at the zenith), the accuracy of the $\Delta\rho^{tropo}$ determination would be estimated only by the accuracy of excluding the errors of the pseudo distance equation components. It is believed that the radio signal in GNSS observations passes through the Earth's atmosphere immediately. That is, the real state of unstable atmosphere at a given time is taken into account. However, the $\Delta\rho^{tropo}$ value is determined from the solution of the pseudo distance equation after exclusion of other errors and, besides, the $\Delta\rho^{tropo}$ is estimated not directly at the zenith, but at a certain zenith distance, which is reduced to the zenith by means of mapping functions. In most cases, while GNSS measurement processing the Neill's mapping function is used, which is not dependent on the meteorological parameters (Niell A. E., 2001). The error of the Neill's mapping function at $Z = 75^0$ is 5-6 cm and increases to 20 cm at $Z = 85^0$.

According to model representations of the mapping functions it is considered that the atmosphere is homogeneous, i.e. the horizontal gradients of refraction are not taken into account. Horizontal gradients of refraction bring error into the determination of the tropospheric delay at 3-5 cm at $Z = 83^0 - 85^0$ (N.Kablak et al, 2005).

To determine the precipitable water vapour (*IWV*) by the formulas (6) and (7), we need to know the average temperature T_m of the atmosphere above this point. At a certain atmosphere altitude *h* the meteorological parameters *e* and *T* can be determined by means of aerologic sensing of the atmosphere but it is not possible to carry out in every point, moreover, continuously and synchronously with GNSS-measurements. That is why the correlation between T_0 (ground temperature) and T_m which is calculated by the formula (7) in those moments when *e* and *T* are measured at different altitudes *h* within the troposphere is found. In determining the average temperature it is suggested to use this regression dependence on ground temperature:

$$T_m = a\,T_0 + b. \qquad (12)$$

Depending on the obtained coefficients when determining the average temperature in the troposphere by the values of ground temperature, the *IWV* value varies from 0.3 to 1.0 mm.

Therefore, to improve the accuracy of the precipitable water vapour determination on the basis of the operational processing of GNSS data it is reasonable to use local values of the correlation dependency coefficients of T_m on T_0.

The denominator of (5) ξ is determined by the constants R_w, K_2', K_3 and the average temperature T_m, which can be found by the formula (6). The maximum error value of the determination $K_2' = 17 \pm 10\ \mathrm{K\,mbar^{-1}}$ gives the error in determination $\Delta(IWV) = 0.3 - 0.9\ \mathrm{mm}$. The maximum error value of the coefficient determining $K_3 = (3.776 \pm 0.004) \cdot 10^5\ \mathrm{K\,mbar^{-1}}$ gives the error of $\Delta(IWV) \approx 0.02\ \mathrm{mm}$.

To assess the accuracy of the precipitable water vapour, the *IWV* value was also determined according to aerologic sensing of the atmosphere using the gas equation of state:

$$eV = \frac{m}{\mu} RT \ . \tag{13}$$

We accept that the volume V is a water vapour column in the atmosphere with height h, cross section S, and mass m. Then, for a homogeneous atmosphere (9) it takes the form:

$$eh = \frac{m}{S} \frac{R_w}{\mu} T \ .$$

As in the real atmosphere the quantities e and T are functions of height and integrated water vapor is

$$IWV = \frac{m}{S} \ ,$$

then from the gas equation of state we get the following formula to calculate the integrated water vapour IWV_e by aerologic observations of water vapour pressure e and temperature T:

$$IWV_e = \frac{\mu}{R_w} \int_{h_0}^{h} \frac{e(h)}{T(h)} dh \ . \tag{14}$$

In the formula (12) the integration is carried out on the height of point h_0 to the height of wet atmosphere h.

During the research period of the precipitable water vapour calculated by this method varies from 2.3 mm in winter to 42.75 mm in summer.

The relative error (d) is:

$$d \ = \ \frac{IWV - IWV_e}{IWV_e} \ ,$$

2,7% in average.

The IWV value determined by the results of GPS observations in average are larger than IWV_e, obtained by formula (14) based on aerologic observations. The differences between IWV and IWV_e values lie in the range from 0.2 to 1.6 mm. This is explained by the fact that IWV determination errors are laid in the very method of water vapour determination.

Thus, the IWV values based on operative data processing from the permanent station network ZAKPOS are calculated using ground meteorological data, such as temperature and pressure, as well as radio sensing data. The results are presented in a tabular form and in a variety of graphical forms. The figure provides IWV values determined on the basis of operational GNSS data processing from reference station network ZAKPOS in the form of isolines. Due to the implementation and ongoing operation of the Ukrainian network of active reference stations ZAKPOS / UA-EUPOS, now it is possible to process GNSS IWV data in real time with the discreteness of 1 min.

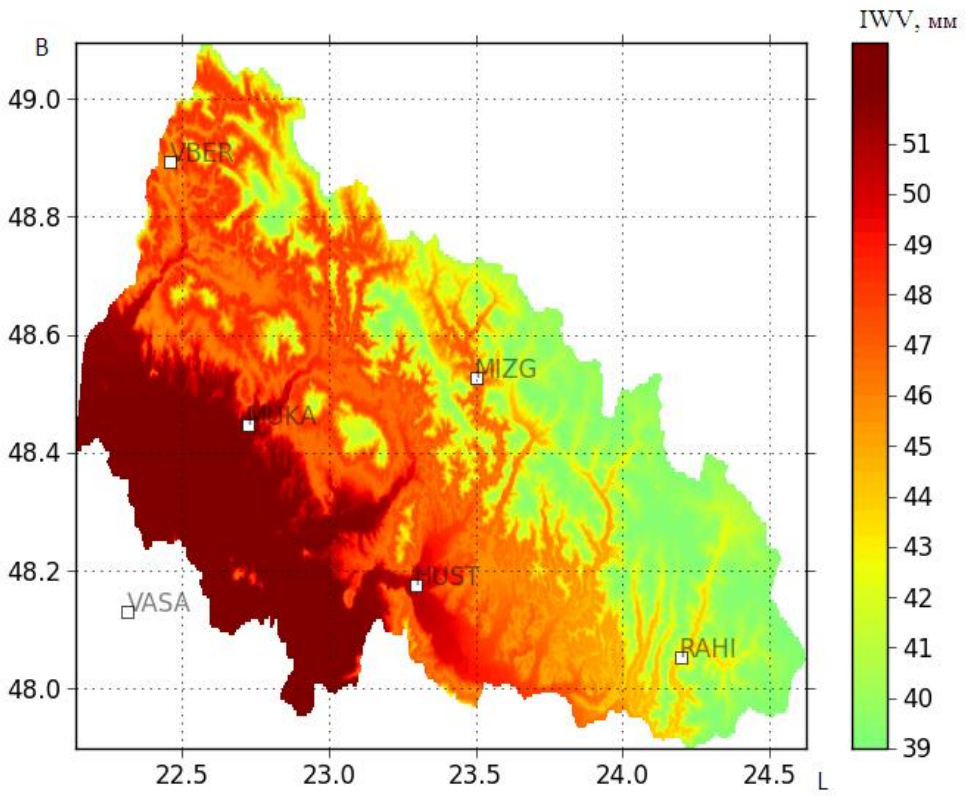

Fig. 1. Precipitable water vapour (15.07.2012, 00^h00^mUT).

Conclusions

The analysis of water vapour determination in the atmosphere during the year based on GNSS observations and aerologic sensing of the atmosphere showed:

- the average difference of the zenith atmospheric delays obtained by two methods used for the determination of water vapour in the atmosphere is about 1.5 cm; error of $\Delta\rho_{aer}^{tropo}$ in the zenith, which is caused by measurement errors of the meteorological parameters, varies from 0.006 to 0.012 m;
- the average differences of hydrostatic atmospheric delays calculated basing on aerologic sensing and the Saastamoinen Model, about 1 cm;
- the calculated *IWV* values vary from 0 to 43 mm. The differences of *IWV* values determined by the results of GNSS observations and IWV_e, derived from aerologic observations lie within the range of 0.2 to 1.6 mm.

To improve the accuracy of the precipitable water vapour values (*IWV*) on the basis of operational GNSS data processing it is needed to:

- use the local modelling representation for the hydrostatic component of the tropospheric delay;
- know the pressure and temperature on the ground;
- know the average temperature T_m, which correlates well with the ground temperature T_0;
- use appropriately the local values of coefficients of the correlation dependency of T_m on T_0.

Providing such conditions we should expect the increase of *IWV* accuracy to 1.5 mm.

This *IWV* error estimation applies to measurement at a particular time (single). Due to one-a-second (continuous) GNSS measurements, we should expect the increase of *IWV* accuracy. Basing on observations of GNSS network stations ZAKPOS and using cross-border cooperation with European countries, we can have accurate, dense and frequent sample of *IWV* values on large territories, which allow us to define and predict the dynamics of water vapour changes in real time.

In connection with importance of the given research we have elaborated the project HUSKROUA/1101/252 “SPACE EMERGENCY SYSTEM – cross-border system for pre-diction of natural disasters incidents on basis of exploitation of satellite technologies in Hungary, Slovakia, Romania and Ukraine” in the framework of the Cross-Border Cooperation Programme Hungary-Slovakia-Romania-Ukraine 2007-2013.

Within this project launch and stable operation of the system of cross-border area monitoring in real time is planned. It will assist solving the problem of timely pre-diction of natural disasters incidents, climate and environmental monitoring of the given area.
Thus, activities of this project as a multifunctional and integrated system will cause:

- carrying out international research and observations in field of geodynamics, meteorology, study of atmospheric processes etc;
- continuous atmosphere tomography;
- environmental monitoring (space-time changes of content of integrated water vapour in troposphere, pre-diction of thundershowers, floods etc);
- use of obtained data for improving accuracy of long-term weather forecasts.

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Information about authors

Ivan Kalynych, Doz., Dr.Sc., Uzhgorod National University, e-mail: kalunu4@gmail.com
Stepan Savchuk, Professor, Dr.Sc., National University Lviv Polytechnic, Lviv, Ukraine, e-mail: ssavchuk@polynet.lviv.ua
Nataliya Kablak, Doz., Dr.Sc., Uzhgorod National University, e-mail: kablak@mail.ru
Oleksander Reity, Doz., Dr.Sc., Uzhgorod National University, e-mail: okreity@gmail.com

PROGRESSION ROUTE OF LAND CONSOLIDATION IN LATVIA

Velta Parsova[1], Edvins Kapostins[2], Virginija Atkoceviciene[3], Vilma Sudoniene[3]
[1]Latvia University of Agriculture, [2]Ministry of Environmental Protection and Regional Development of Latvia, [3]Aleksandras Stulginskis University (Lithuania)

Abstract
The main reason of land fragmentation in Latvia was the restitution of ownership rights to former landowners or their heirs, as well as the land acquisition by other persons in the process of the land reform. As a result the ownership structure was obtained which is not competitive in the aspect of production efficiency. Different instruments as land consolidation, land reallotment and others can be applied for the reduction of land fragmentation. The reduction of land fragmentation should play an essential role in the use of the land corresponding to the spatial development plans which determines perspective land use. Therefore the improvement of the ownership structure should be one of the stages of land use planning.
Key words: land fragmentation, land consolidation, cadastre information system, land use, spatial plan

Introduction

Land fragmentation is a problem in almost all European countries. The implementation of the land reform in Latvia resulted in fragmented land ownership structure, significantly complicating the use of the land. It is a common problem in rural areas and in some cases in urban areas, too. The distance between land parcels might reach more than ten kilometres. Therefore efficiency of land use is significantly reduced by higher transportation, land cultivation and harvesting costs. The complicated shape of land parcels requires different treatment (Lemmens, 2010). The land market and the public sector are not able to guarantee the appropriate development of efficient land use, as well as solve the consolidation of the ragmented land.

One of the main principles of the Land Policy is to create the best possible conditions for land use and its sustainability. The promotion of the development of territory use is one of the most important responsibilities of the local government because it is one of the ways how to facilitate economic development and to improve land use ensuring its higher productivity. Land consolidation can be one of the most effective means of reducing land fragmentation. In the future land consolidation will become an integral part of land administration to implement the formation of rational real property structure and to adopt new legislative acts accordingly. In the process of solving the problem of land fragmentation it is necessary to involve both personal and public initiative (Lisec, Sevatdal, 2012).

The land consolidation concept is rather rarely used in Latvia even for describing the experience in other countries. Until now no land consolidation projects have been implemented in Latvia because it was supposed that the best consolidator is the land market. However, small-size land parcels are not competitive in modern farming situation.

Land reallocation is going to be implemented in some places as a separate process or as part of the land consolidation process. As regards land reallocation, the state is an important actor. Mostly it is the initiative of the government therefore land reallocation occurs when the government decides to redevelop certain areas for the benefit of a wider community. Besides statutory land reallocation, there is also voluntary reallocation. It is a fairly popular tool nowadays which can be particularly successful if the number of participants is not too large (Munro-Faure, Palmer, 2012).

From the above mentioned the conclusion can be made that until now different solutions have been used for the prevention of land fragmentation. It is necessary to identify different suitable instruments for the reduction of land fragmentation to be applied in the case of Latvia and its conditions.

As land consolidation issues have not received sufficient attention in Latvia yet, there is an urgent need to do research, develop respective legislative acts and methodology, as well as incorporate land consolidation in the pattern of land policy.

Methodology of research and materials

The study was carried out on the basis of the results of the land reform. Statistical data of the Cadastre information system of State Land Service and other sources were used for describing land stock and results of the land reform. Generally, the ratio (percentage) of area registered in the Cadastre in relation to the total area of a municipality as measurument of the land reform success was used. The ratio of the land registered in the Cadastre and returned to former owners or their heirs, other physical and legal persons, the state authorities and municipalities in the frame of the land reform was used.

As a tool for the facilitation of territory use development and the reduction of land fragmentation on the territory of the local municipality, the authors offer a package of measures for the reorganisation of land properties which has to be realised as a long-term activity. These measures are focused on the reduction or elimination of disadvantages of the land reform, real property formation and transactions. This package of measures provides development of the thematic spatial plan as a basis for reorganisation of real property structure of the whole territory of the local municipality or a part of it. The thematic spatial plan is observed as one of the spatial planning documents intended as a plan to be developed on a cartographic base of the Cadastre map. The main objective of the thematic spatial plan is to provide compliance of real properties with the planned land use.

One of the first tasks before developing the thematic spatial plan is to evaluate the territories where there is a necessity to improve the structure of real properties in accordance with their intended purpose and to determine territories where there is a necessity to form monolithic land plots, and where the formation of monolithic land plots is a priority. Land consolidation is not necessary everywhere and not all types of land use require transformation of real properties. There are some places where it even could be prohibited because land fragmentation has not only negative but also a positive side. For instance, some degree of fragmentation is preferable for ecological, scenic and recreational quality (Williamson, Enemark, 2010).

In most cases the thematic spatial plan will be developed for certain agricultural territories having high level of fragmentation of agricultural land, int.al. inter-areas. However, the authors hold the view that the development of such plans is applicable in the cases when fragmentation of real properties exists in territories for industrial construction, business (commercial), forestry and other areas. It means that the thematic spatial plan can be developed both for agricultural territories and for territories of other intended purposes.

The development of the thematic spatial plan for the reduction of land fragmentation provides a framework for the formation of monolithic land plots. A perspective monolithic land plot is a land parcel or a set of land parcels owned by a person together with land parcels owned by other persons, having a common external boundary. So the perspective monolithic land plot may consist of several land parcels (or parts of land parcels) owned by different persons. The perspective monolithic land plot may also contain land parcels of leased land. In the planning process it is necessary to carry out the analysis of perspective use of the territory, existing buildings and infrastructure, drainage systems, etc. (Parsova, Jankava, 2012) The formation of monolithic land plots is based on the information about land parcel boundaries therefore the following principles have to be taken into account:

- The territory of monolithic land plots has to be formed in a compact shape, preferably without inter-areas;
- inter-areas are acceptable only as meadows or forests, or if a residential building is located in the village;
- boundaries of monolithic land plots are preferable to allocate along natural features - rivers, streams, large ditches, as well as state and municipal roads;
- boundaries along rivers, streams and large ditches have to be allocated midline;
- boundaries along roads usually are allocated on the road edge;
- in open areas, particularly in the fields, boundaries of monolithic land plots have to make straight lines without fractures, their turning angles have to be close to 90^{O} in order to form fields suitable for mechanized management;
- an external boundary of a monolithic land plot may not correspond with surveyed or allocated boundaries of land parcels, but, if that is possible, existing boundaries should be taken into account.

The following priorities have to be taken into account when designing monolithic land plots:

- Priority 1 – a landowner lives in the building located on the land parcel and uses the land according to planned perspective land use;
- Priority 2 – a landowner does not live in the building located on the land parcel but uses the land according to planned perspective land use.

A landowner using the land according to planned perspective land use always has priority. In such a case the perspective monolithic land plot has to be developed near the farmstead.

The object of the research is land stock of Latvia and the structure of real properties created as a result of the land reform.

Discussions and results

Characteristics of the structure of land properties after the land reform. The land reform was one of the first steps of the agrarian reform after the restoration of independence. The objective of the land reform was to reorganise the legal, social and economic relationships of land property and land use through its gradual privatisation (Zemes reforma – atslēga…, 2012). However, in spite of the objectives of the land reform in Latvia, the property structure established in Latvia does not comply with effective land use and land development requirements. Fragmentation often is the result of the system of inheritance where the land is divided among heirs resulting in many parcels of land (Parsova, Gurskiene, 2012). During the land reform former owners and their heirs, as well as other persons could apply for acquisition of the land in ownership. If the land belonged to one former owner often three or more heirs applied for restitution of ownership rights. In such cases the land was divided into the corresponding parts and assigned for ownership.

After more than 50 years of the Soviet period, the situation in land use had changed substantially. The former boundaries remained neither in the documents and nor in the terrain. During the land reform former owners frequently requested the restoration of land ownership, land use and boundary allocation according to the rules before the year of 1940 despite the current situation in land use (Dambite, Parsova, 2010). As a result the land properties were created where it was complicated to use the land for its intended purposes, sometimes persons owned only the land without buildings and other means of production on it thus being unable to manage the land (Sudoniene, Atkocevičiene, 2011). In some cases the previous activities of land owners have not been relevant to agriculture. The analysis of the Cadastral map shows that land parcels of one land property were located as inter-areas, often wide apart (Jansone, 2008) (Figure 1).

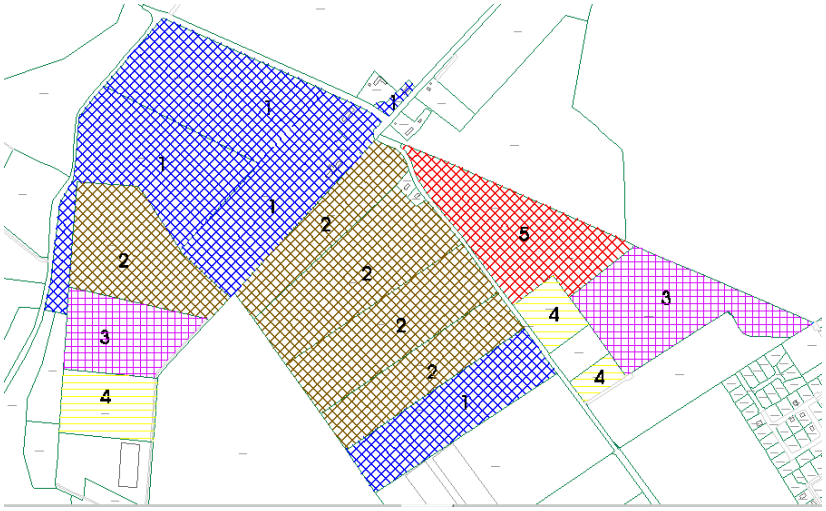

Fig. 1. Territorial location of land parcels included in composition of land properties

Table 1 shows the breakdown of land properties in compliance with the number of land parcels included in the composition of land property.

The majority of real properties (90%) in rural areas consist of one or two land parcels. However, large numbers of land properties consist of three and more land parcels. The location of land parcels and their size do not satisfy all requirements of rational and efficient land use. The mentioned examples and information confirm that real property structure is a problem. Its solution cannot be delegated just to the free market; the enforcement of administrative and financial instruments is necessary.

Table 1

Land parcels included in composition of land properties in rural areas (on 01.12.2013)

Number of land parcels in one land property	Number of land properties	% of total number of land properties
1	394,599	75
2	76,837	15
3	28,008	5
4	11,594	5

5	5,389	1
6-10	5,931	1
11-20	1,180	-
21-100	411	-
>100	8	-

One of the indicators characterising the structure of land properties, is average acreage of land parcels. According to the data of the Cadastre information system, the average area of a land parcel owned by natural persons in rural areas is 7.47 ha, int.al. agricultural land - 4.52 ha. Land parcels owned by legal persons are slightly larger – the average area is 14.33 ha, int.al. agricultural land - 8.44 ha (Platonova, Setkovska, 2011) (Table 2).

Table 2

Average area of land parcels

	Average area of	
	land parcels, ha	**agricultural land per parcel, ha**
In ownership and use of natural persons	7.47	4.52
In ownership and use of legal persons	14.33	8.44

The analysis of the data of the Central Statistical Bureau in 2007 with regard to the structure of land properties showed that its average area was 25.5 ha, int.al. agricultural land - 17.0 ha. In comparison with 2001, the average area of land properties had increased approximately by 4 ha. However, the number of land properties, the area of which exceeded 10 ha, made more than 60% of the total number of land properties. During last 10 years this trend shows an increment of small-size properties. Analyzing this information in connection with the information on the average size of land parcels, it can be concluded that the location of land parcels and their size does not cover all requirements of rational and efficient land use and protection.

Land use planning and property structure. In 2008 the government of Latvia approved Land Policy Guidelines which state that the objective of land policy is to ensure the sustainable use of land as a unique natural resource. Concerning the land as a resource and its use, one of the preconditions for land use sustainability is spatial planning, including the development of land use plans at the municipal level. Local governments play one of the main roles in realisation of land policy and land management. Planning of territory development by local governments influences the use of the land owned by natural and legal persons located in the particular administrative territory to a great extent. They perform land monitoring as well as ensure land management of the land owned by the local government and the reserve land. Facilitation of development of territory utilisation, including land consolidation, is the most important responsibility of the local government because it is one of the ways to promote economic development on territory of the local municipality and to improve and rationalise land use achieving its higher efficiency and providing more land for public purposes. To ensure sustainable territory development and realisation of planned land use, it is necessary to establish an appropriate structure of land properties. The plan of territory development sets requirements for the size of land parcels, their location, compactness, etc. (Figure 2).

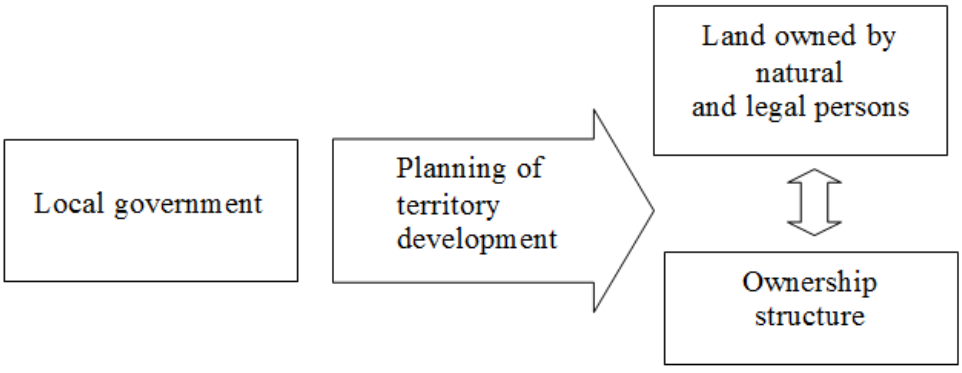

Fig. 2. The role of local government in land management.

The spatial plan is a planning document which identifies possibilities, directions and limitations of the development of the local municipality and prospective land utilisation, including the development of all kind of construction, inter alia construction of transport and utility infrastructure. These plans are relatively detailed. They reflect the present and planned (permitted) utilisation of the territory and the restrictions on the utilisation of such a territory; besides, planned use in long-term (12 years) perspective for each land parcel is determined. The spatial plan is approved by the binding regulations of the local government and it is the legal basis on which the decision regarding the use of each specific land property is made (Paršova, Kāpostiņš, Giluča, 2012).

Land fragmentation from the aspect of land use causes significant inconvenience in the areas where the primary use is agriculture; in fact, land fragmentation is most commonly encountered exactly in agricultural territories. Land fragmentation encumbers the organization of agricultural activities and increases the cost of production (Paršova, Kāpostiņš, 2012).

Land property structure has an essential importance in urban areas, too. For example, the spatial plan invisages the construction of an industrial park, but a large number of small-size land properties are located in this territory. In such a case any development projects may be realised only if the use of land properties agrees with the plans for this territory.

Tools for reducing land fragmentation. With regard to activities designed to reduce land fragmentation, the following three questions should be answered: *whether, when and how*? The question "*whether*" has been discussed in the text above describing the results of the land reform and ownership structure, int.al., the size of land parcels and farms. The situation can be characterised not only by the size of land property. Land consolidation is an integral part of rural development, however, it has often been neglected. During last twenty years the situation in different parts of Latvia has changed substantially, and indications of degradation of socio-economic environment in rural areas can be observed. If, at the beginning of the land reform, prospective landowners were full of enthusiasm, the market economy disappointed many of them and not all of them were able to survive in the competition. As a result, people moved from rural regions and territories to cities and towns, or even migrated to other countries. Therefore relatively large land areas are abandoned. The data show that in 2010-2011 approximately 16% of agricultural land was not used and gradually became overgrown. This is another factor providing the answer to the question why we have to look for solutions.

We have to answer the question "*how*". The answer to this question will give an answer to the question "*when*". From the above mentioned the conclusion can be made that different solutions have been used for the prevention of land fragmentation up to now. But there is a question, whether traditional solutions that work well and are implemented in one country, are automatically transferable to any other country hoping that these solutions will be applicable and effective there. However, it is clear that each country has its own characteristics and differences from other countries circumstances and traditions, as well as the framework of real estate legislation. Therefore, as regards the case of Latvia, it is necessary to look for different suitable instruments for the reducing land fragmentation.

The world practice shows that a range of different tools are used to prevent land fragmentation. One of the most well known instruments is land consolidation. In general, land consolidation is a set of procedures that enhance the quality of life and encourage non-agriculture activities as well as improve the efficiency of traditional farming. In previous years the main emphasis in land management was on the land reform, while the land consolidation concept was rather rarely used even for describing the experience of other countries. The situation in Latvia differs from that in some regions of Central and Eastern Europe where land fragmentation characterizes farms consisting of up to 15 small land units, some less than one hectare in size. Property structure in rural areas can be described as uneconomic farming.

Limitation of further land fragmentation. Improvement of the property structure may be realised by decreasing land fragmentation, at least by preventing its further spread, especially in the areas where land fragmentation has a significant impact on the efficiency of land-use. To improve the situation, in 2010 the development of the Law on Land Management was started aimed to promote sustainable land administration providing efficient and effective monitoring of the use and protection of the land. To achieve these objectives, restrictions were imposed on further land fragmentation, as well as the transformation of agricultural land into non-agricultural land on the territory recognized as agricultural area of national importance or where the value of the land quality is more than 50 points (Baumane, 2009). For instance, if a land parcel is located in an agricultural area of national importance and its main economic activity is agriculture, it is not permitted to form land parcels with the size less than 10

ha. There are exceptions, for example, a land parcel has a farmstead. The remaining part of a land parcel, if its size is less than 10 ha, has to be joined to the neighbouring land parcel.
Restrictions of land fragmentation also are envisaged in ongoing physical planning process by adoption of the regulations on land use and construction by the local municipality, as well as mandatory binding regulations for all property owners. In addition, the Cabinet of Ministers in nearest future will adopt "General regulations on physical planning, land use and construction" for municipalities in order to introduce a common practice of limitations of land fragmentation. This document will define that the minimum area of a newly formed land parcel in rural areas is 2 hectares. It means that local municipalities will have the right to set a higher minimum area of a newly formed land parcel in order to limit further land fragmentation. The above mentioned is related to the measures of restricting further fragmentation of the land in areas where it is not desirable. On the other hand, land fragmentation features not only a negative side but also a positive side. For instance, some degree of fragmentation is preferable for ecological, scenic and recreational purposes (Parsova, Kapostins, 2011).
Perspective of land consolidation. What should be done in the area, where territory development plans envisage, for example, agricultural production, but the land property structure is completely inappropriate for it? To solve such situations, the project of the Law on Land Management includes a general framework for land consolidation. Land consolidation is defined as the set of measures which include rearrangement of land parcel boundaries and respective ownership rights, as well as leasehold. The above mentioned project states that the land consolidation process should be based on the following principles:

- principle of voluntary participation - land owners participate in land consolidation process voluntarily;
- principle of effectiveness and profitability – properties, created in land consolidation process, guarantee more efficient and rational use of land and increases improvement of environment;
- principle of equivalence – exchange of land parcels, involved in land consolidation process take place taking into consideration proportionality of real property value;
- principle of fairness - for ensuring of land consolidation process the land can be expropriated on contractual basis and for fair compensation;
- principle of respecting of public interest – individual interests are balanced with public interest in land consolidation process as much as possible;
- principle of participation and openness - land consolidation process provides participation of people and harmonizes interests of landowners and society.

Procedure for land consolidation. Considering the above mentioned that one of the principles of land consolidation is voluntary participation, results greatly depend on involvement of landowners and their activity. The authors consider that, before starting the land consolidation process, it is necessary to carry out a survey among landowners. Landowners' viewpoints are very important in the current situation to clarify reasons of inefficient use of land, intentions of landowners in conservation of their ownership or dealings with the land, motivating factors regarding participating in land consolidation process or in avoiding it. The authors consider that the survey of landowners might also serve as a promotion activity of land consolidation and information of landowners. The previous experience shows that knowledge and information regarding land consolidation is very insufficient.
The project of the Law on Land Management provides that land consolidation may be initiated by:

- at least two landowners whose land is located in particular administrative territory;
- the state authority or state enterprise, if land consolidation is necessary for development of objects of national interest;
- a local municipality at request of more than a half of landowners or on its own initiative.

The local municipality evaluates local spatial planning documents and other circumstances and makes either a positive or a negative decision on the development of land consolidation project.
However, in order to evaluate documents and make an informed decision on the development of land consolidation project or its rejecton, the authors consider that the development of the thematic spatial plan as a basis for reorganisation of real property structure for the whole territory of the local municipality or a part of it is necessary as one stage of spatial planning. The thematic spatial plan is one of the spatial planning documents intended to be developed on the cartographic base of the Cadastre map. The main objective of the thematic spatial plan is to provide compliance of real properties with the planned perspective land use because land consolidation is not necessary everywhere and not all types of land use require transformation of real properties; the elimination of

land fragmentation is not an end in itself. It has to go hand in hand with the spatial planning. The thematic spatial plan can be developed both for agricultural and territories of other intended purposes.
The local municipality prepares conditions or terms of reference during the decision making process taking into account land consolidation financial issues and if existing spatial planning documents set achievable goals. At the same time document should describe all the properties within the affected area, including important environmental areas such sites of scientific interest.
Land consolidation process is provided by the local municipality within its competence, and the State Land Service carries out methodological management of land consolidation process.
Land consolidation financing. Land consolidation is relatively expensive and time-consuming process. Expenses of land consolidation projects are high including not only the land surveying and project development costs, but also expenses related to improvement of rural infrastructure taking into account the new situation concerning the shape and areas of newly formed land parcels. Land consolidation results to a great extent depend on financial resources to support this process. During the last decade frequent debates took place regarding the questions: who is responsible for what and who is going to finance land consolidation. According to the practice of other countries, land consolidation projects can be realised if this process is financially supported by the state or using other means. In the frame of the Rural Development Programme 2007-2013 the EU support for the activities of land consolidation were envisaged. There are some countries where land consolidation is partly financed by the EU funds (Lithuania) or other donors (Armenia). There are countries (Finland, Sweden) where land consolidation is partly financed by the state. But how to deal with the issue of land consolidation in the circumstances where the state does not have necessary resources? So far, in Latvia financial support as an instrument for improvement of ownership structure has been assigned neither by the state nor by other funds. Wherewith it is necessary to look for different facilities for reducing land fragmentation, which would not be too complicated, too lengthy and would be usable for conditions of Latvia, specially keeping in mind that the success in one country does not guarantee the success in another.
If the state or local municipalities cannot directly support implementation of the land consolidation process in form of grants, one of the options could be involvement of landowners in land consolidation measures using indirect support tools, for example, exemptions from duties and taxes, which are payable for transfer of ownership. In Latvia real property deals require payments of the state fee of 2% of higher value - cadastral value or transaction price. Another options could be exemption of landowners from the property tax for 3 - 5 years after the completion of land consolidation process. Such initiatives could create a friendly climate for introduction of land consolidation process.

Conclusions and proposals
The aim defined in the land policy is to create best possible conditions for land use and its sustainability. However, it is clear that the long time period will be necessary for correction of failures in land use and further ensuring of sustainable land use. The improvement of the land property should be conducted in close interface with the spatial planning development and land administration process. Land consolidation could be considered as one of the instruments of the implementation of spatial planning. Consolidated land properties corresponding to the intended purpose defined in the spatial plan and property structure appropriate to planned land use can be successfully used for realisation of production-oriented projects and increase of production efficiency.
Results and benefits of real property consolidation can be formulated as follows:

- property consolidation reduces and eliminates disadvantages of the land reform, real property formation, real property transactions, and fragmentation of real property structure;
- development and realisation of thematic spatial plans can ensure the compliance of real properties with requirements of rational and efficient land use and create circumstances for the best possible land use and sustainability forming the basis for regional development;
- property consolidation establishes the frame for more effective support for the purchase of land for Latvian farmers and promotes reduction of unused territories.

The results of land consolidation, to great extent, are dependent on cooperation of many institutions, but the determinant factor is interest of landowners and their ability to see the benefits of land consolidation. Therefore it is important to develop appropriate financial instruments facilitating this process.

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Information about authors

Velta Parsova, Dr.oec., professor, Department of Land Management and Geodesy of Faculty of Rural Engineering of Latvia University of Agriculture. Address: Akademijas St. 19, Jelgava, Latvia, LV- 3001, phone: +37163026152, e-mail: velta@parsova.lv

Edvins Kapostins, Mg.sc., Ministry of Environmental Protection and Regional Development of Latvia. Address: Peldu street 25, Riga, Latvia, LV-1494, phone: + 37129107636; e-mail: edvins.kapostins@varam.gov.lv

Virginija Atkocevičienė, Dr. of technology science, lecturer, Institute of land use planning and geomatics of fakulty of Water and Land Management of Aleksandras Stulginskis university (Lithuania). Address: Universiteto g. 10, LT-53361, Akademija, Kauno raj., Lithuania, phone: +37037752372, e-mail: virginija.atkoceviciene@gmail.com

Vilma Sudoniene, lecturer, Institute of land use planning and geomatics of fakulty of Water and Land Management of Aleksandras Stulginskis university (Lithuania). Address: Universiteto g. 10, LT-53361, Akademija, Kauno raj., Lithuania, phone: +37037752372, e-mail: wilmasu@gmail.com

RESEARCH OF NATIONAL GEODETIC NETWORK ELEVATIONS AT EASTERN PART OF LATVIA

Armands Celms, Aivars Ratkevics, Janis Rusins
Latvia University of Agriculture

Abstract
Along with the development of the technological possibilities, the Global Positioning Satellite System (GNSS) is increasingly used in geodetic measurements. Using GNSS, measurements are performed in horizontal plane as well as for point elevation determination. The aim of the article is to demonstrate that the GNSS measurements' static mode has a high accuracy. To achieve the aim the following objectives were set: 1) to perform global positioning measurements in Class I national leveling network, 2) to calculate the elevation above the sea level, 3) to evaluate the accuracy of performed GNSS measurements. The following research methods were used: static measurement method and analytical method for comparison of the obtained data.
Key words: GNSS, point heights, elevations, class I leveling, measurement accuracy.

Introduction

More and more the advantages of the Global Navigation Satellite System (GNSS) are used across the world and in Latvia. With help of GNSS, plane coordinates and heights could be obtained anywhere on the Earth. Determination of heights between points with levelling method can take up for several days, but using the benefits of GNSS, measuring points with static method takes at least 4 hours obtaining almost similar data in comparison with performing leveling. This study is an attempt to find out whether sufficiently accurate data can be obtained with GNSS measurement techniques.

The aim of the article is to demonstrate that the GNSS measurements static mode has high vertical measurement accuracy. To achieve the aim the following objectives were set: 1) to perform global positioning measurements in national Class I leveling network, 2) to calculate the elevation above sea level, 3) to evaluate the accuracy of performed GNSS measurements. Within the study measurements of Class I leveling network geodetic signs were performed, measured by GNSS method in two different time periods – on 14th December, 2012 and 22th November, 2013. These measurements were performed in the static mode for 4 hours throughout the territory of Latvia at the same time. Why the GNSS method was used? At first, it allows to significantly reduce the measurement time and the number of staff compared to the classic levelling. In this method it is necessary only to center on the geodetic point and take measurements in the static mode. Developing selected GNSS method, surveying and calculating ellipsoidal coordinates for several times, it is possible to organize the systematic control of height changes at the height system's output zero point and at the selected regional reference points. For the points where it is not possible to make direct measurements with GNSS, there would still remain the need for precise geometric levelling. The second direction of GNSS application is to use it for new height point determination in the national normal height system. (Lazdāns u.c., 2009) For such point determination an accurate geoid model throughout the country is required. At this moment in Latvia national geoid model LV'98 is used providing 8-10 cm accuracy. In the future, the geoid model with 2 cm accuracy is planned to develop for the entire territory of Latvia (Reiniks, 2010). New satellites are launched into the Earth orbits which can provide more accurate measurement results. The latest GPS III satellites are planned for 25% longer service life; they would prove three times better accuracy and eight times better protection against signal interference. These satellites were started to launch into space from the end of 2013. On the basis on the results of this study, it is possible to determine the Earth's crust vertical movements, register their parameters and create modules. This type of the study has not been carried out previously in Latvia, so there is no methodology for this type of the research.

Methodology of research and materials

GNSS measurements were performed in Class I levelling network. As the basis for the comparison of measurement results 2000 – 2010 reconstructed class I leveling network was used resulting in the currently topical GNSS elevation measurement accuracy comparison in relation to geometric levelling results. For the measurements in class I leveling network with GNSS receivers, the existing Class I leveling network nodal points were surveyed to ascertain the point position and an open horizon around the point to be sure that there would not be interference with satellite signals reception. During the follow-up it was identified weather the point is precisely located at the site, as well as it was

shortly measured with GNSS receiver in real time to verify the sufficient satellite location over a point. If it was found out that the site of the geodetic sign is not suitable for application of GNSS method, the search and survey for next point of levelling line was carried out until the suitable point was found and then surveying was performed from that point. During the measurements the suitable settings for GNSS receivers were installed to get the correct results.
Measurements were performed with GNSS receivers in static mode for at least 4 hours. At first this kind of campaign took place on 14th December, 2012, the second campaign was on the 22th November, 2013. Measurements were carried out for 4 hours – from 10am to 2pm. For this study 3 class I leveling points were selected which were measured in both campaigns – ground benchmark 1415 located between Jēkabpils and Pļaviņas; fundamental benchmark 1484 which also is the nodal point and is located near Pededze; ground benchmark 1001 near Zilupe (see Figure 1). For the processing of measurements the LatPOS network data were used. On each of these points the company Leica GNSS instrument was installed.

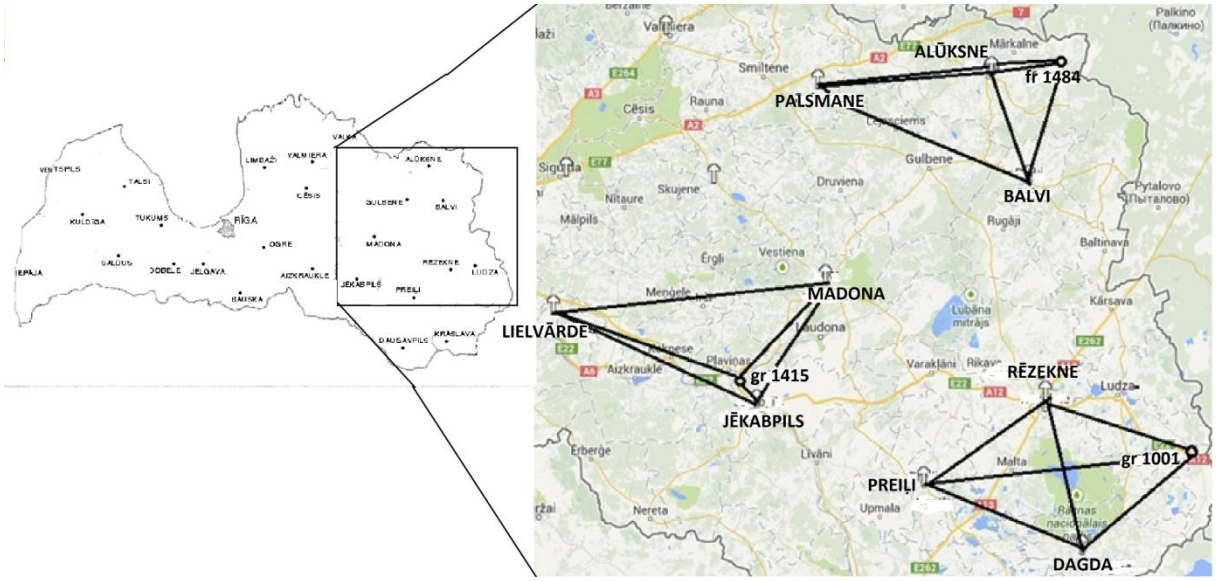

Fig. 1. Class I levelling network points locations and GNSS vectors to the nearest LatPOS base stations.

For data processing the data from 3 nearest LatPOS base stations for each class I levelling network points, used in this study, were obtained. These data were obtained from the LatPOS website, accordingly selecting these base stations. Three nearest LatPOS network base stations for geodetic point No. 1415 is Jēkabpils, Madona and Lielvārde; for point No. 1484 – Alūksne, Balvi and Palsmane, but for point No. 1001 – Rēzekne, Dagda and Preiļi (see Figure 1).
After obtaining the data from GNSS receivers and LatPOS website, for measurements equalizations Trimble Business Center measurement adjustment program were used. This program allows to see accuracy of the measurements over the measurement time. When adjustments are made to obtain accurate data, LatPOS validated base station coordinates were also taken into account. After the data adjustment, the vectors accuracy from the base station to point as well as precise point coordinates and heights were obtained. According to the adjusted data, elevations between the class I points used in this study were calculated which then were compared with the data received from Latvian Geospatial Information Agency (LGIA) obtained with class I geometric levelling method.

Discussions and results
GNSS vector accuracy was obtained from the Trimble Business Center program adjusted data allowing to pinpoint the coordinates of point and height. Table 1 shows the calculated GNSS vector accuracy from measurements performed on14th December, 2012. Obtained vector accuracy allows to determine the height precision, which allows to determine elevation between points.

Table 1

GNSS vector accuracy

From the point	To the point	Horizontal accuracy (m)	Vertical accuracy(m)	V^2 (vector)	V^2 (to the point)
Madona	Jēkabpils	0.003	0.010	0.000100	X
Madona	1415	0.004	0.013	0.000169	0.000169
Madona	Lielvārde	0.006	0.017	0.000289	X
Jēkabpils	1415	0.004	0.014	0.000196	0.000196
Lielvārde	Jēkabpils	0.005	0.014	0.000196	X
Lielvārde	1415	0.006	0.017	0.000289	0.000289
Rēzekne	Preiļi	0.003	0.011	0.000121	X
Rēzekne	Dagda	0.003	0.011	0.000121	X
Preiļi	Dagda	0.004	0.012	0.000144	X
Preiļi	1001	0.007	0.020	0.000400	0.000400
Dagda	1001	0.004	0.013	0.000169	0.000169
Rēzekne	1001	0.007	0.020	0.000400	0.000400
Palsmane	1484	0.008	0.025	0.000625	0.000625
Palsmane	Balvi	0.006	0.016	0.000256	X
Balvi	1484	0.004	0.016	0.000256	0.000256
Balvi	Alūksne	0.003	0.009	0.000081	X
Palsmane	Alūksne	0.005	0.013	0.000169	X
Alūksne	1484	0.004	0.014	0.000196	0.000196
			SV=summ	0.004177	0.002700
			d=SV/n	0.000232	0.0003
			s=SQRT(d)	0.015233	0.017321

Table 1 shows that the mean square vector accuracy is 0.015 m, but accuracy of the vectors is 0.017 m, which is a very good indicator. GNSS vector precision, acquired by 22th November, 2013 data adjustment, is depicted in Table 2.

Table 2

GNSS vector accuracy

From the point	To the point	Horizontal accuracy (m)	Vertical accuracy(m)	V^2 (vector)	V^2 (to the point)
Madona	Jēkabpils	0.002	0.009	0.000081	
Madona	1415	0.003	0.011	0.000121	0.000121
Madona	Lielvārde	0.003	0.009	0.000081	X
Jēkabpils	1415	0.003	0.013	0.000169	0.000169
Lielvārde	Jēkabpils	0.003	0.009	0.000081	X
Lielvārde	1415	0.003	0.010	0.000100	0.000100
Rēzekne	Preiļi	0.002	0.009	0.000081	X
Rēzekne	Dagda	0.002	0.009	0.000081	X
Preiļi	Dagda	0.003	0.009	0.000081	X
Preiļi	1001	0.003	0.011	0.000121	0.000121
Dagda	1001	0.003	0.012	0.000144	0.000144
Rēzekne	1001	0.003	0.012	0.000144	0.000144
Palsmane	1484	0.018	0.018	0.000324	0.000324
Palsmane	Balvi	0.003	0.009	0.000081	X

Table 2 continuation

From the point	To the point	Horizontal accuracy (m)	Vertical accuracy(m)	V^2 (vector)	V^2 to the point)
Balvi	1484	0.003	0.016	0.000256	0.000256
Balvi	Alūksne	0.003	0.010	0.000100	X
Palsmane	Alūksne	0.003	0.009	0.000081	X
Alūksne	1484	0.004	0.019	0.000361	0.000361
			SV=sum	0.002488	0.001740
			d=SV/n	0.000138	0.000193
			s=SQRT(d)	0.011757	0.013904

Table 2 shows that the mean square vector accuracy is 0.012 m, the geodetic vector accuracy is 0.014 m. The comparison of the measurements taken in 2013 with measurements taken in 2012 shows that more accurate measurements were made in 2013. Perhaps this can be explained by better placement of satellites during the measurements made in 2013.
Table 3, Table 4 and Table 5 shows the height differences of class I levelling network points measured in 2012 and 2013; the pictures shows the measured point and its neighborhood.

Table 3

The point heights by GNSS measurements

Year	Point No.	Height, m	Calculated height error, m
2013	1484	156.784	0.023
2012	1484	156.766	0.035

Fig. 2. Class I leveling network point No. 1484 in 2012 (left) and in 2013 (right).

As shown in Table 3, class I levelling network point 1484 has height difference between the measurements made in 2012 and 2013 is 0.018 m. Height difference could be explained by the openness of the horizon, and the possibility of reception. As shown in Figure 2, the geodetic point is near the ruins and the surroundings are little overgrown with trees affecting the GNSS signal to reach the receiver and thus reducing accuracy. Estimated height errors also affect the resulting accuracy of the heights. Height error obtained form 2013 measurements has decreased by 0.012 m. Perhaps the 2012 measurement error was also affected by weather conditions, as shown in Figure 2, at the time of measurements the land was covered with snow.

Table 4

The point heights by GNSS measurements

Year	Point No.	Height, m	Calculated height error, m
2013	1001	138.613	0.018
2012	1001	138.552	0.017

Fig. 3. Class I leveling point No. 1001 in 2012 (left) and in 2013 (right).

Class I leveling network point 1001 height measurements are reflected in Table 4. Between GNSS measurements height difference is relatively large - 0.061m. The height gap could be affected by geoid model whose accuracy is up to 10 centimeters. The comparison of the calculated height errors, which practically are the same, implies that there is a good condition for measurements. Figure 3 shows that the point location is good, the horizon is open, only a small-signal obstacle is power line pole which is near by the point.

Table 5

The point heights by GNSS measurements

Year	Point No.	Height, m	Calculated height error, m
2013	1415	76.856	0.012
2012	1415	76.845	0.025

Fig. 4. Class I leveling point No. 1415 in 2012 (left) and 2013 (right).

As shown in Table 5, measurement data of point 1415 for both years are very similar; the height difference is only 1 centimeter. This could be explained by the fact that visible and opened horizon is around this point. On the other hand, comparing the calculated height error, the difference is larger - 0.013 m.

For further calculations the height values were analyzed. Table 6 shows all 3 points' heights measured with GNSS, from which the elevations between the points and their differences were calculated.

Table 6

The point heights by GNSS measurements

Point No.	Height 2012, m	Height 2013, m	Difference, m
1484	156.766	156.784	0.018
1001	138.552	138.613	0.061
1415	76.845	76.856	0.011

As it can be seen, the difference between the 2012 and 2013 measurements is up to 6.1 cm. In this case, the large effect is constellation above the horizon. The number of satellites at the time of measurements for each point was more than 10, which allows to accurately determine the location of the measuring point, but the difference is affected by the signal reception, which is essential to obtain high-precision data. Accuracy is also affected by solar activities that require additional research.
For further research interconnected class I levelling point elevations were examined acquired with geometric levelling method and measured with GNSS method. The obtained results are summarized in Table 7.

Table 7

Class I leveling network interconnected point elevations

Point Nr. to	Point Nr. from	Class I geometric leveling, m	GNSS measurement 2012, m	GNSS measurement 2013, m
1484	1001	-18.083	-18,171	-18,153
1001	1415	-61.839	-61,707	-61,757
1415	1484	79.936	79,921	79,928

Elevations between the GNSS measurements are similar, but compared to the geometric levelling they are different. Figure 5 graphically displays the elevation difference of class I levelling network points determined by geometric levelling methods and GNSS methods in both measurement campaigns. As the zero-reference line geometric levelling results were taken.

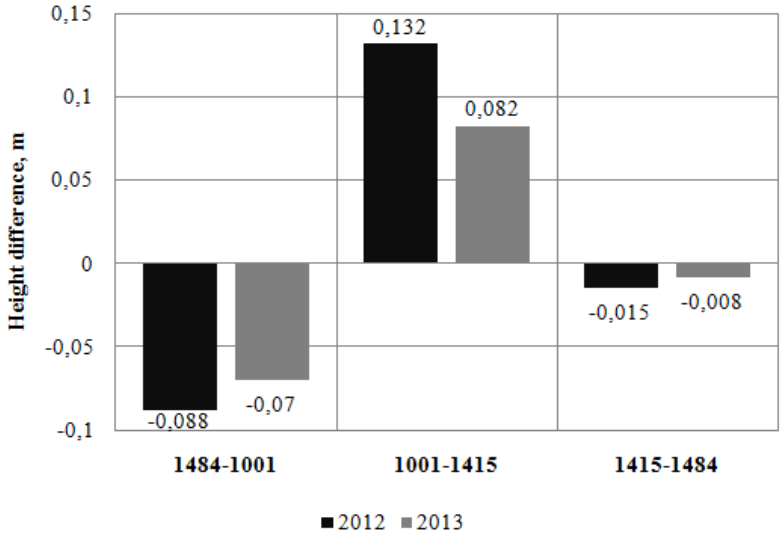

Fig. 5. Elevation difference between the geometric leveling method and GNSS measurement method, for both campaigns.

As shown in Table 5, the elevation difference between the geometric leveling and GNSS measurements for campaign of 2013 is smaller than for campaign of 2012. The biggest difference between the elevations of geometric leveling and GNSS method is 13.2 cm, but the smallest difference is 0.8 cm. The resulting reciprocal comparison shows that the best matching between elevations is for signs 1415 and 1484. Elevation differences obtained at 2013 GNSS measurements is only 8 mm,

which is a good indicator. However, the relatively poor results were obtained between points in 1484 - 1001 and 1001-1414. Obtained elevations fit within the accuracy of the geoid model; however, as shown in Figure 5 the difference with geometric leveling is with opposite signs. Total difference by the 2013 GNSS measurement is 15.2 cm which could be designated as high.

Evaluating the results, one should understand that elevations obtained with GNSS quality determine the accuracy of measurements in the vertical plane which is affected by the horizon condition, solar activity, ionosphere effects, etc. The authors came to the conclusion that the geoid model accuracy increase up to 2 cm in the nearest future could be relatively difficult. Besides, it should be taken into account that class I levelling network accuracy is up to 17 mm, in the direction from west point Jūrkalne to east point Zilupe (Celms et.al, 2013). The accuracy gets worse every year, taking into account the Earth's crust vertical movements in Latvia (Celms et.al, 2007). In further occasions if the aim is actually raise and stabilize the vertical measurement accuracy using GNSS technology in the territory of Latvia, it is advisable to associate all LatPos base station antennas to class I levelling network, thereby providing an opportunity to get regular changes of height adjustments for the entire height grid. Besides, it is necessary to take yearly class I control levelling between LatPos base stations, thereby providing operative and full GNSS and geometric levelling data combining and application for state height systems maintaining. More scientific research is required for the above mentioned impact deployment on practical geoid model with possibility to increase the accuracy up to 2 cm.

In all cases within this study the results obtained with GNSS method measurement show good internal measurement results accuracy (mean vector accuracy is up to 0.02 m.) which relies on the system's possibility to achieve the technically high precision final results, if the exclusion of other factors or compensation issues are resolved.

It should be noted that, although the levelling method is currently showing higher measurement accuracy, however, given the long levelling work performance period during which the Earth's crust movement is continuing, the obtained results in 2010 (when measurements were completed) already had been subjected to deformations, and real GNSS measurement performance time that has passed after the levelling works points to the additional differences in results that might have emerged in this study, but has not yet been identified within a small number of measurements (only two campaigns in order to compare the results of leveling) (Celms et.al, 2012).

If further research results of GNSS technology vertical measurements will be closer to stable 0.02 m maximum deviation values, this method should be recognized as equivalent to levelling work results for elevation data acquiring between points in cases of long-distances (distances greater than 300 km), which will provide the basis for organization of annual national height system precision monitoring.

In the comparison process, levelling elevations accepted as a stencil also should be seen as relative, therefore it is necessary both new levelling work cycle run and repeated GNSS campaigns to continue to obtain the profound basis for comparing and evaluating; their results would show real elevations and their changes of dynamic state, as well as criteria of achieved accuracy.

Conclusions and proposals

1. Performing the measurements with GNSS method in static mode for 4 hours, the obtained average vector accuracy is up to 0.02 m.
2. Performing measurements with GNSS receiver it is important to note that the horizon is open around the measurement point.
3. Using GNSS for determination of elevation between measurement points, measurements should be performed at the same time. Elevation estimates between GNSS measurements obtained in different time periods may show false positives.
4. The difference between GNSS method obtained elevations and class I geometrical levelling elevations was in the range from -0.070 to + 0.082 m during 2013 campaign, but the difference between GNSS method obtained elevations and class I geometrical levelling elevations was in the range from + 0.132 to -0.088m during the 2012 campaign.
5. In order to determine the GNSS methods application possibilities for height determination, it is important to compare GNSS method obtained data with class I geometric levelling elevations.
6. It is advisable to continue such measurements every year in order to better assess the factors of elevation changes. On December 2013 the GPS III generation satellite was launched, which is

more powerful and accurate and which could show the difference with previously obtained data.

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Information about authors

Armands Celms lecturer, Mg.sc.ing., Department of Land Management and Geodesy, Faculty of Rural Engineering, Latvia University of Agriculture. Address: Akademijas Street 19, Jelgava, LV–3001. E-mail: armands.celms@llu.lv

Aivars Ratkevics lecturer, Mg.sc.ing., Department of Land Management and Geodesy, Faculty of Rural Engineering, Latvia University of Agriculture. Address: Akademijas Street 19, Jelgava, LV–3001. E-mail: aivars.ratkevics@apollo.lv

Janis Rusins Geodesy masters student, Bc.sc.ing. Department of Land Management and Geodesy, Faculty of Rural Engineering, Latvia University of Agriculture, Address: Akademijas street 19, Jelgava LV-3001, email: jrusins@inbox.lv

STATISTICAL AND DISTANT CARTOGRAPHY DATA OF ABANDONED (UNUSED) LAND

Daiva Gudritienė[1], Edita Abalikštienė[2]
[1]Aleksandras Stulginskis University, [2]Kaunas Forestry and Environmental Engineering University of Applied Sciences

Abstract
The problem of abandoned agricultural land is relevant in Lithuania, particularly in the territories where poor soils are dominant. The aim of this research is to analyze the statistics of abandoned land in poor soil regions by different estimation methods. The abandoned land was registered for the purposes of the research. Areas might be determined by using statistical data and by applying the results of a distant research method. The initially obtained data showed large differences among the areas of abandoned land determined by different calculation methods, and this might cause a lot of problems, in particular when clarifying the validity of the land taxation. Therefore the initial data of the research concerning abandoned land should be essentially revised. The results of abandoned land accounting and evaluation (inventory) in each territory should be checked and confirmed by the committee of qualified specialists. The reasons of abandonment should be determined for each land plot, and further use of the plot should be determined. Plots of abandoned agricultural land should be estimated for each parcel of the private land and registered in the cadastre data as additional information for estimation of the land tax.
Key words**:** abandoned land, declared farming land, spatial data set of abandoned land in the territory of the Republic of Lithuania.

Introduction

The problem of abandoned agricultural land is relevant in Lithuania, particularly in the territories where poor soils are dominant (Abalikštienė et al., 2013). It has a strong influence on the variations of farming land changes (Aleknavičius, 2007; Aleknavičius et al., 2010).

Determination of abandoned land areas is assigned to institutions performing LIS (Land Information System) administration. It is necessary for the purpose of land taxation provided in the Land Tax Law. The definition of abandoned land stated in this law provides neither the evaluation of the state of the farming land in the locality nor the comparison of determined possible abandoned land areas with the cartography data of the farming land and declared crop areas (there should not be abandoned land in the declared areas for which direct payments are received except for the cases when officers of the National Paying Agency determine the agrarian and environmental state of the land in the area as not good). All information about abandoned land is based only on the analysis of the maps prepared by spatial data and other distant methods, and therefore obtained results do not correspond to the difference between the results of statistical farming land and declared farming land.

According to the Decree of the government of the Republic of Lithuania, the state enterprise the State Land Fund is authorized to determine the data concerning abandoned farming land, and the Ministry of Agriculture is empowered to validate the description concerning the order of determination of abandoned farming land areas. This description regulates the requirements for determination of abandoned farming land, renewal, processing and presentation of data concerning abandoned farming land. The areas of abandoned land in the whole territory of the Republic of Lithuania are determined by distant cartography methods, i.e. interpreting spectral images of the land surface in the territory of the Republic of Lithuania from the artificial Earth satellite related to Lithuanian coordinate system of 1994 LKS-94. Spatial data of abandoned farming land areas are collected in spatial dataset of abandoned land on the territory of the Republic of Lithuania (AŽ_DRLT). Cartographic information about abandoned farming land areas is available on the geographic information website of Lithuania (www.geoportal.lt/az or http://goo.gl/FCL7Y) and in Land Information System (www.zis.lt). It is provided to estimate the taxable values of agricultural land plots.

The aim of the research is to analyze the statistics of abandoned land in poor soil regions determined by different estimation methods. The following objectives were set to achieve the aim: to review the areas of declared farming land in Lithuania, to present statistical data of unused land of unproductive land regions; to present data about areas of abandoned land given in the cartographic material. Unproductive land region was chosen for the research because productivity of the land directly influences the statistics of abandoned land. The following methods were used in the research: the

analysis of literature and cartographic material, comparison of statistical data. The data were processed by Microsoft Excel and ArcGis software.

Results and discussion

There is not a unanimous opinion regarding the concept of abandoned land in Lithuanian scientific literature therefore the definition provided by the Statistical Office of the European Communities is used: areas of land that have not been cultivated for more than 5 years are considered as the areas of land not used for agricultural activities. Unused farming land by the Lithuanian Institute of Agrarian Economics is defined as follows: areas that earlier were used as the farming land but were not cultivated in later years due to economic, social or other reasons (a farmer's disease, unprofitable to farm etc.), areas that were not used in rotation system.

The reasons for becoming abandoned land can be very different. Sometimes abandonment of land in certain territory and emergence of abandoned land can be determined by the whole complex of circumstances (Plieninger,… 2013). J. Moravec and R. Zemeckis (2007), P. Pointereau et al. (2008) indicate such factors of land abandonment: natural (slope of area, land quality, the lie of the land), social (migration), demographic (elder farmers, low birthrate), economic (risk concerning demand of agricultural production, increased costs of resources, to little payments), historical (small land-tenure, fall of collective agriculture system), problems of land cession etc.

Researchers investigating abandoned land (Kuliešis et al., 2010) distinguish the following its aspects:

Administrative. In this aspect farming land is considered as abandoned if it has been untended for more than 5 years and also if land has not been used for agricultural production for 2 years. According to the administrative aspect it is simple to estimate abandoned land during crop declaration because administrative definition of this concept is explicit.

Economic. In this regard the land is considered as abandoned when it is not used as an economic resource. According to this approach the price of abandoned land can be fixed by comparing it to the average market price of farming land. However, the land has not only an economic function. Farming is assessed only as an element of income maximization.

Landscape. Evaluating abandoned land from the landscape point of view, it isdefined as land in which the flora exceeds the standard. According to this approach areas of abandoned land can be simply estimated using satellite imagery or topography. Although at first sight it seems that this approach is the most suitable for unused and abandoned land, it has a disadvantage: the same flora might grow in the land of other purposes.

Agricultural. Abandoned land is the land where the farming is extensive. This approach is the most unfavorable when describing abandoned land because there are many land usages that are complicated to differentiate.

The degree of abandonment in abandoned land might be varied. Other various factors such as geographical, demographic, agro-ecological, social and economic, political, historical are also important.

For the purpose of the research of abandoned land, the following calculations are possible (excluding the land of horticultural communities and their members because all this land is considered to be used with the purpose):

1. To estimate abandoned state land ($A_{Ž1}$). In land accounting this land is shown as not vested for use and not rented agricultural land (farming land in it).
2. To estimate relatively abandoned (unused) private land ($A_{Ž2}$). It is calculated as the difference between farming land present in the private land and the declared land. Declared farming land (the data of 2013) is presented in Fig. 1.

$A_{Ž2}$ might be cultivated but, if the land was not declared, it is presumed to be abandoned. It is based on the assumption that a land owner or a tenant most likely does not cultivate the land if it was not declared because the requirements for receiving certain payments are very simple.

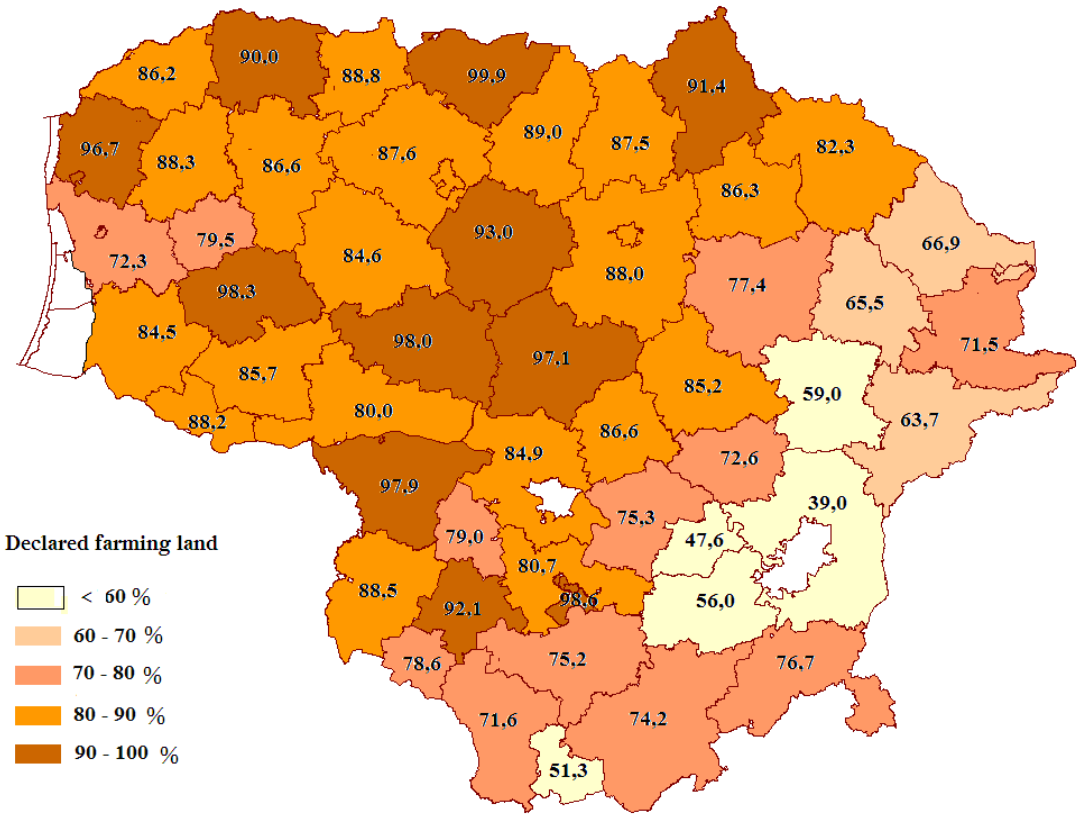

Fig. 1. Declared farming land in Lithuania.

However, since 2013 the areas of abandoned land in Lithuania are determined by distant cartography methods, i.e. interpreting spectral images of land surface in the territory of the Republic of Lithuania from artificial Earth satellite related to Lithuanian coordinate system of 1994 LKS-94 (hereinafter referred to as SŽPV). Spatial data of abandoned farming land areas are collected in spatial dataset of abandoned land in the territory of the Republic of Lithuania (AŽ_DRLT). It is provided in legal acts that technical specifications of AŽ_DRLT and SŽPV are determined, and AŽ_DRLT renewal and SŽPV purchase are organized by National Land Service. AŽ_DRLT is renewed yearly and the following are used for its renewal:

- SŽPV of last year, purchased by National Land Service yearly before the 1st February;
- The newest digital raster ortophoto map at scale 1:10000 of territory of the Republic of Lithuania ORT10LT or digital raster ortophoto map at scale 1:5000 of territory of the Republic of Lithuania ORT5LT;
- Georeferenced datasets of cadastre;
- Spatial dataset of special land use conditions in the territory of the Republic of Lithuania (scale 1:10 000) SŽNS_DR10LT;
- The state cadastre data of forests of the Republic of Lithuania;
- Other information determined by National Land Service (Nacionalinės... 2011).

Comparing the cartographic material of abandoned land prepared by this order in 2013 with statistical data made on the basis of this procedure, it can be concluded that substantial inaccuracies are possible when determining abandoned land only by distant cartography methods (Table 1).

Table 1

The research data of abandoned land in municipalities dominated by inefficient land

Municipality	State-owned land 2013. 01. 01., ha		Declared area 2012, ha		Statistical area of private land Pžs	Unused land, ha		Plots of abandoned land according to VŽF data 2013
	Used Vžn	Not legalized for use Vžn ($A_{ž1}$)	In state-owned land Dv	In private land Dp		Private Pžs – Dp ($A_{ž2}$)	The whole ($A_{ž1} + A_{ž2}$)	
Mun. of Druskininkai district	383	265	174	4,245	7,898	3,653	3,918	1,698
Mun. of Elektrėnai district	229	2,975	-	11,410	20,329	8,922	11,897	2,251
Mun. of Ignalina district	12,871	6,064	12,712	30,201	40,539	10,338	16,402	9,782
Mun. of Lazdijai district	4,681	3,636	4,385	36,962	48,985	12,023	15,659	6,903
Mun. of Molėtai district	3,541	4,488	3,352	33,850	53,787	19,937	24,425	8,942
Mun. of Plungė district	2,764	398	2,493	44,960	50,142	5,182	5,580	4,168
Mun. of Rietavas district	1,838	141	1,740	15,030	19,024	3,994	4,135	1,208
Mun. of Šalčininkai district	16,957	5,998	16,415	33,043	41,228	8,185	14,183	8,201
Mun. of Šilalė district	4,216	233	4,060	59,584	60217	633	866	3,595
Mun. of Šilutė district	22,941	10	22,634	47,565	59321	11,756	11,766	3,069
Mun. of Švenčionys district.	15,433	1,968	15,037	15,871	28,613	12,742	14,710	8,441
Mun. of Telšiai district	4,425	3,494	4,137	59,144	64,594	5,450	8,944	5,079
Mun. of Trakai district	1,152	470	736	21,269	36,812	15,543	16,013	9,021
Mun. of Utena district	4,351	6,076	4,079	36,313	50,447	14,134	20,210	9,118
Mun. Of Varėna district	10,306	1,492	10,019	24,616	34,036	9,420	10,912	8,976
Mun. of Vilnius district	2,996	15,925	1,323	35,712	74,977	39,265	55,190	17,539
Mun. of Zarasai district	7,873	2,766	7,672	25,438	38,028	12,590	15,356	10,430
In total Inefficient land	116,957	56,399	110,968	535,213	728,977	193,767	250,166	118,421
In total in Lithuania:	328166	137,716	307,136	2,475,845	2,892,796	416,951	554,667	240,445
In total in Lithuania, except of inefficient land	211,209	81,317	196,168	1,940,632	2,163,819	223,184	304,501	122,024

Large differences among the areas of abandoned land determined by different calculation methods might cause a lot of problems (in particular when clarifying the validity of land taxation), therefore the initial data of research concerning abandoned land must be essentially revised. Thus it is suggested to use the recommendations presented by specialists who accomplished land usage research in the scientific report (Žemės..., 2011) with more precise cartography and recording of abandoned land.

While correcting available data, the following works should be done additionally:

1. To compare the database of abandoned land with maps expressing soil qualities, to determine the reasons of abandonment of this farming land (contours, plots) and the most adequate further use. The obtained results should be revised during field works in the locality.

2. The results of abandoned land recording and evaluation (inventory) in every municipality should be checked and confirmed by the committee, involving: a specialist of territorial department of National Land Service; a municipality representative, specialist of municipality administration for agricultural or reclamation issues; an expert of the regional Department of Environmental Protection of the Ministry of Environment; a representative of farmers' organization representing leading farms in the area.
3. The reasons of farming land abandonment for each evaluated land plot are determined by common agreement of committee members and should be used while working out proposals concerning further usage of these land plots and providing information for officers responsible for the state control of land use. The main reasons could be:

3.1. A land owner performs agricultural activities, but does not cultivate the land due to:
- extensive farming;
- large costs for land's cultivation (repair of drainage systems, cutting out trees and bushes, etc.);
- poor soils or inconvenient conditions for using agricultural machines;

3.2. A land owner does not perform agricultural activity, and the land is not used because:
- there are no farmers near this land who would like to rent it;
- of possibly large tenant's costs for the land's cultivation (repair of drainage systems, cutting out trees and bushes, etc.);
- the land is not rented due to poor soil or inconvenient conditions for using agricultural machines;
- the land is not rented because farmers cannot find the owners or the required rent is unacceptable for farmers, or owners do not wish to rent the land;
- of other reasons.

4. The most purposeful further use of abandoned land plot could be differentiated as follows:
- to use for arable land (crop), cultivated meadows or natural meadows and grasslands;
- to use for afforestation or transferring areas overgrown by saplings to forest land;
- to keep the present state allowing re-naturalization processes, i.e. to use for growing of bushes and trees, creation of swamps or water bodies;
- other purpose.

Additional repair activities (e.g. land must be ploughed, repair of drainage systems or cutting out trees and bushes is needed) should be determined for land areas that are relevant to be used for agricultural activity again.

5. To estimate areas of abandoned farming land for each parcel of the private land and to register in the cadastre data as additional information for estimation of the land tax.

Conclusions

1. Large differences among the areas of abandoned land estimated by different calculation methods might cause a lot of problems, in particular when clarifying the validity of land taxation. Therefore initial data of research concerning abandoned land must be essentially revised.
2. The results of abandoned land recording and evaluation (inventory) in each district should be checked and confirmed by the committee of qualified specialists.
3. The reasons of abandonment must be determined for each land plot, and further use of the plot should be determined.
4. Areas of abandoned farming land must be estimated for each parcel of private land and registered in the cadastre data as additional information for estimation of the land tax.

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Information about authors

Daiva Gudritienė. Lecturer, Department of Land Management, Faculty of Water and Land Management, Aleksandras Stulginskis University. Address: Universiteto 10, LT-53361, Akademija, Kaunas r., Lithuania, Tel. + 370 37 752372 . Lecturer, Faculty of Environmental Engineering, Kaunas Forestry and Environmental Engineering University of Applied Sciences. Address: Liepų g. 1, Girionys, LT 53101, Kauno r., Lithuania, Tel.. +370 37 383082 e-mail: gudritiene@gmail.com.

Edita Abalikštienė. Assoc. professor dr. of Department of Real Estate Cadastre, Faculty of Environmental Engineering, Kaunas Forestry and Environmental Engineering University of Applied Sciences. Address: Liepų g. 1, Girionys, LT 53101, Kauno r., Lithuania, Tel.. +370 37 383082, e-mail: e.abalikstiene@kmaik.lm.lt

STATUS OF THE POLYGONOMETRIC NETWORK FOR KAUNAS CITY AND REGION

Vilma Kriaučiūnaitė – Neklejonovienė[1,2], Donatas Rekus[1]
Aleksandras Stulginskis University [1], Kaunas University of technology[2]

Abstract
The article presents the research study of the current state and condition of the geodetic base (polygonometric) network for Kaunas city and region as well as the aspects of its compiling. The geodetic base compiled in the post-war years is considered to be of high quality and is used nowadays. The still existing polygonometric network is seldom studied and thus it remains little known. For the purpose of defining the current state of the geodetic base networks, the search for the points in Karmėlava neighbourhood of Kaunas region has been provided. From the total number of 22 points to be searched, five (i.e. 22 percentage) were determined, but only four points (i.e.18 percentage) were appropriate for measurements. The majority of the points have been destroyed during the construction of the residential buildings or roads, or after the reconstruction works. The measurements have been taken by *Trimble R6*, by RTK method, 10 times for each point. The most reliable value of the measured geodetic points X and Y were defined as well as the errors of the mean square for one measurement and of the average.
The results of the survey (100 respondents) showed that the majority of the professionals apply the points of the polygonometric network when making measurements. However, the problems related to a rather rear usage of the network and the aggravated search of the polygonometric points were encountered. A significant part of the professionals suggested the restoration of the polygonometric network.
Key words: polygonometry, geodetic base, coordinates, LKS – 94, accuracy, errors, GPS.

Introduction

The points of the geodetic base network are applied in majority of the countries; they are used for the works of topography, cadastre, engineering works, territorial development and land use. At present the national geodetic base is of good quality; it is comprised of the entire networks together with the coordinates of GPS points. The majority of the geodetic base compiling works were performed in the post- war years, when Lithuania was under the former Soviet Union rule.
From 1940 to 1965 the essential works of the main geodetic networks formation (Kaušakys P., 1965) were performed such as the compiling of triangulation, polygonometry, levelling. The former geodetic base has survived and it is available nowadays. In the post-war years, the networks of the geodetic base were compiled using the method of polygonometry in the cities and towns of Lithuania. However, the networks compiled by this method lack the relevance of those times; unfortunately, they do not meet the present high quality requirements. Most of the points of the previously made geodetic base are destroyed or just do not meet the requirements.
After the restoration of independence from the Soviet Union, Lithuania has inherited the geodetic networks, which neither technically nor physically meet the current technological requirements. Therefore one of the most significant geodetic targets is the objective to extensively develop the geodetic base of Lithuania which could be able to satisfy the current technological requirements and to integrate it into the European system of the geodetic base. Within rather a short time of 20 years in the field of geodesy, the attained progress has been notable as well as many significant works have been presented. The following scientists as P. Petroškevičius, A. Zakarevičius, E. Paršeliūnas, P. Viskontas and A. Neseckas are valued for eleven the most significant works made within the recent 20 years (Petroškevičius P. et al, 2011). These works are related to GPS and GPNS networks formation.
The studies made by P. Petroškevičius, R.Ramanauskas in 1995 and P. Petroškevičius P., Kazakevičius S., Kolosovskis R, Krištaponis B., Putrimas R. in 1997 focused on the analysis of GPS networks compilation; they reviewed the findings and results of the implemented research. The authors consider that the compiled second-class GPS network ensures the usage of the cosmic geodetic methods and measures for consolidation of the geodetic networks. They are required for providing the cartography of Lithuania, the land reform, privatization, land cadastre, for marking the national borders**,** IT system development, for the solution of the international navigation issues and some other important tasks.
Today the majority of professionals employ GPS measuring equipment and devices which allow the field measuring works to be simplified, they assist the professionals in shortening the time allocated for the field works as well as the required accuracy of the measurements is achieved. GPS method serves the planimetric measurements perfectly well, however, the problems might appear because of

the altitude differences which are regarded to be a very acute and sensitive problem while performing the construction works (Rudžiūnienė V., Kriaučiūnaitė V., 2013). The polygonometric network for usage could be the just the right decision in cases when the measurements by a GPS receiver are impossible or limited.

The objective of the research: to investigate and assess the current state and condition of the existing geodetic base (polygonometric) network; to foresee the possibilities for its usage for the demand of Kaunas city and region. The object of the study is focused on the geodetic base compiled by the method of polygonometry.

The methodology of the research and available information

When performing the assessment of the geodetic base, the information was accumulated from various technical reports, scientific works and articles of different periods. The main aspects of the geodetic base development for Kaunas city and region were analysed by estimating the available technical reports:

- Report on Kaunas Municipality local networks upgrading, linking it with the national GPS networks and the recalculation of their coordinates according to the approved parameters (2004);
- Transformation of the previously compiled consolidating geodetic networks into the uniform system of coordinates (1992);
- Report on geodetic network consolidation for Kaunas region (1999);
- Catalogue of geodetic base network for Kaunas region for LKS – 94 system of points (1999);
- Catalogue of the coordinates and altitudes for Kaunas polygonometric network (1977).

The change of the geodetic base network after the transformation of the coordinates into the national LKS – 94 system of coordinates is taken into account. The influence of the transformation on the accuracy of the network is defined as well as the conformity to the modern requirements (Rudžiūnienė V., Kriaučiūnaitė V., Rekus D., 2013).

In order to assess the quality of the geodetic base (polygonometry) network, the experimental study, namely the geodetic measurements, were performed. The measurements made it possible to partly reveal the existing inaccuracies and resulting errors. The measurements were made by Trimble R6. When planning the measurements the adequacy of time was taken into consideration, the additional software 'GNSS planning online' (2013) was used. The measurements were taken on March 30, 2013, in Domeikava residential neighbourhood. The measurements were made by real-time kinematic method (RTK), when each point was measured 10 times. The results of the measurements were processed by the mathematical method when the mean value of all 10 measurements was determined.

The survey of the professionals was carried out in order to determine the demand for upgrading and usage of the polygonometric network. The survey was carried out throughout Lithuania (233 copies of the questionnaires were distributed, 100 were collected, thus the return of the questionnaires amounted to 43%). The questionnaires were distributed on the Internet and directly by handing them out. The work experience of the respondents was up to 10 years and more. The most active were the participants, who were professionals and had about 5 years of experience in topographic measurements (36% of the respondents). Less active were the respondents, the experience of which in land measurement work was from 10 years and more (30% of respondents). Geographically, the respondents were distributed in the following way: from Kaunas and Vilnius region 50%, from Šiauliai and Marijampolė regions – 2%. During the process of the survey an attempt was made to find out not only the necessity for the polygonometric network usage, but also the limitation of the network usage (the most common problems due to which it is impossible to apply the points of the polygonometric network).

Geodetic base of Kaunas city and region

The polygonometric network of the geodetic base for Kaunas city was initiated in 1958. Since the scope of work was huge, it was finished in 1975 (Catalogue 1977). In 2004, the upgrading of the local networks, compiled in 1975, was made as well as the consolidation with the national GPS network. The company "Institute of Aerial Geodesy" and the company "Kaunas engineering research institute" provided the upgrading and consolidation with the national GPS network of Kaunas city geodetic base

(local polygonometric) networks. The available recognoscation data of the geodetic points in Kaunas city made it possible to determine the main reasons why the geodetic base points were destroyed. Thus 2/3 of the points were demolished when constructing residential buildings, erecting and widening the roads. After the transformation of the coordinates of Kaunas local geodetic base (polygonometry) points into the national system LKS – 94 of coordinates 1,374 ground points and 537 wall points (Kaunas city, 2004) were transformed.
In 1998 in Kaunas region, when thickening the geodetic base, the recognoscation of the points of the geodetic base was carried out. During the procedure, the search for 361 points was performed, but only 126 points were found. From the total number of the determined points, 77 % of the points were applied for consolidation works of the geodetic base (Kaunas region, 1999). In 1998 according to the data of recognostication of the geodetic base in Kaunas region, 33.3 % of the points were determined. From all the found points of the geodetic base, 20.6 % were destroyed or were unsuitable for measurements. From all the searched 83 points of the geodetic base polygonometric network for Kaunas region 54.2 % were determined. Within more than 15 years after the recognoscation, the number of the points that survived was much lower.

Search for polygonometric points and considerations on the results of measurements
In order to determine the current situation of the geodetic base network, the search of the points was carried out. The catalogue of the points of LKS – 94 system (1999) for Kaunas region geodetic base network was used for search. The search of points was located in Domeikava and Karmėlava residential neighbourhoods of Kaunas region. The search was targeted for 22 points. Before starting the search of points, the map compiled by GIS methods (Fig.1) was used for determining the approximate location of the points of the geodetic base as well as for locating the possible access roads towards the geodetic sign. GPS device *Trimble R6* was applied in Kaunas region for search and monitoring of the determined points of polygonometry. The device integrated R-Track technology backing up GLONASS satellite system, allowing increasing the number of the visible satellites, when applying various modes of measurements in not in the open location, but the developed one or the location overgrown with trees (Trimble..., 2013).
5 points (i.e. 22%) were found, but for the measurements only 4 points (i.e. 18 %) were appropriate. In Karmėlava residential neighbourhood the points to be determined were located not far from the main street (Vilniaus st.), but they were not found. When determining the location of the points, *Trimble R6* recorded the points in the middle of the road. The conclusion could be made that the majority of the points were destroyed during the reconstruction works of the road. In Karmėlava residential neighbourhood (Dovalgonys), a triangulation point built in the post-war years was located. The condition and state of the triangulation point is doubtful, because it is considered that the point lost its accuracy, although the coordinates of the point were included into the previously mentioned catalogue of the search.

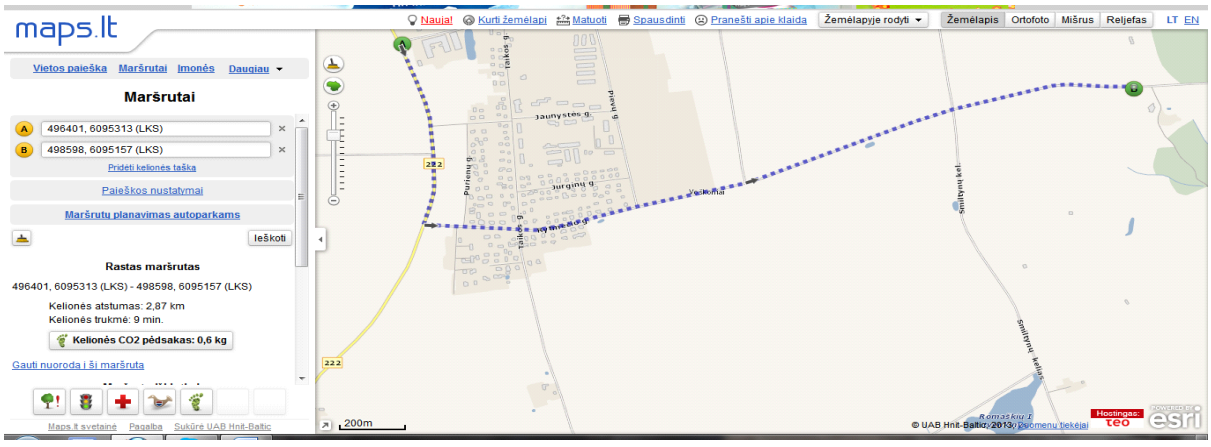

Fig. 1. Surroundings of Domeikava, searched points: 106 (A (6095313.005; 496401.740)) → 159 (B (6095157.565; 498598.284)): straigth movement 2202.04m.

The points destroyed and not proper for measurements (the quality of the points is doubtful) were also determined as well as the points of the good quality (Fig. 2).

a b c

Fig. 2. The appearance of the found points: a) damaged and inappropriate for measurements; b) damaged; c) the point of the good quality. Photo by V. Rudžiūnienė.

For the measurements 4 determined points of the geodetic base were selected located in Domeikava residential neighbourhood, Kaunas region. The number of the satellites visible during the measurements was from five to eight and even more. During the measurements of PDOP (GNSS planning, 2013) their number ranged from 1.6 to 2.5. PDOP value for measurements is appropriate; during the process of taking measurements, they varied having an insignificant difference. The greater part of the measurements was taken before lunchtime when the value of PDOP was up to two. The measurements were made in a rarely urbanized territory. The measurements were taken for all the selected points, 10 times each. Table 1 presents the coordinates from the catalogue of LKS – 94 system points of the geodetic base network for Kaunas region (1999) as well as the most reliable value of the geodetic point X and Y measured 10 times; and the mean square errors of a single measurement and the average errors.

The most reliable value closest to the coordinates presented in the catalogue is of the point 0027. If the results are estimated in accordance with the mean square errors, then the mean square errors for one measurement of m_X varied from 4.4 mm to 7 mm, the mean square errors for m_Y varied from 3.2 mm to 6.2 mm. The mean square errors of the average varied in the following way: $m_{\bar{X}}$ varied from 1.4 to 2.2 mm, but $m_{\bar{Y}}$ varied from 1 mm to 1.9 mm.

Table 1

The results of the measurements

Point number	The coordinates of the point, in LKS-94 coordinate system		10 times measured geodetic point					
			The most reliable value, m		Square errors, mm			
					of one measurement		of average	
	***X* (m)**	***Y* (m)**	$\overline{X}$	$\overline{Y}$	m_X	m_Y	$m_{\bar{X}}$	$m_{\bar{Y}}$
0106	6095313.005	496401.740	6095313.010	496401.730	5.4	3.2	1.7	1.0
Romask.	6093662.269	495240.084	6093662.271	495240.090	4.4	4,7	1.4	1.5
0027	6091074.119	494862.360	6091074.120	494862.361	7.0	6.2	2.2	1.9
0024	6092897.647	495287.249	6092897.644	495287.247	5.1	5.9	1.6	1.9

It is possible to make an assumption after the instrumental analysis that a great number of polygonometric points were disrupted. The points located in the private property area during the construction works were demolished or levelled (there were no signs regarding the location of the polygonometric points). In Domeikava residential neighbourhood, the state and conditions of the polygonometric network were satisfactory, the determined points even damaged were appropriate for measurements.

Geodetic base necessity in measuring works

The development of new modern technologies along with the development of more accurate and upgraded measuring devices and equipment resulted in the reduction of the demand for the geodetic base points. In cases of the application of modern geodetic measuring devices and equipment, field works tend to be reduced since the additional possibilities for the obtained data processing as well as for compiling plans in the digital character have appeared.

In order to determine the feasibility of the polygonometric points to be applicable nowadays, the survey was carried out. The answers received by the respondents revealed that (from 100% – 100 answers) the majority of the professionals employ the points of the polygonometric network when taking measurements (Fig. 3).

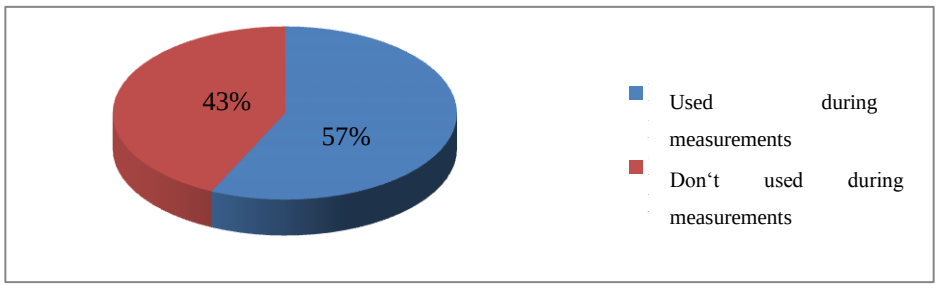

Fig. 3. The usage of polygonometric network during measurements.

Nevertheless, the points of the polygonometric networks were employed only by 40% of the respondents relatively frequently. The main problems related to the usage possibilities of the polygonometric network were identified as well (Fig. 4). Overall, 36% of the respondents pointed out the reasons for using (or not using) the polygonometric network:

- The majority make measurements with the help of modern GPNS receivers as it is a simpler and faster method;
- The geodetic base is applied only for determining the accurate altitude (in works requiring the altitudes);
- Professionals who apply single-use GPS devices, use the points of the geodetic base network frequently because the deduction is required for the location.

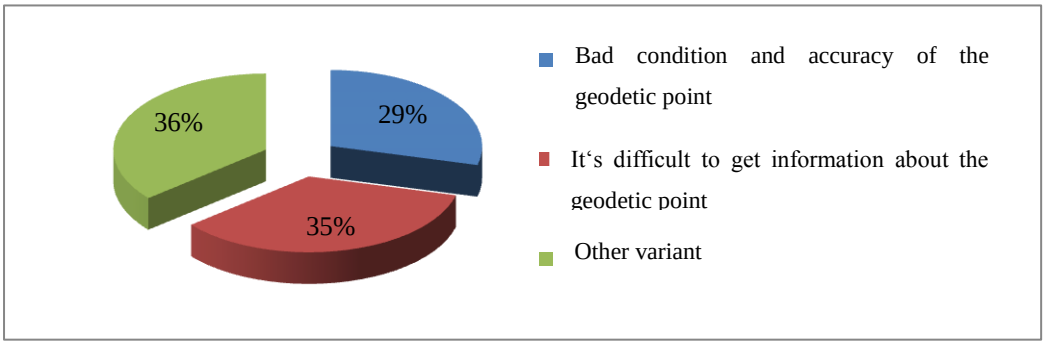

Fig. 4. The problems of usage of polygonometric points during land measurements.

The feasibility for recovering and upgrading of the polygonometric network is assessed positively. More than a half of the respondents (53%) consider the network to be supervised and upgraded, 12% of respondents have no opinion on the issue. The respondents comprising 35% do not approve of the upgrading of the polygonometric network and consider the efforts to be wasted.

After the assessment of the results of the survey, the conclusion was made that the majority of the professionals tend to apply GPS receivers, but avoid the search for the existing geodetic signs. Therefore it is suggested to digitalize the existing catalogues compiled on the geodetic base and to provide the access to the possibly existing data on the points.

Conclusions

1. In the post-war years provided geodetic base formation works are of high quality, the geodetic base is available for use up to the present days. The research of the state and conditions of the existing polygonometric network is insignificant.
2. The state and conditions of the available geodetic base for Kaunas city and region are considered to be satisfactory. The greatest part of the points of the geodetic base was demolished during the construction works. In Kaunas region about 33% of the points of the geodetic base have survived. Within the period of 15 years, the renovation and upgrading works related to the geodetic base (polygonometry) network for Kaunas city and region have not been provided.
3. During the instrumental research study from the total number of 22 searched points, 5 (i.e. 22%) were determined, the number of points applicable for measurements was 4 (i.e.18%). The majority of the points were destroyed during the construction of the residential buildings and roads or reconstruction works. The conclusion was made after estimating the results from the point of view of the mean square errors. The mean square errors for one measurement of m_X tended to vary from 4.4 mm to 7 mm, while the mean square errors for m_Y varied from 3.2 mm to 6.2 mm, but the mean square errors of the average varied for $m_{\bar{X}}$ from 1.4 to 2.2 mm and for $m_{\bar{Y}}$ from 1 mm to 1.9 mm.
4. The data of the survey for the professionals indicate that the polygonometric network is employed. However, the problems related to a rather rare usage of the network have appeared causing the necessity for the search of the polygonometric points. A large part of the professionals expressed their wish to revive and to reconstruct the polygonometric network.

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Information about the authors

KRIAUČIŪNAITĖ-NEKLEJONOVIENĖ, Vilma. Associate professor, doctor. Aleksandras Stulginskis University, Institute of Land Management and Geomatics, Faculty of Land and Water Management. Address: Universiteto str. 10, LT – 53361 Akademija, Kaunas. Ph. (37) 752372. Lecturer, doctor. Kaunas University of Technology, Faculty of Civil Engineering and Architecture. Address: Studentų str. 48, Lt - 51367, Kaunas. Ph. (37) 300494. e-mail: vilma.kriauciunaite@ktu.lt

REKUS, Donatas. Lecturer, doctor. Aleksandras Stulginskis University, Institute of Land Management and Geomatics, Faculty of Land and Water Management. Address: Universiteto str. 10, LT – 53361 Akademija, Kaunas. Ph. (37) 752372. e-mail: donatas.rekus@ktu.lt

THE ANALYSIS OF ACCESS TO LAND PROPERTY

Daiga Paršova
The Ministry of Environmental Protection and Regional Development

Abstract
The aim of the article is to discuss practical issues of establishing the access to land property during the land reform as well as today, and to propose solutions to the identified problems. The methods of research include the analysis of scientific literature and legal acts as well as the case study and the analysis of documents. In this article several proposals are made. It is proposed that the law should include the condition that the establishment of servitudes is allowed only in rural areas and only as an exception if the access from the state or municipal road cannot be granted. The legal solution must be found for the servitudes without the dominant property which have been established during the land reform. The right for local authorities to determine the dominant property should also be considered. The suggestions may be used to elaborate legislative proposals.
Key words: land reform, servitudes, public roads.

Introduction

Legal access to the real estate is one of the key factors determining the use and the value of the real estate. There are several possibilities to establish the access to a land plot. The most common way of the access is the municipal or state roads. The access can also be established from a private road belonging to an owner of the land plot benefiting from it. Servitudes of a right of way are widely used in Latvia to ensure the access to a land plot, both at the time of the land reform and today.
The legal institution of servitudes has been taken from the Roman law meaning right by which the full ownership right is limited for the benefit of a certain person or certain real estate. Unfortunately, the issues connected to servitudes of a right of way often cause conflicts because the interests of a land owner to fully use his or her real estate clash with the interests of a road user. Therefore, this article will deal with the theory and practice of establishing the servitudes of a right of way in Latvia.

Methodology of research and materials

The methods used in this research include the analysis of scientific literature and legal acts as well as the case study and the analysis of documents. Several cases of the improper establishment of the access were examined and analysed in accordance with the relevant legal acts.

Discussions and results

1. Servitude rights of way during the land reform

All roads can be classified by their significance as state roads, municipal roads, enterprise roads, and residential roads (Law On Roads, 1992). The state and municipal roads are public and can be freely used by any person without a special agreement. The enterprise and home roads are in private property, so their owners can restrict the access or, in contrary, to grant the access to specific persons by establishing a special kind of servitude – a right of way.
Servitude of a right of way means that the servitude is established in favour of a certain dominant property and does not end with the change of an owner. Real servitude can be established if there are at least two properties – the dominant property which benefits from the servitude, and the servient property which is encumbered in favour of the dominant property.
Servitude of a right of way can be established by law or court judgement, or in the civil manner: by a contract or testament (Civil Law, 1937). Servitudes are rarely established by law. In the beginning of the land reform the laws on carrying out the land reform empowered the local governments and the land commissions to establish servitudes by their decisions (administrative acts) regarding the restoration of land ownership rights or allocation of land (Law On Land Use and Land Survey, 1991). In this case a note (non-binding remark) had to be made indicating what restrictions and encumbrances have been specified by the decision. This note had to be replaced with the entry (binding remark), if the land owner or the owner of dominant property submitted a request for corroboration (Law On Recording of Immovable Property, 1997). Unfortunately, the local governments and the land commissions often allotted the land which was under municipal roads. In other cases the dominant property was not specified in the decision of the local authority, thus servitudes were not established in accordance with the Civil Law and could not be regarded as legally established and binding.
It is essential that according to the Civil Law the servitude is fully binding to both sides only after it is

registered in the Land Register. Until then only personal obligations between both sides exist which are not binding to other persons. If an owner of dominant or servient property changes, the obligations expire unless the servitude is corroborated in the Land Register (Civil Law, 1937). In the described cases when the decision of the authorized institutions had not defined the dominant property, there was only an informative note in the Land Register that could not be replaced with an entry because of the lack of the dominant property.

A typical case of incorrect establishment of servitude will be examined further (Fig.1). In the beginning of the land reform the land commission restored the ownership rights to the previous owner and established servitude of a right of way without specifying the dominant property. As a result, a note was recorded in the Land Register. The local government stated that the absence of the dominant property meant that servitude was established for the benefit of general public and the road was marked as a municipal road in the spatial plan of the administrative territory. The ownership rights of the private owners of the land were violated as the local government also widened the road.

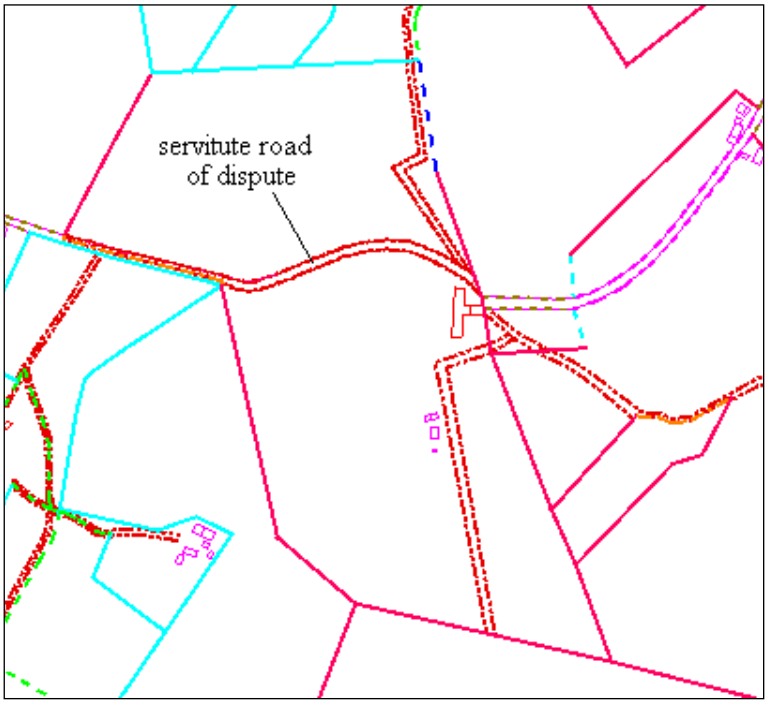

Fig. 1. A servitude road as a part of municipal road (cadastral map).

The court of the first instance and appellation stated that, despite the note of servitudes in the Land Register, the road was not a part of the real estate. However, the Supreme Court returned the judgement to new adjudication. It stated that the court did not consider whether, by the restitution of the ownership rights to the land, the local land commission also had intended to privatise the roads. According to the law *On roads* the complex of road includes also the land beneath it in the extent necessary for the road use and protection, thus court's assumption that the landowners owned the land beneath the road while the local government was the owner of the road contradicted it (Judgement in case No.C240103204, SKC – 64/2013).

2. The development of new residential road network

The boom of the real estate market was followed by a tendency of urban sprawl. Many new villages were developed along with a new road network. In several cases the roads were formed as separate land parcels being in co-ownership of the owners of building plots. In some places these roads were called *roads of common use* (in Latvian – *koplietošanas ceļi*) in the detailed plans of new villages. To establish the procedure of road maintenance and use, owners of these plots signed mutual contracts. The problems arose along with the emergence of new villages also willing to use these roads, misleadingly called *roads of common use.*

The terms *roads of common use* and *public roads* are broadly used as synonyms and as opposites of *private roads*, although they are not defined in law. However, in the practice the roads of common use are not always public, i.e., publicly accessible without any restrictions and charge.

A typical case of conflict arose when the use of a street was restricted and a private person could not

access her property by using the shortest way (Fig.2). The local building inspection and the local government adverted to the detailed plan on the basis of which the street had been built. As the person's property was located outside of the territory of the detailed plan, the plan did not solve the access to it. The particular street was free to use only for the owners of the building plots in the territory of the detailed plan, because the street still was in the private property.

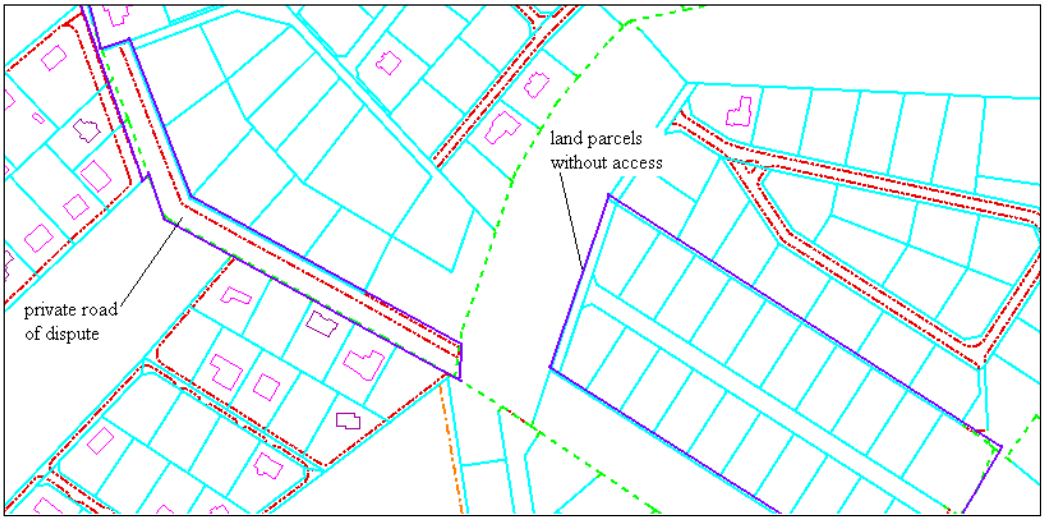

Fig. 2. A private road in the village territory (cadastral map).

The claimant also complained to the Administrative Court stating that the servitude had been established in favour of general public and that the local government had approved its public status by approving the detailed plan which named the street as of *common use* in the detailed plan. All the instances dismissed the claim, because according to the law *On roads* the street was a residential road, not municipal one, thus it was not available for public use. Although the road was initially designed in the local spatial plan and the detailed plan, yet it was located on the private land. The use of the public property is not limited to particular persons, it can be used by anyone. Thus, if the street had been of common use, there would have been no need to establish servitude of rights of way (Decision in case No.A420632910, SKA – 376/2012). Therefore it could be concluded that the initial intention was not to make the street available for public use.

3. The planning of the road infrastructure in the local spatial plan

The development of public infrastructure, including roads, is planned in the local spatial plan (Spatial Development Planning Law, 2011). This plan is approved by local binding regulation which is a local normative act. Although at present local authorities or other administrative bodies have no rights to establish servitudes of a right of way, several local governments have rather an interesting interpretation. Thus a local government demanded an owner of a forest land parcel to establish servitude on this parcel as it was not sufficiently established during the land reform (Fig.3)

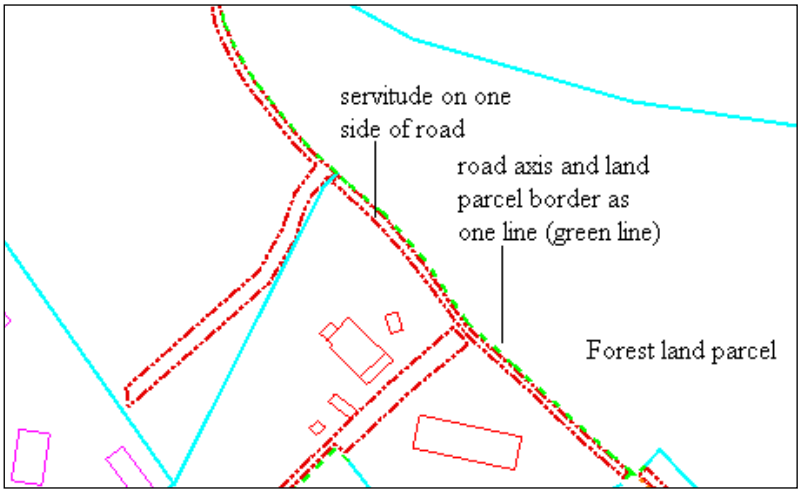

Fig. 3. A servitude on one side of road (cadastral map).

During the land reform the border of the forest land parcel was admeasured along the road axis. The servitudes were established on the other side of the road axis where dwelling houses were situated. Concerning that the servitudes were established just for one side of the road, this road as a whole was marked in the local spatial plan as traffic infrastructure territory and the local government claimed that herewith they established the servitude of a right of way.
According to the Civil Law, servitudes can be established by law. It means that either a particular law establishes servitude or the law delegates the authority to establish servitudes under certain preconditions to other public persons. The current case law (Judgement in case No.2002-01-03) confirms that the term *law* means also the normative acts as local binding regulations that have been issued on the basis of delegation included in the particular law. In this case no law delegates the right for the local government to issue the local binding regulation on establishment of servitudes. Thereby the local government did not have the right to establish servitude of a right of way by the local spatial plan or by binding regulations.

Conclusion and proposals
Several **conclusions** can be made:

1. Improperly established servitudes cannot be treated as divided property. In the Latvian legal system such legal relations when the land owner and the owner of the building are different persons are known as divided property. Divided property was often formed in the process of the land reform and it usually affected dwelling houses. The Civil Law stated that in such cases the owners of the buildings and the owners of the land beneath them had mutual pre-emption right, but until then the lease agreement had to be concluded. However, in the first described case the local government, claiming to be the possessor of the road, had not concluded a lease agreement with landowners.
2. The Civil Law does not permit to establish servitude for public use. In order to decide whether the servitude is required, it is essential to determine whether the road is meant for public use. In this case servitude is not proper because the state and municipal roads are publicly available and *the servitudes on the use of these roads are not necessary and are not admissible* (Višņakova G., Balodis K.,1998). In turn, servitudes can be established only on enterprise and residential roads.
3. In case of the development of new settlement, the newly built roads are not always publicly available even if they are called *roads of common use* in the local spatial plans or detailed plans of the new villages. The Supreme Court has emphasized that in cases when the street is privately owned, there is no reason to a viewpoint that an owner of the land has to guarantee public use of the land plot underneath the road or has to build the road just because it was designed in the local spatial plan or in the detailed plan as a road of common use (Decision in case No.A420632910, SKA – 376/2012). Thus this is not the status of common use but the municipal ownership right that guarantees the public availability of a road.

When analysing the failures made during the land reform process in the establishment of servitudes, it becomes clear that an urgent state-level solution is required. Within the existing regulation the local governments can propose to buy a land plot beneath the servitude road or, if no agreement can be reached, the local governments can expropriate it according to the complicated procedure set in the law. Still, this solution cannot be used broadly both because of the financial resources needed and because of the significant limitation of the fundamental right of property set in the Constitution of Latvia. The shortages in the process of carrying out the land reform cannot justify massive expropriation of land beneath the roads across the country.
In view of these considerations, the author has several **proposals**:

1. Each local government must make an inventory of the servitude roads established during the land reform, and this task should be set in the national legislative act, such as Land Management Law (The proposal of Land Management Law, 2013).
    1.1. If these roads are a section of a municipal road or they are used by a significant number of land properties, they should be defined as an infrastructure of public relevance. In this case the local governments must be given the rights to expropriate the land beneath the roads or to establish a new type of encumbrance that ensures the public availability of a road and at the same time allows the local authority to maintain it and a landowner to get a sufficient compensation. Being aware that these proposals are time and money consuming, each local

government should plan these measures according to the municipal budget in the long run.

1.2. In other cases, if dominant properties of the servitude could be detected, the local governments should be granted the rights to define them in a legally binding way so that they could be recorded into the Land Register as a legally binding remark.

2. It should be considered to introduce an obligatory condition that the road network in the newly developed villages or other densely populated areas must be handed over to the municipality. The amount and form of compensation could be an issue for discussions. While very common in other states, for instance in Finland (Land Use and Building Act, 1999), such practice is still unusual in Latvia.
3. Besides, it should be defined in legislative acts that in cases of dividing a land parcel the servitudes of a right of way are allowed only in the rural areas where new villages are not planned and only in case if it is not possible to ensure the access from state or municipal road. All the new roads should be formed as separate land parcels to facilitate their transfer to local authority in future if necessary. If the access to a new village is not included in the territory of the detailed plan, all the necessary measures to ensure the access (e.g., contracts with road owner or expropriation of the road) must be taken before the plan is approved.

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Information about author

Daiga Paršova. Mag.env., senior expert at the Land Policy Division, Spatial Planning Department, Ministry of Environmental Protection and Regional Development, Latvia. Address: Peldu Str. 25, Rīga LV-1494, Latvia, Tel: (+371) 66016512, e-mail: daiga.parsova@varam.gov.lv. Fields of interest: spatial planning, land management, land consolidation.

THE TAX SYSTEM OF REAL PROPERTY IN POLAND AND IN LATVIA

Maria Heldak[1], Vivita Baumane[2]
[1]Wroclaw University of Environmental and Life Sciences, [2]Latvia University of Agriculture

Abstract
The article deals with the subject of the real property taxation system currently in force in Poland and in Latvia. The current basic real property taxation rate in Poland applies per 1m² of the estate's total area and additionally depends on the manner in which the property is used. Real property tax income becomes part of the budget of the commune in which the property is located. The forest tax and the agricultural tax are established separately. For many years there have been plans for changing the tax system used in Poland to the cadastral tax, which uses the cadastral value, resembling the market value of the real property, as the basis for real property taxation. Cadastral assessment in Latvia is mainly used for calculating the real property tax. To calculate the cadastral value of a particular object, five assessment models have been developed. They are: assessment model for building land, assessment model for rural land, assessment model for buildings, assessment model for apartments and assessment model for engineering technical objects. Real property tax and the amount of objects are determined by the law in Latvia.
Key words: tax system, cadastral tax, cadastral assessment, real property

Introduction

The governmental changes in Poland which began in the late 1980s stimulated a huge economic transformation for the entire country. One of the most important changes involved switching from a centrally planned economy to a free market economy. This had its consequences in many areas and fostered e.g. the development and growth of the real property market. This was related to a simultaneous process of changes initiated with regard to the existing regulations and their adaptation to the new situation.

This was followed by a thorough state governance reform which aimed at the decentralisation of power with the concurrent creation of self-government communities (commune, poviat and voivodeship self-governments). Market regulations have been introduced into the domain of real property trade while real property ownership rights have been regulated and granted to legal persons. This was followed by the privatisation of companies and the implementation of ownership transformations in the domain of agricultural economy (Źróbek S., Źróbek R., Kuryj J., 2006).

Many new legal acts were established in the process of legal changes, including ones which normalised real estate taxation.

The real property tax in Latvia is a mandatory payment made by the owner to the local government in the territory of which the rel property is located. The real property tax is paid by:

- physical and legal persons in whose property or the legal possession there is the real property (owner, legal possessor);
- for the real property, that on the joint ownership right is owned by several persons or it is in joint possession, pays each of the co-owners (joint possessor) on the basis of his deemed part of joint ownership (joint possession);
- the user pays for the state's or local government's property (land, buildings and engineering structures) but, in the absence thereof, the payer is the lessee.

The aim of the article is to assess common and different features of the real property tax in Poland and in Latvia. Therefore, in order to achieve the aim the following objectives were set: to explore the regulatory documents which govern the real property tax and to explore the process of determining it in Latvia and in Poland, as well as to provide research conclusions.

Methodology of research and materials

The research was chosen to analyze the tax system of real property in Latvia and in Poland. For the analysis the normative acts of the land reform were selected. The above research conducted and the authors' opinions were taken into aacount.

Applying scientific research methods assessed tax system of real property common and different features. Monographic descriptive method, analysis and synthesis methods are used in the research of historical development, theory aspects and problem elements. Empirical research method is used to

develop general statements from separate facts or to determine regularities. Logical construction and interpretation method are used for developing conclusions.

Discussions and results

The tax system in Poland

In the early 1990s the government carried through an act regarding taxes and local fees, which normalised matters related to the real estate tax (Act from January 12, 1991 regarding taxes and local fees (i.e. 2010 Journal of Laws no. 95, item 613 as amended) (Act from January 12, 2010).

In accordance with article 2, section 1 of the Tax and Local Fees Act, real property taxation applies to real property or structures including:

1) land,
2) buildings or their parts,
3) structures or their parts related to business activity.

The act regulates the basis for real property taxation, i.e.:

1) area in the case of land;
2) floor space in the case of buildings or their parts;
3) in the case of structures or their parts related to business activity, subject to Act 4 - 6, the value defined in the regulations for income taxes, established for January 1st of the fiscal year, which serves as the basis for calculating the amortisation for the given year, not net of depreciation. In the case of fully depreciated structures, the value used comes from that established for January 1 of the year of the most recent amortisation write - off.

The current basic real property taxation rate in Poland applies per 1m² of the estate's total area and additionally depends on the manner in which the property is used. Real property tax income becomes part of the budget of the commune in which the property is located. The fee rate for the real property tax is determined by the town board through a resolution. The size of the fees cannot exceed legal fees (with regard to maximum fees) which are determined yearly by the minister of finances via a regulation 6. (Cymerman J., 2009). The real property is the area determines the size of the tax.

The tax authorities keep electronic real property tax journals for the purpose of measuring the tax assessment and in order to retrieve real property taxes as well as agricultural and forest taxes. These journals include data regarding the taxpayers and what is subject to taxation, especially the data provided by the taxpayers in the declarations they submit (Cymerman J. 2009).

Within the current system the owners of separate real property of identical area pay the same tax regardless of the location or the condition of these properties. Quite often real property owners do not possess the funds required to properly maintain their property. In some cases a person may live in a very large house or venue in an attractive location, but their income does not allow them to maintain their real property.

There are two separate taxes established for agricultural and forest land. These are governed using separate regulations. These taxes involve lands classified in the Land and Property Register as agricultural and forest lands with the exception of land occupied for the purpose of running a business activity other than agricultural or forest activities.

The following data serves as the basis for agricultural taxation:

1) in the case of agricultural farms: the number of conversion hectares established on the basis of the area, the types and classes of arable land figuring in the Land and Property Register, as well as depending on whether the commune is part of the taxing district,
2) for other types of land: the number of physical hectares figuring in the Land and Property Register.

An agricultural holding is defined as a area of land classified as arable land, wooded or shrubbed land located within arable land, with the exception of lands occupied for the purpose of pursuing a business activity with their total area exceeding 1 ha or 1 conversion ha.

The basis for forest tax taxation is the area of the forest expressed in hectares, figuring in the Land and Property Register.

Currently, the maximum tax rate for the property other than agricultural and forestry are expressed in zloty and converted to 1 m².

In accordance with the proclamation by the Minister of Finances from August 7, 2013 regarding the upper fee limit for taxes and local fees in 2014 (Official Gazette of the Republic of Poland from September 9, 2013, item 724), published based on article 20, sec. 2 of the 12 January 1991 Act on

Taxes and Local Fees, town boards cannot establish tax and fee rates higher than the following maximum rates.
These equal:
1. Land fees:
a) related to business activity, regardless of the manner of qualification in the Land and Property Register: 0.89 PLN per 1m^2 of area,
b) below lakes, reserved for retention reservoirs or water plants: 4.56 PLN per 1 ha of area,
c) other, including those reserved for paid public welfare statute activities by public welfare organisations: 0.46 PLN per 1m^2 of area;
2. Buildings or their parts:
a) residential buildings: 0.74 PLN per 1m^2 of floor space,
b) related to business activity or residential buildings or their parts reserved for business activity: 23.03 PLN per 1m^2 of floor space,
c) reserved for business activity in the domain of qualified seed grain trade: 10.75 PLN per 1m^2 of floor area,
d) reserved for business activity in the domain of providing health services: 4.68 PLN per 1m^2 of floor space,
e) other, including those reserved for paid public welfare statute activities by public welfare organisations: 7.73 PLN per 1m^2 of floor space;

It is common for town councils to locally establish fees that are slightly lower than those presented above.

The planned taxation alterations in Poland

Under the current circumstances the planned implementation of the cadastral tax seems a sensible and justified solution, as the tax would enable the owners of real property to cover their maintenance costs. A set cadastral value resembling the market value would function as the basis for determining the cadastral tax. Unfortunately, this change will inevitably foster an increase in the financial encumbrance of real property owners, which is why its implementation remains debatable.
Universal real property taxation becomes part of the information system of a state. It ensures access to specific information regarding a given real property, i.e. its cadastral value. This information will be represented using taxation maps and taxation tables.
The experiences of many well-developed states indicate that this solution is efficient and justified. It serves as a sort of objection towards the inappropriate allocation of capital in space (Hozer J., Kokot S., 2005).
The cadastral tax will be dependent on the data figuring in the real property cadastre, and established with regard to the percentage rate and the subject and object of taxation. The aim of the cadastral tax is thus to strive towards a situation in which it will serve as one of the main sources of profit for local governments.
Universal real property taxation is related to the valuation of many real properties. This can be performed at a mass scale or individually, yet the latter method requires a huge amount of funds, is time-consuming and hard to execute and revaluate at a later time. It is thus sensible to utilise the other method, which makes it possible to estimate a large number of real estate in a short period of time and using a unified approach using the proper algorithm. This specific manner of valuation requires table and map databases as well as the tools to combine these two types of data.
Due to the planned changes in the taxation system in Poland there are efforts towards a more effective and rational real property taxation system which will depend on the cadastral value of real property. These efforts will constitute an element of universal real property taxation, while matters related to this type of taxation will be regulated through the following introduced legal acts:
1) act from August 21, 1997 regarding Real Property Economy (2010 Journal of Laws consolidated text, no. 102, item 651 as amended).
2) regulation by the Council of Ministers from June 29, 2005 regarding Universal Real Property Taxation (Journal of Laws no. 131, item 1092).

In accordance with the act on local government unit income, the income of a commune includes e.g. inflow from the real property tax and from forest and agricultural taxes. It will thus be in the best interest of the commune to introduce a more efficient real property taxation system. The current contribution from the real property tax constitutes ca. one third of the income of a commune. It is far larger in countries which have implemented the cadastral tax, with as much as 70% in the Netherlands (Krawczyk M., 2009).

Determining representative real property is the basis of establishing the cadastral value. Representative real property is determined for each type of real property existing in a given taxation zone. A taxation zone is a contiguous area of land which plays a crucial role in the local spatial development plan and which possesses similar features contributing to the value of the land (Regulation by the Council of Ministers from June 29, 2005 regarding universal real property taxation; 131 Journal Od Laws, item 1092).

Two types of land are distinguished for taxation purposes. The first type is developed land and land reserved for development, as well as lands reserved for non-agricultural and non-forest purposes; agricultural land and forest land constitute the second type.

The tasks related to the implementation of universal real property taxation belong to the staroste. In order to achieve this, the staroste commission's real property valuers to evaluate the cadastral value of representative real property along with their component parts, which will serve as the basis for establishing taxation maps and tables.

Wolanin M. (Wolanin M., 2005) claims that the procedure of real property universal taxation is comprised of a number of activities including:

- determining the value of representative real property;
- establishing taxation maps and tables and making them accessible to the public;
- approving taxation maps and tables by the town board by means of a resolution and deciding upon the comments and objections raised regarding the presented taxation maps and tables;
- rendering a decision by the staroste and announcing it in the official gazette of the voivodeship.

The tax system in Latvia

Cadastral data of Cadastre information system are used for this purpose. Latvian (or foreign) physical and legal persons (or groups of such persons) are payers of the tax. Contract or other agreement, which have ownership or legal possession of real property are the basis of tax impose. Only people whose ownership rights have been confirmed in the Land Book are considered as the owner of real property (Parsova V., Gurskiene V., Kaing M., 2012).

For the purposes of cadastral valuation:

- land is divided in accordance with the purpose of use specified for the real property :
  - rural land;
  - building land.
- buildings are divided into building types and the building types with similar criteria, which form the value, shall be joined in groups of building types;
- engineering structures are divided into types of engineering structures and the types of engineering structures with similar criteria, which form the value, shall be joined in groups of engineering structure types.

Cadastral assessment in Latvia is mainly used for calculating the real property tax. In Europe and in other market economy countries large-scale or cadastral assessment is based on the information of real property market. The process and methods of determining cadastral values are similar to individual assessment, but it has to be taken into consideration that during cadastral assessment a big number of objects has to be assessed at the same time and assessment costs should be low (Baumane V., 2010).

And thus, to determine the cadastral value of land applying the cadastral assessment models of building land and rural land, the data of the real property market, the data of the Cadastre, socio-economic indicators, data of the territory planning of the local municipality and other information about the qualitative situation of the soils, pollution and the geological investigation of the land, existing communications in the assessed territory etc. are necessary (Baumane V., Paršova V., 2010).

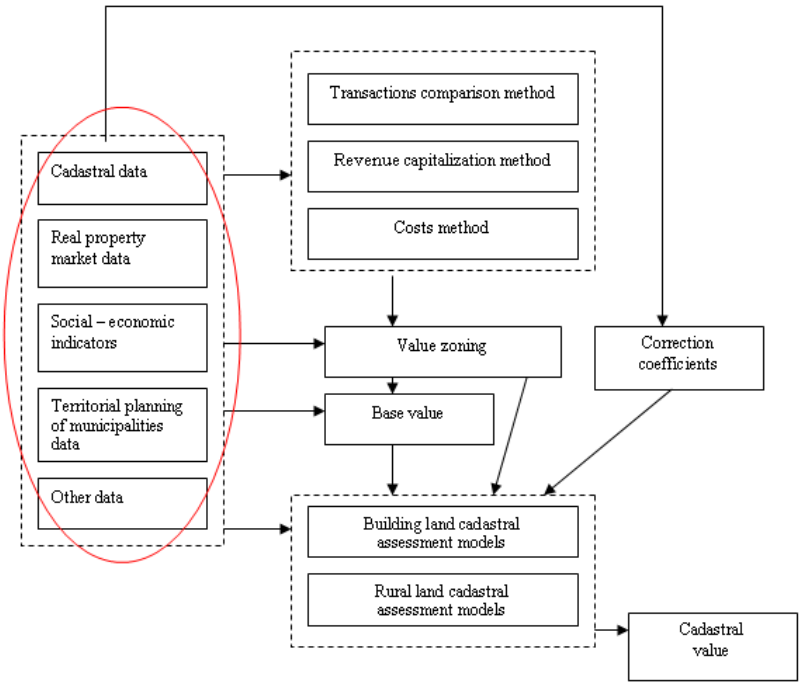

Fig.1. Use of data in the cadastral assessment process in Latvia.

The compulsory tax rates are given below (On Immovable Property Tax, 1997):

1. Tax rate on the land, buildings or parts thereof and engineering constructions is 1.5 percent of the cadastral value of the real property.
2. Tax rate on residential buildings, regardless of whether or not they are divided into residential properties, residential parts of the set of premises in non-residential buildings, the functional use of the accommodation, as well as set of premises, the functional use is associated with living (garages, car parks, basements, storage and utility rooms), if they are not used for economic activities is:

- 0.2 per cent of those which cadastral value do not exceed EUR 56,915;
- 0.4 per cent of those which cadastral value is from EUR 56,915 to EUR 106,715;
- 0.6 per cent of those which cadastral value exceeds EUR 106,715.

3. 1.5 per cent additional tax rate is imposed on unused agriculture land.

The taxation period is the calendar year. Cadastral valuation is a set of operations in order to specify the value of a cadastre object. It is also a systematic valuation of property groups on a particular date, performing the valuation according to a standardized procedure. Mainly is used for calculating the *real property tax*. Cadastral value shall be calculated for all cadastre objects and real property registered in the Cadastre information system.

The State Land Service (SLS) as a governmental institution of the Republic of Latvia is in charge of real property object data accumulation and dissemination to institutions responsible for land management and supervision. The SLS is supervised by Minister of Justice.

The SLS is also responsible for cadastral valuation according to procedures determined by The Cabinet. It is important that information regarding real property transactions is used at least for last two years. The SLS registers and analyses the prices of the real property market. It also lease payments and determines the price level. In order to accumulate and process information regarding real property transactions, the Cadastre information system maintains the database of the real property market.

Lots of data registered in the Cadastre information system are taking into account during the process of cadastral value calculating (Parsova V., Gurskiene V., Kaing M., 2012):

- the base of cadastral value,
- data characterising the cadastre object,
- purposes of use of the real property,
- encumbrances of the real property object.

The SLS is performing operations in Cadastre information system which are mentioned below (The local government has to administer the tax):

- maintenance of data regarding the object of real property,
- entering the information regarding the payer of the tax.

It is worth to note the fact that cadastral value excludes the value of forestry plantations. The cadastral value does not include the value of forest stands, but the value of forest stands is taken into account for taxation purposes, too. The State Forest Service is the right institution for calculation of forest value.
The local government prepares a payment notice (administrative act) with a cadastral tax. Every taxpayer is obliged to pay the tax on the basis of this payment notice. If a payer of real property tax has not received a payment notice by 15 February of the current assessment year, he/she has an obligation to inform the local government within one month. The tax shall be paid once in each quarter – not later than 31 March, 15 May, 15 August and 15 November – in the amount of one quarter of the yearly tax sum. There is also one more opportunity: the tax may also be paid once a year by advance payment.
There are also some opportunities to receive abatements: for real property tax the amount of tax may be reduced for politically repressed persons - by 50%, but only in case if the immovable property is not used for economic activity, the local governments may accept regulations, which provide abatements for separate categories of taxpayers in the amount of 90%, 70%, 50% or 25% of the tax amount. Such amount of abatement (90%) may be granted to persons, having status of low income persons or families.
The SLS maintains information systems, which provide data for administration of real property tax:
- calculation of the cadastral value for real property taxation,
- gathering information on taxpayers,
- preparing lists of objects imposed on real property tax and taxpayers,
- calculation of the total amount of foreseen values of real property objects.

The SLS is responsible only for calculation of the cadastral value since 2010. Except of this it still regularly transfers to municipalities about 80 percents of data, stored in the Cadastre information system.
The local governments by issuing the binding regulations have the right in 2012 to restrict the growth of the tax volume on land or maintain the size of the land to maintain it at the level at that of 2011, as well as to determine the extent of the growth restriction and the terms for implementing the regulations (What is Immovable Property…, 2014).
In 2008, 2009 and 2010 and 2011, after updating of the cadastral value of the real property, the amount of real property tax, if the purpose for use of the real property does not change, shall not exceed the amount of tax calculated for the previous taxation year (not taking into account the abatements) by more than 25% for each unit of land and each building separately. The limitation for growth of the amount of real property tax shall also be applied to such objects of the real property tax in a multi-unit residential house that consist of one group of premises and undivided parts of land. If the area of the object of real property tax has been changed in 2008, 2009, 2010 and 2011 in comparison with the area for which real property tax was calculated in the previous taxation year, the real property tax shall be calculated following the amount of real property tax for one square metre calculated in the previous taxation year.
Real property tax on land in protected natural areas, except in the neutral zones and natural sites in 2010, does not exceed the tax amount of 2009.

Conclusions

1. The first part shows problems, process and proposition related to general valuation of Real Property in Poland (Universal real property texation).
2. Within the current system in Poland the owners of separate real property of identical area pay the same tax regardless of the location or the condition of these estates. Quite often real estate owners do not possess the funds required to properly maintain their property.
3. Universal real property taxation is related to the valuation of many real property. This can be performed at a mass scale or individually, yet the latter method requires a huge amount of funds, is time-consuming and hard to execute and revaluate at a later time.
4. To ensure determining the cadastral value of real property for the needs of the country, municipalities and society, the operation of the cadastral assessment system in Latvia is organised in three stages – data collection, data analysis, calculation of cadastral values.

5. Until December 31, 2005 cadastral assessment of real property was regulated by the law "On Real Property Tax", but from January 1, 2006 it is also the Immovable Property State Cadastre Law and the Regulations No.305 of the CM - Regulations on cadastral assessment that provide the cadastral assessment models of building and rural land and characterise in detail the model indicators.
6. To determine the cadastral value of land applying the cadastral assessment models of building land and rural land, real property market data, the Cadastre data, socio-economic indicators, data of the territorial planning of local municipalities and other information about the qualitative condition of soils, pollution, geological research of land, existing engineering communications in the territory to be assessed etc. are necessary.

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Information about authors

Maria Heldak, dr hab. inż., Head of Department of Surveying Equipment, Agricultural and Economy Real Estate; Wroclaw University of Environmental and Life Sciences, Department of Spatial Management, Poland; Address: ul. Grunwaldzka 53, 50-357 Wroclaw, e-mail: maria.heldak@up.wroc.pl. , Fields of interest: real estate management, real estate valuation, spatial.

Vivita Baumane, Dr.oec., Associate professor, Latvia University of Agriculture, Faculty of Rural Engineering, Department of Land Management and Geodesy. Address: Akademijas 19, Jelgava, Latvia, LV-3001, +37163026152, vivita.baumane@llu.lv, Fields of interest: agrarian economics, land use, land degradation, assessment of real property, market of real property

VERIFICATION OF SET OF ABANDONED LANDS' DATA BY THE FIELD METHOD

Daiva Gudritienė[1], Rasa Jasiniauskaitė[1]
[1]Aleksandras Stulginskis University

Abstract
The aim of the research was to identify the change of abandoned lands in Ūdrija cadastral area of Alytus district. This particular area was selected due to the diversity of land cover objects and because of a good agrarian condition. According to the data of 2010, the cadastral area of Ūdrija had 176 plots of abandoned land with the total area of 61.41ha. After the verification 179 plots of a land were found, with the total area of 62.84ha. It can be said that there is a minor increasing tendency of abandoned lands. During field verification as many as 41 mismatches were identified. The mismatch of the data was influenced by two main factors: a two year period between the information of the data set and field verification, as well as errors of the data set. To sum up, the information of verification has changed slightly. It happened because some mismatches were positive (identified new areas of abandoned land), while others were negative (plots of land which were in a set of data were denied during the verification).
Key words: abandoned land, spatial abandoned land of the territory of the Republic of Lithuania.

Introduction

The Ministry of Agriculture has prepared a procedure (the order of the Republic of Lithuania ...1992) for the identification of abandoned agricultural land located in each plot of a land. Abandoned agricultural land area is defined in the State Land Fund. All the abandoned agricultural land areas of the Republic of Lithuania are identified with distant cartography methods by interpreting spectral images of the Earth's surface from artificial Earth satellite of the territory of the Republic of Lithuania, which are connected with 1994 year‘s Lithuanian coordinate system LKS-94. The spatial data of abandoned agricultural land areas are stored in the data set of spatial abandoned land of the territory of the Republic of Lithuania AŽ_DRLT.

Every year by 17th of July the National Land Agency provides the updated AŽ_DRLT to state enterprise Centre of Registers, which processes AŽ_DRLT and the spatial data of real estate's cadastre map's boundaries of plots of land and prepares the required data for the calculation of land tax of abandoned agricultural land in accordance with set requirements. Afterwards, it is provided to an administrator of the central taxation. For this reason, the data provided in AŽ_DRLT must be precise and regularly updated. There was an idea to choose one of the cadastral areas and to check the existing data of abandoned lands using the method of field interpretation. Afterwards, to carry out an investigation to see the changes of it. This article analyzes the abandoned agricultural lands, because it is becoming an important issue of the twenty-first century.

For the detailed analysis Ūdrija cadastral area of Alytus district was selected because it belongs to the district, which is dominated by unproductive land. There was also an opportunity to investigate this area thoroughly, using the interpretive method of field orthophotographic mapping. The object of the research is the abandoned agricultural land in Ūdrija cadastral area of Alytus district. The aim of the research is to identify the change of abandoned agricultural land in this particular cadastral area. The objectives of the research are: 1) to identify the concept of abandoned lands, 2) to analyze the change of abandoned lands in Ūdrija cadastral area of Alytus district.

During the research the analysis of literature and cartographic material and the comparison methods of statistical data were applied. For the processing of the data Excel and AutoCad programs were used.

Results and discussions

The concept of abandoned agricultural land

In order to analyze abandoned lands, first the definition of abandoned land (AL) must be given. There are a lot of definitions of abandoned land in foreign scientific literature, which differ in its goals and the methods of its determination. In most of the countries the term of abandoned land (AL) is not even justified. It is mentioned in Lithuanian legal acts, but the specific content is not detailed. (G. Kuliešis...,2010)

Some foreign authors' opinion of abandoned land‘s concept:

- According to Coppola (2004), abandoned land can be considered as abandoned land, when it is not used as means of production;

- Moravec (2007) defines the same concept as a shift from the traditional use of land to less intensive one, i.e. the land abandonment is not only limited to the cessation of farming, but is also associated with the change of land use in a farm;
- Pointereau (2008) believes that the shift from a certain land use model (often intensive, traditional farming) to a less intensive one (due to limited human activity) may be considered abandoned land, because after that land is overgrown by bushes eventually becoming a forest;
- Pinto Correia (T. Pinto Correia, 1993) states that the exact meaning of abandoned land is relative. The fact of abandonment, according to the author, usually is the activity, which leads to less intensive care of the land or it could happen because of the land itself. Then the soil is not used anymore;
- Plieninger emphasizes that the land abandonment has a number of consequences for ecosystems' processes, including functions and services that are not well understood and are often specific in nature, such as the frequency and intensity of fire, nutrient cycle, values of cultural landscape or water balance. (Plieninger,… 2013).

In the requirements of good agricultural and environmental condition in the United Kingdom and Greece abandoned land is defined as land, which is not used for agricultural production, but still may be suitable for it. (Pointereau,..., 2008).
Germans think that if the land is not a fully grown forest, but is no longer used for agricultural production (although it is in a quite good agrarian and environmental condition), it may be considered as abandoned (Von Armin 2010). In Germany and Great Britain the land is considered as abandoned if it is not used for five years in a row or more.
According to Food and Agriculture Organization of the United Nations (FAO), the abandonment of land is a process when human-controlled and previously used land is left for the nature, in other words - unattended. After a few years, depending on the climate and ecological zones, the land can be considered to be completely abandoned. In addition, some of the law (forest law) or natural conditions (desertification, fast forest growth) when restoring the use of land becomes impossible or not incentive. According to the definition of the Statistical Office Of The European Communities (Eurostat) the land is considered to be not used for agricultural reasons when the plots of it are not used for cultivation for more than five years.
In the Law of Land Taxation of Republic of Lithuania (Relevant editorship 2013-01-01) abandoned agricultural land is defined as land overgrown by woody plants (except of green plantations) in a parcel of land or agricultural land inside of it, which is identified with distant cartographic methods in the Republic of Lithuania or the procedure laid down by its authorized institutions.
In Rural Development Projects (RDP) another term was used; there abandoned land was defined as land for agricultural purpose, but still not used for it and not declared for at least 3 years in a row. However, this concept has been applied only for RDP measures and in accordance with this concept, abandoned land has not been accounted. (G. Kuliešis...,2010).
After analyzing foreign and Lithuanian definitions of abandoned land, it is suggested to define abandoned land as land, whose intensity of using is reduced for at least 3 years. The land itself is no longer used as a means of agricultural production and is visually altered, i.e. it is overgrown by woody plants, which complicate the agricultural activity. It can be identified using distant cartographic methods.
This definition particularly names the concept of abandoned land, describes the causes limiting land cultivation and defines the method of its estimation.

The dynamics of abandoned land in Ūdrija cadastral area before the verification and after it

Currently there is no completely accurate data, however, 278 thousand ha of abandoned land has been calculated.
The district of Alytus consists of 31 cadastral areas, with the total area of 134,654.1 ha. The total number of 18,039 parcels of land are considered to be abandoned. It is 5,110.58 ha or 3.8 percent of all cadastral areas in that district. There are not many abandoned land plots in Ūdrija cadastral area and the whole territory of it is quite small. The following factors will make the data verification fast and successful. This particular area is chosen not just because of intensive agricultural activity, but also because of land cover objects, which usually influence the formation of abandoned land. These objects may include forests, lakes, rivers and narrow streams.

Analyzing the dynamics of abandoned lands in Ūdrija cadastral area, the information provided in the data set of abandoned lands was compared with the data obtained from this particular area, using the interpretation of orthophotographic mapping by the field method. Collected information was systematized and according to it the current situation of abandoned lands (using AutoCad program) was displayed in the ortophotographic map.

Three types of abandoned areas were identified. Firstly, these are plots of land marked as abandoned in the data set (1), i.e. areas previously used for agricultural production and not included in abandoned land areas. However, the data of verification has revealed that they are abandoned (2); plots of land, which are marked as abandoned in the data set, but the verification reveals no signs of abandonment (3).

The areas of Type 1 are formed near bodies of water such as rivers, lakes, coastlines of ponds. In these areas some kind of protective lines prevail, where agricultural activity is limied or simply it would be difficult to cultivate the land because of an irregular shape of land or topography. A large part of it is near forests or in areas which intervenes with a forest. It is inconvenient and irrational to carry out agricultural activities in areas like that. (Fig 1.)

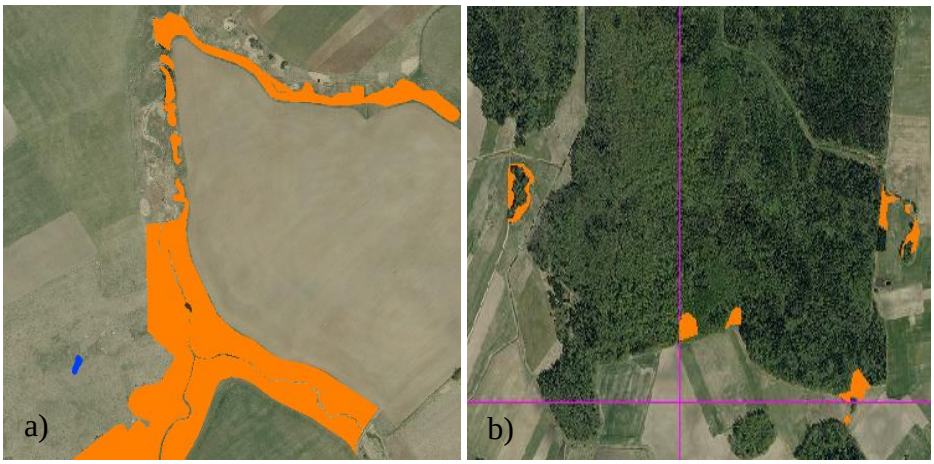

Fig. 1. Areas of Type 1: a) abandoned agricultural plots of a land near the riverside b) widespread forest.

During the research areas of Type 2 were identified:

- near bodies of water,
- near abandoned farmsteads and farms,
- near forests,
- interfere into cultivated fields.

The majority of abandonment features of these areas were identified in ortophotographic map, however, it was not marked in the data set. For this reason, they were specified by the field method and marked as abandoned plots of land (Fig 2.).

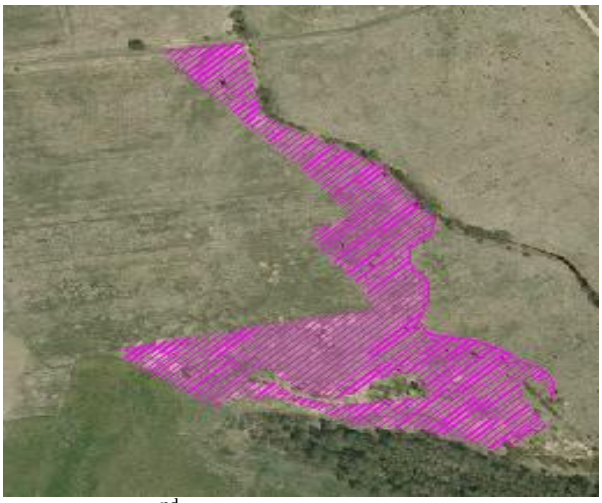

Fig. 2. The 2nd type of abandoned parcel of a land.

It has been found that unmarked abandoned plots of land have already been forming for more than a year. It shows the woody vegetation, which is several years old. (3 Fig.).

Fig. 3. A parcel of a land, whose features of abandonment were identified during interpretation of a field: a) the photo of a land parcel; b) the marked parcel of a land.

Areas of Type 3 were identified near forests and lakes. The parcels of land were marked as abandoned lands, but during the verification of the field, it was identified that they are not abandoned. Most likely these territories were not abandoned, because in one of them there is a homestead (Fig 4.), in the other one the lake shore is adapted for recreational purposes. Either these areas were included in abandoned lands by mistake or they were put in order. Incorrectly marked areas dominate near the forests, where the darkness of tree shadows might remind of abandoned land.

Fig. 4. Parcels of a land, which were incorrectly marked as abandoned land.

The total area of Ūdrija cadastral district is 3,743.45 ha. According to 2010 data, the abandoned lands in 176 parcels of a land take 61.41 ha. It is approximately 1/60 of the total land area.
After the work of field interpretation, the results showed that there are neither new plots of abandoned land nor plots of abandoned land marked in the data set. (Table 1).

Table 1

The change of abandoned lands in Ūdrija cadastral area

	The type of abandoned land			
	The information of data set (1)	**Parcels of a land, which were not included into the data set during the verification (2)**	**Areas, which were denied during the verification (3)**	**The data determined by the field interpretation**
The amount (in units)	176	22	19	179
The area (ha)	61.41	3.11	1.68	62.84

According to the data of 2010, the average plot of abandoned land was 2.86 ha. The verification results of 2013 show that now the average plot of abandoned land has decreased to 2.85 ha. The data mismatch was influenced by two factors: a two year period between the information of the data set and field verification, and also errors of the data set. During the field verification as many as 41 mismatches were identified, however, the final information changed slightly. It happened because some mismatches were positive (identified new areas of abandoned land), while other were negative (plots of land, which were in a set of data, were denied during the verification). After the verification plots of abandoned land were found only by three land parcels more than two years ago. Nevertheless, it can be stated that there is an increasing tendency of abandoned lands.

Conclusions

1. After analyzing the definitions of abandoned lands by foreign and Lithuanian authors, it is suggested to define the concept of abandoned land as the land the use intensity of which has been reduced for at least 3 years. The land itself is no longer used as a means of agricultural production and it is visually altered, i.e. it is overgrown by woody plants making complicated the agricultural activity. It can be identified by using distant cartographic methods.
2. According to the data of 2010, the cadastral area of Ūdrija had 176 plots of abandoned land, with a total area of 61.41ha. After the verification 179 plots of land were found with a total area of 62.84ha. It can be said that there is a minor increasing tendency of abandoned lands.
3. During field verification as many as 41 mismatches were identified. The mismatch of the data was influenced by two main factors: a two year period between the information of the data set and the field verification, and also errors of the data set.
4. To sum up, the information of verification has changed slightly. It happened because some mismatches were positive (identified new areas of abandoned land), while other were negative (plots of land, which were in a set of a data, were denied during the verification).

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Information about authors

Daiva Gudritienė. Lecturer, Faculty of Water and Land Management, Aleksandras Stulginskis University. Address: Universiteto 10, LT-53361, Akademija, Kaunas r., Lithuania, Tel. + 370 37 752372 .
Lecturer, Faculty of Environmental Engineering, Kaunas Forestry and Environmental Engineering University of Applied Sciences. Address: Liepų g. 1, Girionys, LT 53101, Kauno r., Lithuania, Tel.. +370 37 383082, e-mail: gudritiene@gmail.com.
Rasa Jasiniauskaitė. Student of Land Management, 1st year, master degree, Faculty of Water and Land Management, Aleksandras Stulginskis University. Address: Universiteto 10, LT-53361, Akademija, Kaunas r., Lithuania, Tel. + 370 37 752372, e-mail: rasa.jasiniauskaite@gmail.com.