LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
ALEKSANDRAS STULGINSKIS UNIVERSITY (Lithuania)
UNIVERSITY OF WARMIA AND MAZURY IN OLSZTYN (Poland)

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FOREWORD

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- Institute of Land Use Planning and Geomatics of Aleksandras Stulginskis University, Lithuania

The journal includes 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 mentioned issues.
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(baltic.surveying1@gmail.com)

CONTENT

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PERSPECTIVES OF APPROPRIATE NON-PRODUCTIVE LAND USE IN LITHUANIA

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

Abstract
The average land productivity score is about 41.8 in the Republic of Lithuania. However, in separate regions it ranges from 30.5 to 55.1. The research object is agricultural utilities in rural municipalities of the Republic of Lithuania. The analysis of land use plan fragments in the selected areas shows that land is abandoned mostly in land areas where non-productive land or hilly relief prevails. Having improved conditions of land use, about 44 % of abandoned agricultural utilities can be transferred into intensive farming.
Key words: non-productive land, unused land, land use

Introduction

Preservation of land suitable for agriculture and its appropriate consumption is an important aim worldwide. The problem is specific as agricultural land is limited and in practice non-renewable natural resource. Therefore, the legal regulation stating that land plots for agricultural purposes must be used for agricultural activity only by their owners and/or consumers must be issued. (Abalikstiene, Aleknavicius, 2013; Abalikstiene, Stravinskiene, 2011; Aleknavicius, 2007, 2010, 2012; Krisciukaitiene et al, 2009; Kuliesis, Salengaite, 2010; Sinkeviciute, Gudritiene, 2011).

Lithuanian municipalities with the average land productivity less than 37 scores were selected as the research object. Land in 18 rural munisipalities out of 52 rural municipalities scored less than 37. In non-productive areas it is important to identify the most reasonable use of land regarding economic, social, environmental and technological aspects. The use of land considered as less favourable for agriculture was evaluated by conducting the research into abandonment of less favourable areas seeking EU support, good agrarian state practice, and support for rural communities. (Hatna, Bakker, 2011; Pelucha, Kveton, Jilkova, 2013; Bouma et al, 2012; Pasztor, Szabo, Bakacsi, 2010).

The research object is non-productive land for agricultural purposes in rural municipalities of the Republic of Lithuania. The aim of the research is to analyse prospects of rational non-productive land use in Lithuania. The following objectives were set to reach the aim: evaluate land use changes on the basis of cartographic material; to design methodological regulations for land use planning. The scientific novelty and practical relevance is the analysis of agricultural land use in non-productive areas on the basis of cartographic sources.

Methodology of research and materials

The methods of information search, systemising, the analysis of cartographic material and statistical data as well as scientific and methodological literature analysis, comparative analysis, and generalization were employed to reach the aims and objectives of the paper.

The main data for the research were obtained in the National Land Service under the Ministry of Agriculture, the State Land Fund, National Paying Agency under the Ministry of Agriculture, and the Register Centre. Cartographic data and databases found in Land Information System were used for analytical research.

Discussions and results

The analysis of reasonable non-productive land use allows us to state the main methodological principles for the change of existing land use, which can be employed:

- when preparing territory planning documents, which predict the change of land utility composition (first of all, transforming agricultural utilities into other utilities as well as transforming other land utilities and abandoned land into arable land, agricultural meadows, or forest (forest land));

- by optimizing the support for subjects of agricultural activity, which would induce one to use land by assessing its natural and farming qualities;
- when planning prospects of agricultural land users' activity;
- when planning the funding for drainage, other work of land improvement, and infrastructure equipment;
- while giving a permit to cultivate forest in agricultural utilities.

One of the most significant principles when determining prospects of non-productive land use is assessing the possibilities to realize the predicted changes and measures. The second principle is the balance of all interested people's suggestions and demands.

Changes of land use in cartographic material. When cartographic material designed during different periods is available, one can identify changes of agricultural land utilities and their causes.

Arbitrary signs in the images mark:

– agricultural land utilities in use (as declared);

– former agricultural utilities, which have turned into other utilities and have not been connected to control blocks for declaration of agricultural utilities and crop;

– areas of former agricultural utilities connected to control blocks but not used (non-declared); according to conducted distance research ascribed to abandoned lands (i.e. starting to be overgrown by trees and bushes);

– other uncultivated (not declared) agricultural land utilities connected to control blocks.

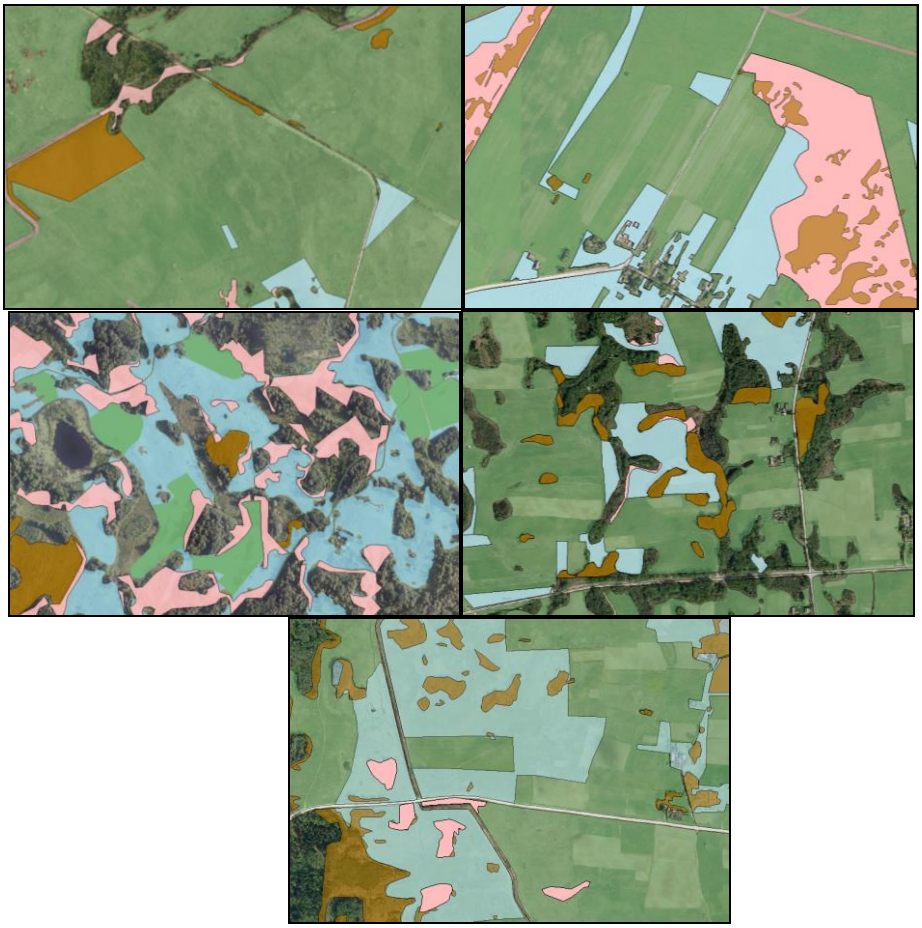

Fig. 1. Land use (plan fragments)

Following the analysis of provided examples, one can make the conclusion about the causes of agricultural land utilities deterioration or abandonment (Fig. 1). Unused agricultural utilities could be subdivided in the following way:

1) land plots where agricultural activity is not pursued. These are territories where the forest is cultivated after obtaining the permit, former gardens in farmsteads are used as green areas, land areas are included into the territory of extended farmsteads or used for construction and equipment;
2) former meadows and natural pasture no longer in use, land has overgrown with shrubs, forests or turned into non-used land (the number of families keeping domestic animals had reduced and detached farmsteads had disappeared when rural inhabitants stopped keeping cows, calves, sheep and horses);
3) former plots of agricultural utilities are not used (not declared) due to reclamation system's defects;
4) former plots of arable land are not used (not declared) due to inconvenience: the small size of a plot, not embedded among agricultural utilities, long distance from arable land fields and good quality roads;
5) other former arable land and pasture plots near good roads or farmsteads have started to overgrow with trees and shrubs or are uncultivated due to non-productive lands and other causes (land owners do not have possibilities or do not wish to undertake agricultural activity, there are no farmers capable of hiring the land).
The analysis of land use plan fragments in selected areas showed that land was abandoned mostly in land areas where non-productive land or hilly relief prevail.

Table 1

Reasons of unused agricultural utilities in the analysed areas of non-productive lands

Indices	**Location (villages)**				
	Paukste-liskes	**Mergis-kes**	**Ropiskes**	**Buniskiai**	**Sadziunai**
I. Land area in the territory analysed, ha:	73.6	73.9	73.9	74.1	74.4
I. 1. Area of former agricultural utilities, ha	69.3	40.8	71.8	55.9	69.3
I. 2. Out of which :					
1) turned into different kind of utilities and have not been connected to crop declaration control blocks	3.9	4.1	4.0	4.8	9.6
2) have been connected to control Bl1 blocks, though not declared	3.8	27.8	22.7	8.1	21.9
3) area in use (declared)	61.6	8.9	45.1	43.0	37.8
II. Causes decrease in former agricultural utilities, ha					
II. 1. Land areas which have been cultivated with forest after obtaining the permit	-	-	-	-	-
II. 2. Former gardens in farmsteads used as green areas; land plots used for construction or extension of farmsteads	-	-	-	0.5	0.7
II. 3. Former meadows or natural pasture, not used due to the lack of necessity	0.4	4.1	3.4	1.7	5.6
II. 4. Former plots of agricultural utilities, not used (not declared) due to defects in reclamation systems	-	-	-	-	1.7
II. 5. Former plots of arrable land, not cultivated (not declared) due to inconvenience:					
- small size of the plot	0.1	-	-	2.3	1.3
- have been situated outside agricultural utilities	-	-	-	-	-
- long distance from the arable land fields and good quality roads	-	10.2	-	2.5	0.5
II. 6. Other plots of arable land and pasture unused due to:					
- low fertility (productivity score up to 30)	-	10.5	19.8	2.8	4.9
- low farming value (productivity score – 31–35)	3.5		3,5	-	-
- overgrown with shrubs near forests	0.7	7.1	-	3.1	4.8
- other reasons	3.0		-	-	12.0

The research data shows that most of land abandonment cases occur in areas (see Fig. 2) where non-productive land and hilly relief are dominating. 27.3 % of former agricultural utilities are not used although they have road access whereas soil is of average farming value.

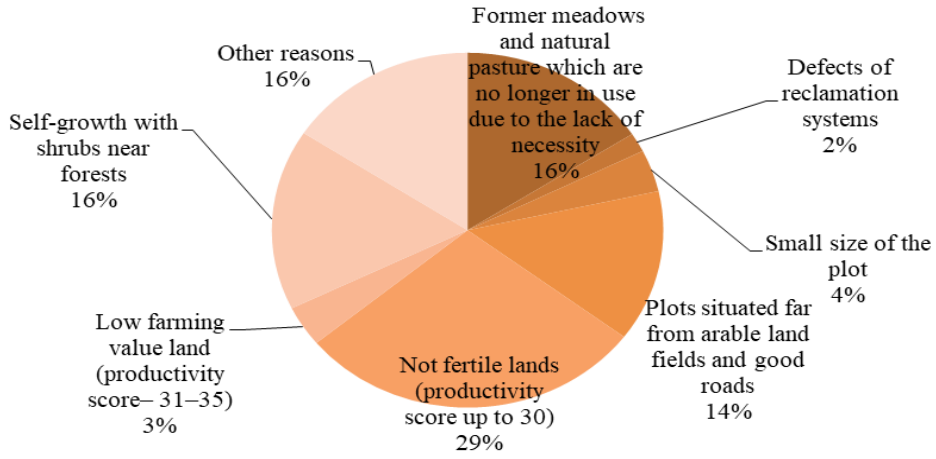

Fig. 2. Causes of decrease in agricultural utilities

Therefore, it is advisable to use the land for the purpose. Having improved conditions of land use, about 44 % of abandoned agricultural utilities can be transferred to intensive farming.

Methodological principles for land use planning. While preparing documents of agrarian territory-planning, the procedure, which would allow using more thorough assessment of the present state and soil examination material, is suggested. It includes the following information:

1. Definition of where and for what reasons former agricultural utilities have changed – their area has transformed into forests, shrub and tree greeneries, marshes, other unused land or is not used for cultivation (in bare fallow, is abandoned). The results of the analysis must be marked by conventional signs in cartographic material.

2. While compiling the drawing of planning document solutions, the areas (abandoned or changed) are defined and recommended for the certain directions of use:

1) for arable land – land plots or their parts, the soil of which is suitable for cultivation of annual plant crops. Only the land plots smaller than 0.5 ha can be an exception, not used due to straightening of land plot boundaries as well as spontaneously growing forest plantations in the abandoned land, which, during forest management activities were recorded and registered as forest (forest land);

2) for agricultural meadows – land plots or their parts, where earlier after essential reclamation measures, agricultural meadows were established; or these are the areas of drained peaty and humus soils larger than 0.5 ha or the land area with eroded soils on hills and in valleys, the slope inclination of which exceeds $5–7^0$. Agricultural meadows can also be established in small plots of current or former arable land, which, due to its small size is not appropriate to be used for mechanical cultivation from economic point of view or the access roads cannot be improved for the same reason. Only abandoned land plots overgrown with shrubs containing drainage systems of poor or satisfying condition, where it is not efficient to use machinery for cultivation of agricultural meadows and exploitation, can be an exemption;

3) on the basis of the current state for natural land utilities, the remaining area of former agricultural utilities overgrown with shrubs and trees or having changed into marshes or water pools. Natural meadows and pastures, which must not be drained, ploughed, or the state of which and composition of herbs cannot be changed in some other ways, are also attributed to the areas.

4) for cultivation of forest and field protective tree and shrub greeneries – the remaining area of unused (abandoned) agricultural utilities, the cultivation of forest is not against the law.

3. When planning transformation of agricultural utilities, to assess the possibility to realize changes mentioned in Section 2 by land users themselves or when pursuing the foreseen drainage reconstruction work in reclamation projects. It is also crucial to assess ecological diversity of landscape and identify greeneries for soil preservation or the ones which should be protected because

of their value from an ecological point of view. The remaining insignificant tree and shrub greeneries in reclamation projects, land areas changed into marsh or unused plots having soil suitable for crop growing can be transformed into agricultural utilities.

4. Having completed the actions provided in Sections 2 and 3, it is crucial to analyse the current possibilities and to cultivate non-productive agricultural utilities with the forest. While preparing methodological recommendations, it is advisable to use the suggestions of the performed scientific research (Zemes..., 2011) concerning propsects of land use. New forests in agricultural utilities in use can be designed on the basis of the suggestions only if it is reasonable with regard to rural cultural landscape formation under the guidance of the main regulations and requirements, concerning the increase of Lithuanian forest coverage.

Conclusions

1. Having conducted the analysis of land use plan fragments in the selected areas, it was defined that land is abandoned mostly in land areas where non-productive land or hilly relief prevails. Having improved conditions of land use, about 44 % of abandoned agricultural utilities can be transferred to intensive farming.
2. While preparing documents of the agrarian territory planning, such a procedure is suggested which would allow the use of more thorough assessment of the present state and soil examination material.

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Information about authors

Edita Abalikstiene. 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

Daiva Gudritiene. 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.

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ANALYSIS OF EXISTING SPATIAL INFORMATION SYSTEMS IN TERMS OF ITS USE FOR THE RENEWAL AND REVITALIZATION OF RURAL AREAS

Mateusz Ciski, Krzysztof Rzasa, Marek Ogryzek
Institute of Geography and Land Management
University of Warmia and Mazury in Olsztyn

Abstract
Revitalization is a set of urban and planning activities, coordinated by local self-government administration, aim of which is a social, architectural, planning and economical advantageous transformation of the specific area of the municipality, being in a state of crisis resulting from economic and social factors. Whereas, the renewal of the countryside is understood as shaping the living conditions of people in rural areas, with the local community as an animator and subject. The combination of revitalization and renewal of rural areas is a particularly important and urgent task, connected with rural and architectural chaos, decline of cultural context and local tradition. The aim of the article is to examine information needs for the renewal and revitalization of rural areas, and the possibilities of satisfying these needs using available spatial information systems.
The first part of the paper contains an analysis of information needs in the field of renewal and revitalization of rural areas, created on the basis of literature and valid legal provisions. The created information resource illustrates the scope of data necessary for proper planning of renewal and revitalization of rural areas.
In the second part, specific information needs were compared with the capabilities of existing spatial information systems. The possibility of obtaining free of expense information necessary for renewal and revitalization of rural areas was analysed. Systems which may be useful in the implementation of related activities are also indicated.
Key words: spatial information systems, revitalization, renewal of rural areas, data sources.

Introduction

In accordance with the Revitalisation Act of 9 October 2015, revitalisation is a process for deriving from a state of crisis in degraded areas, carried out in a comprehensive manner through integrated activities for the local community, space and economy, geographically concentrated and led by revitalisation stakeholders based on a municipal regeneration programme. According to the guidelines of Ministry for Regional Development on programming activities related to housing, the process of revitalisation is comprehensive, coordinated, long-term and carried out on a specific area of spatial transformation. It is technical, social and economic, initiated by the local government in order to take an area out of a state of crisis by giving a new functional quality and creating conditions to it for its development on the basis of the specific local determinants (Narodowe… 2008). The Scientific Committee of the Institute of Urban Development defined revitalisation as a coordinated process conducted jointly by the local government, the local community and other participants as part of development policy with a view to preventing the degradation of the urban space and crisis phenomena, boosting development and quality changes by increasing social and economic activity, improving the environment and the protection of national heritage, while also maintaining the principles of sustainable development (Rewitalizacja… 2017).
Revitalization nowadays is a serious challenge for local authorities. We can no longer afford misplaced, individual projects and wasting of public money, including European funds for revitalization. Actually, there are no municipalities in Poland today, where there are no areas concentrating negative social and infrastructural phenomena (Kołacz, Wielgus, 2015).
Revitalization includes the optimal use of specific conditions of a given area and strengthening its local potentials (including cultural potential), and is a long-term process led by stakeholders of this process (including entrepreneurs, non-governmental organizations, property owners, public authorities, etc.), mainly in cooperation with the local community. Activities to support revitalization processes are carried out in a coherent manner: internally (individual actions between each other) and

externally (with local sectorial policies, e.g. transport, energy; with goals and directions resulting from strategic and planning documents).
In the process of revitalization, the proper determination of the degraded area and the area of revitalization is particularly important. In accordance with the Revitalisation Act of 9 October 2015, degraded area is the area of the municipality in crisis state due to the concentration of negative social phenomena, in particular unemployment, poverty, crime, low education or social capital, as well as insufficient participation in public and cultural life. The degraded area must also be characterized by at least one of the following negative phenomena: economic, environmental, spatial and functional, technical.
An area covering all or part of a degraded area, characterized by a high concentration of negative phenomena, on which, due to significant importance for local development, the municipality intends to carry out revitalization process, is designated as a revitalization area.
The concept of "renewal of rural areas" has been functioning in Poland since 1997, when Wilczyński, inspired by actions for the development of rural areas in Austria and Germany, initiated the creation of the first regional program of renewal of rural areas in the Opolskie Voivodeship (Wilczyński, 2003). Renewal of rural areas means the planned and implemented by the rural community development process, based on local resources using external support (Wilczyński, 2008). These activities are based on the involvement of citizens motivated by responsibility for the fate of their own surroundings. The most important thing in this noble idea is that the inhabitants of the Polish village themselves should initiate changes in their localities, and together they would strive to improve the quality of life and economic independence. Inhabitants of the village should therefore be both the subject and the driving force for the development of their region, should feel responsible for what they can do for themselves and future generations, caring for the preservation of their identity but without giving up modern technical solutions or ideas used e.g. in EU countries (Wilczyński, 2003). In the renewal of rural areas, development factors (including non-material ones) are launched from the bottom up – of will and for the benefit of residents. Activities falling within the scope of renewal of rural areas should lead to deeper integration of rural societies (among others, through the creation of the Village Renewal Groups by the residents) and to improve economic conditions by shaping entrepreneurial attitudes. The activity of local communities is based on support from the regional level in the form of regional/voivodeship programs of renewal of rural areas (Wilczyński, 2012). Renewal of rural areas is the direction of rural development, combining respect for tradition with the need to look for a place for a village in the changing world. It is process of constant adjustment to social and economic, internal and external changes, that should lead to the overall shaping of the living conditions of rural residents (Idziak, Wilczyński, 2013).
The combination of renewal and revitalization of rural areas is a particularly important and urgent task, connected with rural and architectural chaos, loss of cultural context and tradition of the place, as well as many social problems occurring in rural areas (Biczkowski, Biczkowska, 2017). The aim of the article is to examine information needs in terms of renewal and revitalization of rural areas and the possibilities of meeting them with the use of available spatial information systems.

Methodology of research and materials

In order to achieve the research goal set in the article, the authors in the first stage analysed in detail the processes of revitalization and renewal of the rural areas. The legal bases of these activities, ministerial guidelines and scientific literature on this subject were analysed. On this basis, the main information needs necessary to implement these processes have been identified. Not all information resources needed and functioning in cities are just as important in rural areas (Cellmer, Źróbek, 2008; Szafraniec, 2012).
When establishing a degraded area, a number of quantitative and descriptive information should be collected, primarily of a social nature, but also: economic, environmental, spatial and functional, and technical. This requires the analysis of negative phenomena in the spheres:

1. social (information on: high unemployment, significant poverty, high crime, low level of education and social capital, insufficient level of participation in public and cultural life)
2. economic (information on: low level of entrepreneurship, poor condition of local enterprises, low economic activity)

3. environmental (information on: exceeding the environmental quality standards, the presence of waste posing a threat to life, human health or the environment)
4. spatial and functional (information about: insufficient equipment in technical and social infrastructure or its poor technical condition, lack of access to basic services or its poor quality, non-adaptation of urban solutions to the changing functions of the area, low level of communication service, shortage or poor quality of public areas)
5. technical (in particular, degradation of the technical condition of buildings (including housing), and failure of technical solutions enabling effective use of construction facilities, in particular in the field of energy efficiency and environmental protection).

In both analysed activities, social participation is very important. Activities related to renewal of rural areas require the participation of the local community as a factor triggering this process. Therefore, it is necessary to collect data on residents' expectations regarding the local area by carrying out, for example: surveys, tests, standardized and free interviews, debates, public hearings, etc.

As part of the revitalization carried out, it is necessary to examine its links with other strategic and planning documents in the municipality. Therefore, it is necessary to obtain data from: municipality development strategy, study of the conditions and directions of the spatial management or a municipal strategy for solving social problems.

All this information must be spatially referenced and associated with location data – only then it can be the basis for conducting proper analyses. As in all spatially related activities, information should contain: course of borders, location of various objects, structure of use, type and functions of buildings, designation of areas for various purposes, technical infrastructure, communication systems, etc.

After analysing the demand for information, in the second part of the article, the authors analysed the available functioning spatial information systems. The possibility of the user obtaining free of charge information necessary for renewal and revitalization of rural areas was analysed. Systems, which may be useful in the implementation of related activities, are indicated – the next chapter contains the results of these analyses. It became the basis for conclusions from the research carried out in the last part of the article.

Discussions and results

Spatial data, on which spatial information systems are based, are acquired from many different sources today. The most popular and, at the same time, the most important ones are: satellite images, aerial photographs, terrestrial (stereoscopic) pictures, GPS receivers, automatic measurement stations, geodetic measurements, field work and surveys, maps and plans, state data resources, data resources of various institutions (Zhao, Bryan, King, Song, & Yu, 2012; Freire & Painho, 2014; Wei, Hsu, Peng, & Lee, 2014). The aim of the article is to review available spatial information systems, and more specifically its key element – online databases. All spatial data described in this chapter has been visualized in the ArcMap component of ArcGIS 10.4.1 software, while screenshots from the described spatial information systems come from the corresponding websites.

GEOPORTAL website (*geoportal.gov.pl*) provides access to current and accurate spatial information, including data on the geographical environment. Thanks to the GEOPORTAL project, implemented by Head Office of Geodesy and Cartography (pol. *Główny Urząd Geodezji i Kartografii, GUGiK*) spatial information infrastructure services are available electronically not only for selected units of government and local government administration, which create or maintain registers, but also for individual users or other organizational units. WMS browsing services (Web Map Service) is an international standard for sharing spatial data in a raster format. Available through the *geoportal.gov.pl* service, it consists of a series of maps of the entire country (e.g. topographic map, orthophotomap, numerical terrain model, etc.). WMS services are distributed by municipal or county WMS servers. Figure 1 presents areas threatened by floods, WMS service from Polish Geological Institute, via GEOPORTAL website.

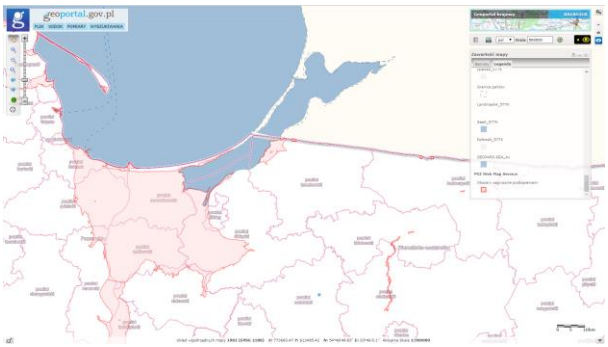

Fig. 1. Areas threatened by floods, Polish Geological Institute (pol. Państwowy Instytut Geologiczny, PIG), *mapy.geoportal.gov.pl/imap/?gpmap=gp0*, 17.07.2018

Center for Geodetic and Cartographic Documentation (pol. *Centralny Ośrodek Dokumentacji Geodezyjnej i Kartograficznej*, CODGiK, *codgik.gov.pl*) collects, maintains and shares available databases of central geodetic and cartographic resources. 31/12/2017 CODGiK was liquidated and its duties were taken over by GUGiK. CODGiK commissioned by GUGiK maintains the *geoportal.gov.pl* service in its infrastructure and trades data collected in the central geodetic and cartographic resources. In accordance with the Act on Geodetic and Cartographic Law of May 17, 1989; no fees are charged for sharing data sets of: state register of boundaries and areas of territorial division units of the country (pol. *państwowy rejestr granic* – PRG), state register of geographical names (pol. państwowy rejestr nazw geograficznych – PRNG), database of general geographic objects (pol. *baza danych obiektów ogólnogeograficznych* – BDOO), a numeric terrain model with a grid interval of at least 100 m (NMT_100), index grids for topographic maps and non-standard topographic studies, PL-1992 layout split sheets in scales 1: 1250, 1: 12500 and 1: 5000. Vector data on territorial division – state register of boundaries and areas of territorial division units of the country (PRG) –are available in SHP format and cover the area of the whole country in the scope of boundaries and surfaces of basic units of the three-tier territorial division of the country (i.e. municipalities, counties, voivodeships). The state register of boundaries and areas of territorial division units of the country databases also contain vector data in SHP format with Special Borders, which includes the following boundaries: the area of activity of the head of the civil defence of the voivodeship; Maritime Office; regional water management board; Regional Prosecutor's Office; internal sea waters; exclusive economic zone; technical belt; appellate prosecutor's office; capital police station; National Archives; County Police; squadron of border guards; tax office of large taxpayers; Country Court; marina; voivodeship command of the fire brigade; voivodeship administrative court; the area of activity of the head of the civil defence of the municipality; county fire brigade command; appellate court; border guard institution; regional police command; basic tax office; statistical region; superintendence; census circuit; tax agency; coastal belt; regional directorate of the State Forests; police station; territorial sea of the Republic of Poland. Figure 2 shows municipalities and registration districts of Braniewo county.

As a part of the LPIS project (Land-Parcel Identification System, pol. *System Identyfikacji Działek Rolnych*, which is managed by the Agency for Restructuring and Modernisation of Agriculture, pol. *Agencja Restrukturyzacji i Modernizacji Rolnictwa*, ARiMR) the cadastral data from all geodesic centres in Poland was catalogued and merged into one database. Do not expect geodetic accuracy from it, however, it is a very useful collection for everyone who wants to have an overview of the distribution of parcels; data can only be used for the approximate identification and spatial location of the parcel and for estimating its area. The data is made available for download as ZIP packages containing data in the SHP format, by area division into counties. Figure 3 depicts cadastral data for Braniewo county.

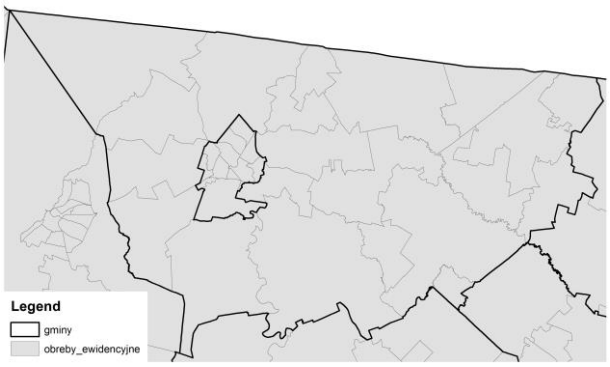

Fig. 2. State register of boundaries and areas of territorial division units of the country (pol. państwowy rejestr granic – PRG), municipalities and registration districts, *gugik.gov.pl/pzgik/dane-bez-oplat/dane-z-panstwowego-rejestru-granic-i-powierzchni-jednostek-podzialow-terytorialnych-kraju-prg*, 17.07.2018

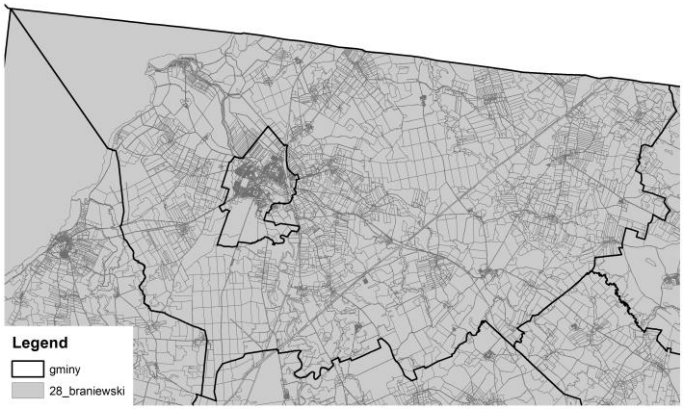

Fig. 3. Cadastral data for Braniewo county, *geoportal.gov.pl/web/guest/DOCHK*, 17.07.2018

Statistics Poland (pol. *Główny Urząd Statystyczny*, GUS) is the owner of many spatial data (including data covered by the INSPIRE Directive). Geostatistical portal GUS (*geo.stat.gov.pl/start*) is a solution for presenting statistical data in spatial terms. It fulfils the task of gathering, presenting and sharing information for a wide audience, including public administration, entrepreneurs, individual users and scientific and research institutions. In addition to strictly spatial data, statistical data published at the Local Data Bank (pol. *Bank Danych Lokalnych, bdl.stat.gov.pl/BDL/start*) may be useful for GIS users. It's possible to download statistical data and combine it with geometric data, for example, with boundaries of territorial division units from CODGiK, to create cartograms. Figure 4 presents statistical data of registered unemployment rate, division into Polish counties.

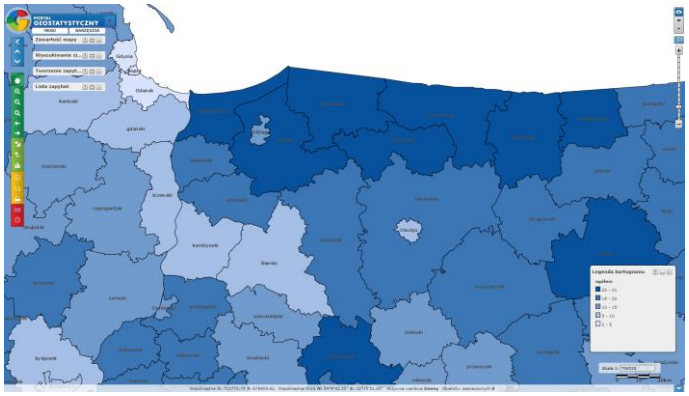

Fig. 4. Registered unemployment rate, division into counties, *geo.stat.gov.pl/imap*, 17.07.2018

General Directorate for Environmental Protection (pol. *Generalna Dyrekcja Ochrony Środowiska*, GDOŚ) is the most reliable source of spatial data about forms of nature protection. GDOŚ provides free of charge data in WMS and SHP formats, containing information about: National parks, Landscape parks, Nature reserves, Protected landscape areas, Special areas of conservation ("habitats" Natura 2000), Special protection areas ("Bird" Natura 2000), landscape-nature complexes, Documentation sites, Ecological areas, Natural monuments (division into counties), RAMSAR Areas, Landscape Convention (mezoregions), Ecological corridors. The GDOŚ Spatial Information System can be found at: *geoserwis.gdos.gov.pl/mapy*. Figure 5 depicts various forms of nature protection on the example of Braniewo county from GDOŚ Spatial Information System.

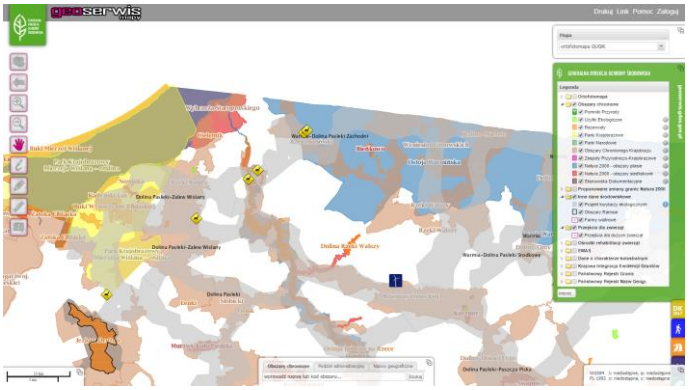

Fig. 5. Various forms of nature protection on the example of Braniewo county, *geoserwis.gdos.gov.pl/mapy*, 17.07.2018

OpenStreetMap (OSM) is an online community project aimed at creating a free and available map of the entire globe, it is edited by registered users. The creation and development of the OSM was motivated by limitations in the accessibility and use of maps and the emergence of inexpensive portable satellite navigation devices. The data and the maps created on their basis are currently published on the Open Database License. The online service of the German company GEOFABRIK (*download.geofabrik.de*) collects vector data from around the world, updates it every 24h, and also allows free of charge download in SHP format. In the GEOFABRIK database, the following vector data (points, polylines and polygons) can be found: buildings, land uses, towns, sacral buildings, historical monuments, sports and recreation facilities, railway lines, roads, water reservoirs and waterways, and many more. Figures 6 and 7 shows OpenStreetMap data from GEOFABRIK service, respectively: landuse; and buildings, railways, roads, traffic information, water and waterways; on the example of Braniewo county.

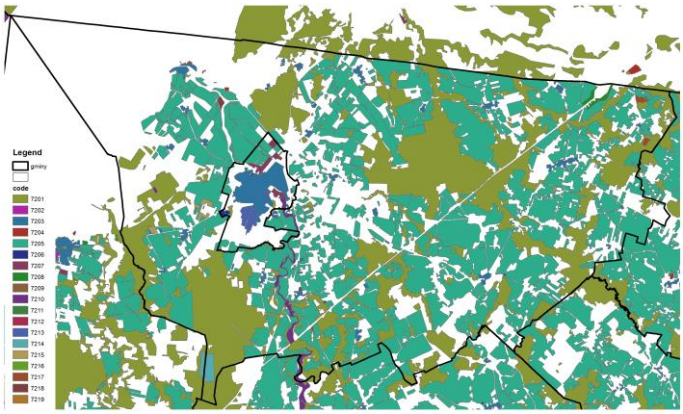

Fig. 6. OpenStreetMap data from GEOFABRIK service, land use on the example of Braniewo county, *download.geofabrik.de*, 17.07.2018

Fig. 7. OpenStreetMap data from GEOFABRIK service; buildings, railways, roads, traffic information, water and waterways; on the example of Braniewo county, download.geofabrik.de, 17.07.2018

DanePubliczne.gov.pl is a website that aims to collect in one place data (not only spatial) of particular importance for the development of innovation in the country and the development of the information society. Data sets can be searched by categories, data providers, keywords and also by entering a search phrase. No registration is required to use the website. The data providers include, among others: government administration; The Polish Social Insurance Institution; The Agricultural Social Insurance Fund; National Health Fund; state research institutes; Polish Academy of Sciences; and scientific units. The duty of the suppliers is to provide data on the website, to frequently update and to ensure availability for download. The website contains data in many formats, e.g. SHP, CSV. Figure 8 presents density of historic monuments, on the example of Braniewo country, from the National Inventory of Historical Monuments.

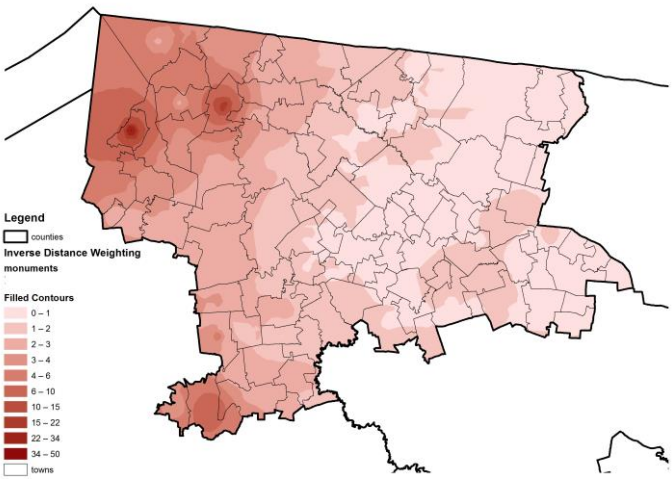

Fig. 8. Density of historic monuments, on the example of Braniewo country, from the National Inventory of Historical Monuments, *danepubliczne.gov.pl*, 17.07.2018

Sentinel is a series of European space-based remote-sensing missions. Name "Sentinel" covers both proper satellites (e.g. Sentinel-1) and single satellite instruments (e.g. Sentinel-4). Sentinel missions are part of the Copernicus program, initiated and funded by the European Union. Technological supervision over the construction of Sentinel satellites and instruments is carried out by the European Space Agency (ESA). EO Browser (*sentinel-hub.com/explore/eobrowser*) makes it possible to browse and compare full resolution images from a complete archives of Sentinel-2, Sentinel-3, Sentinel-1, ESA's archive of Landsat 5, 7 and 8, global coverage of Landsat 8, Envisat Meris and Proba-V. The service also allows to analyse the spectrum of light, giving following indicators: NDVI, moisture index, SWIR, NDWI, NDSI; and also allows any colour bands setting. The website gives the

possibility of downloading free of charge raster data for any place in the world. Figures 9 and 10 shows respectively: moisture index and Normalized Difference Vegetation Index on the example od Braniewo county.

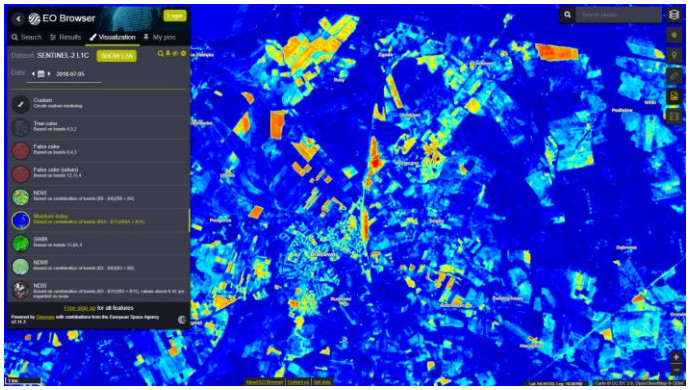

Fig. 9. Moisture index on the example od Braniewo county, *sentinel-hub.com/explore/eobrowser*, 17.07.2018

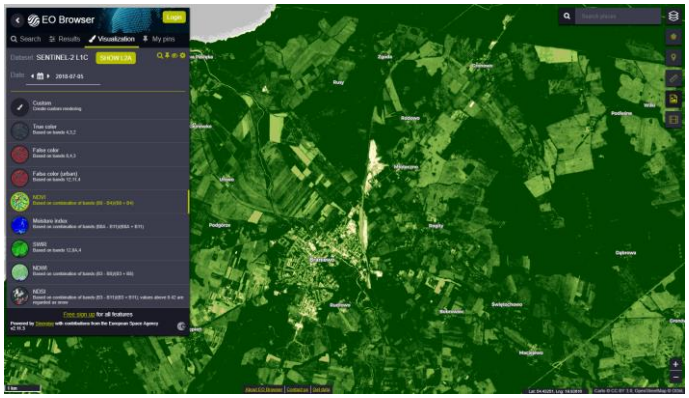

Fig. 10. Normalized Difference Vegetation Index on the example od Braniewo county, *sentinel-hub.com/explore/eobrowser*, 17.07.2018

The European Environment Agency (EEA) is an agency of the European Union that provides reliable and objective information about the environment. The tasks of the EEA include supporting sustainable development and helping to achieve a significant and visible improvement of the environment in Europe by providing up-to-date, relevant, and reliable data to decision-makers and the public. The EEA website (*eea.europa.eu*) contains huge amounts of spatial data for EU Member States. The data is divided into a number of topics, e.g. air pollution, land use, water and marine environment, agriculture, energy, industry, transport. There is a possibility of free of charge download of vector and raster data, in many formats. The service also contains many interactive maps. Figure 11 presents fragmentation pressure of urban and transport infrastructure expansion.

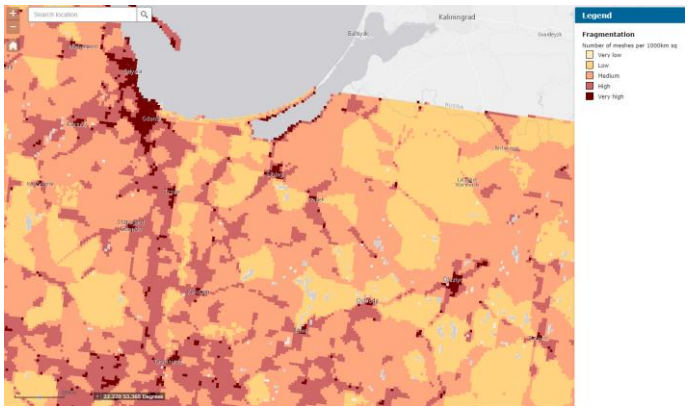

Fig. 11. Fragmentation pressure of urban and transport infrastructure expansion, light colours mean less fragmentation pressure and dark colours mean more fragmentation pressure exerted by urban and transport infrastructure expansion, *eea.europa.eu/data-and-maps*, 17.07.2018

Conclusions and proposals

Research carried out in the article allowed to formulate the following conclusions and proposals:

1. For conducting analyses related to revitalization and renewal of the rural areas, detailed spatial location of data is necessary. In existing spatial information systems, the level of accuracy usually ends at the level of territorial division units (most often it is the county or municipality level), while the revitalization and renewal of the rural areas needs point or line data.
2. In order to carry out revitalization and renewal of the rural areas, additional data from local institutions needs to be obtained, e.g.: Municipal Social Welfare Centre, municipal office, municipal police, employment service, environmental protection inspectorate, conservator of monuments, National Support Centre for Agriculture (pol. *Krajowy Ośrodek Wsparcia Rolnictwa*, KOWR), etc.
3. Spatial data is made available for users free of charge, in convenient and useful formats (e.g. SHP). However, it cannot be directly used in the analyses related to revitalization and renewal of the rural areas. The GIS software (e.g. ArcGIS, QGIS) needs to be used to process data obtained from spatial information systems.
4. In the revitalization and renewal of the rural areas, the participation of the local society is necessary. Activities of renewal of the rural areas require initiation by the residents, therefore, data on their expectations regarding local space should be carried out, for example in the form of: surveys, tests, standardized interviews, debates, public hearings, etc.
5. Some spatial data is mandatory for the revitalization and renewal of the rural areas. This includes: cadastral data (to establish ownership boundaries), boundaries and areas of territorial division units (for localisation of analysed area), forms of nature protection (to define restrictions), various statistical data, and mentioned earlier data from the participation of the local society. All this data needs to be spatially referenced (associated with location), to be the basis for spatial analyses.
6. In order to improve the process of social participation it is advisable to create an online platform for gathering and exchanging opinions of the local community. It is suggested to integrate this platform with GPS mobile devices (e.g. smartphone), which will allow for accurate spatial data placement.
7. The optimal solution for the technical improvement of revitalization and renewal processes would be to create a separate local spatial information system dedicated to the revitalization and renewal of the rural areas. It will be collecting in one place data from the spatial information systems identified in the article and supplemented with local data obtained from other sources mentioned in point 2 (with additional implementation of data obtained as a result of activities related to social participation). Such system would enable comprehensive support for the process of revitalization and renewal of the rural areas.

Acknowledgments
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Information about authors

Mateusz Ciski, MSc, assistant and PhD student, University of Warmia and Mazury in Olsztyn, Faculty of Geodesy, Geospatial and Civil Engineering, Institute of Geography and Land Management. Prawochenskiego 15, 10-720 Olsztyn, Poland, tel. +48 895234210, e-mail: mateusz.ciski@uwm.edu.pl . GIS, cartography, geostatistics, historical maps, spatial planning.

Krzysztof Rząsa, PhD, assistant professor, University of Warmia and Mazury in Olsztyn, Faculty of Geodesy, Geospatial and Civil Engineering, Institute of Geography and Land Management. Prawochenskiego 15, 10-720 Olsztyn, Poland, tel. +48 895234210, e-mail: krzysztof.rzasa@uwm.edu.pl . Socio-cultural conditions of spatial management, management of non-urbanized real estate, spatial planning, sustainable development.

Marek Ogryzek, PhD, assistant professor, University of Warmia and Mazury in Olsztyn, Faculty of Geodesy, Geospatial and Civil Engineering, Institute of Geography and Land Management. Prawochenskiego 15, 10-720 Olsztyn, Poland, tel. +48 895234210, e-mail: marek.ogryzek@uwm.edu.pl . GIS, The Agricultural Property Agency, spatial planning, geostatistics, sustainable development.

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POTENTIAL OF BROWNFIELDS AS DEVELOPING TERRITORIES IN BRATISLAVA

Julius Golej, Miroslav Panik
Slovak University of Technology in Bratislava, Slovakia

Abstract
The issue of brownfields and their analysis in Slovakia have not been given such emphasis over the last decade as in the neighbouring EU countries, such as in Austria or in the Czech Republic. The situation is completely different in Bratislava and also in the rest of Slovakia and the development of this type of area is almost unrealized. A frequent argument is problematic ownership relationships to the unused, degraded land. However, the real problem is the higher financial costs associated with brownfields regeneration. Despite this fact, brownfields can be considered as an area with relatively large development potential within the urbanized area and one form of hidden reserves of both, local and national economy. Among the indisputable benefits of using brownfields, we can include reduction of the extensive land use of agricultural land for rural area. In the long run, Bratislava is preparing a search study of neglected and unused land within the capital. It is due to be completed in the course of 2018, and will be an important basis for a new territorial plan and the development of Bratislava. In the following article, we analyse brownfield land in Bratislava. The already realized brownfield projects are also mentioned, while we are trying to point out their main advantages and disadvantages.
Key words: brownfield, Bratislava, property development, greenfield.

Introduction

Generally, historical centres and major transport hubs are considered to be the most attractive places for construction, especially in large cities. Historic centres are very interesting for housing, hotel business, services and lucrative office space, especially to simple accessibility by both public and private transport and prestige addresses for owners and also for tenants. Their attractiveness is also enhanced by quality architecture, plenty of greenery, shops and services. Of course, on the other hand, construction options are quite limited in these locations.

A critical problem of the urban development in Slovakia is appearance of the underused sites after the suppression of the industrial activities (Špirková, Zúbková, 2017). Particularly in these localities, Bratislava has great potential. It is a naturally growing economic and cultural centre that requires new construction and innovative concepts of development.

Brownfields as areas that are not used in accordance with the original function represent a significant land reserve for the future development of Bratislava. Around 40% of former industrial sites remained unused by brownfields after the building boom in Bratislava, the capital of the Slovak Republic (Stanilov, 2007). Unlike Vienna, where brownfields are the only areas for development in the densely populated area of the capital of Austria. As examples we can mention the airport in Aspern (Fig. 1), where a new quarter is built predominantly with the function of housing or in the past refurbished gas tanks Gasometer (Fig. 2). The city's leadership approaches the shaping of the future of these territories through a participatory policy. The development of a new block or neighbourhood is open to the professional public as well to all actors in the area.

The non-use of brownfields is often conditioned by lack of or insufficient inventory and cataloguing of existing problems and values of the territory, unclear ownership and lack of concept of individual public sector activities (Finka, 2011).

Bratislava is the capital and fulfils the function of the top administrative and political centre of the Slovak Republic. It is administratively divided into 5 urban districts, which are further divided into urban areas and local areas, some of which are further divided into local sections. There are 17 urban areas and 48 localities in Bratislava. Urban areas are managed by local authorities. The district offices provide the state administration in the city and the regional office ensures the performance of the state administration at the level of the region. The city is incorporated into the Bratislava Region, which consists of 3 outer city districts and 5 inner city districts. Bratislava is an independent urban whole

with an area of 367.6 km2 with a population of 425,000 inhabitants and a wide regional background of 600,000 inhabitants (Master plan of the city of Bratislava, 2007).

Fig. 1. Aspern, district of Vienna – on the left: the original area of the airport; on the right: a new residential area.
Sources: http://fm4v3.orf.at/stories/1663777/index.html;
http://www.igzt.at/index.php?seitenId=11&projekteId=115

Fig. 2. Gasometer - a city within a city
Source: https://en.wikipedia.org/wiki/Gasometer,_Vienna#/media/File:Gasometer-hyblerpark-2001.jpg

Development in the form of new construction is currently evident in almost every part of Bratislava. It is a positive fact that in many cases there is thickening within the city's intravilan, which making the space more efficient. On the other hand, the free landscape is also being urbanized. Future developments should go more strongly into the city, especially to the brownfields. In this case, environmental burdens have to be removed, one of the biggest problems of Bratislava. Investments in brownfield regeneration are often associated with high risks. Developers without accurate costing and risk factors cannot assess the real profitability of the regeneration project. This is why they often prefer construction on greenfield areas (Petríková, 2011). In addition, brownfield projects require not only an experienced developer, but also a financially strong company. The economically demanding restorations lay in high costs for decontamination, including demolition work. Other hindrances include financing and organisational obstacles contained in the tax system and its application, difficulties in obtaining loans, the lack of quality developers and investment advisors, complicated procedures with respect to obtaining all the construction permits, etc. (Špirková, Zúbková, 2017).

Main goal of the article

It is to point out the current problems of the city of Bratislava resulting from the current events caused by many development activities on brownfield areas, located in the very center of the city. The main and often the only benefit of these projects is that they eliminate the problem of abandoned territories. However, these activities often prove that the city has no elaborated concept of its development and so its future is basically decided by the developer with their projects. New projects are made without consideration, only for the purpose of achieving the highest profit, as the current situation on the real estate market in Bratislava is more than favorable.

Methodology of research and materials

Neither Slovakia nor the city of Bratislava has currently mapped their abandoned and unused territories. Only during May 2018, initiative emerged from the city and mapping of the brownfield area in Bratislava was launched. The study has consistently identified 390 such locations, including not only former production facilities, but also premises after civic amenities, transport facilities, army facilities or neglected and unused public spaces.

The Municipality of Bratislava focused on large unused areas through a questionnaire forms. The aim is to map the abandoned territories (where they are located and what their basic characteristics are) and to find out who owns the land. In the questionnaire, the municipality defines a brownfield as a space / site affected by a construction that has lost its original use and is completely abandoned or only partially used (approx. 30% of utilization). These areas should have at least 5000 m2 (0.5 ha) and loss of their full function lasts more than 2 years.

The questionnaire is intended as part of the preparatory work of urban studies - Brownfields in the city Bratislava. Its elaboration will be an important basis for the new Master plan and for the future development of Bratislava with the expected date of completion in 2019.

Further involvement of the public in addressing the brownfields issue in Bratislava has been organized by the Initiative "Bratislava City - Where I Want to Live" in 2016. Through a questionnaire forms about 1,200 inhabitants were interviewed about the most abandoned locations in the city. These should be located in the wider city centre and occupy a larger area. Based on a consultation with several experts, the order of brownfields was compiled that met these parameters and the public has drawn up a list of the most problematic areas in Bratislava.

Below, we present the 5 most problematic areas perceived by the public. Contrary to this survey, we also show two examples of the most successful brownfield regeneration projects in Bratislava, again from the point of view of the public as well as the experts.

Discussions and results

The most negative perceived brownfield areas in Bratislava

1. Former railway station „Filialka“ at Trnavske myto

Bratislava Filialka Railway Station (Fig. 3) stands near the place where the first railway station in Slovakia - Pressburg Blumenthal was. The Filialka was part of it. The decision to omit the station from the Trnava - Bratislava electrification program after 1980 caused the beginning of its decline. Passenger traffic here was cancelled in 1985, and the station was subsequently removed from the list of stations. Several projects have been planned here in the past, but they have never been implemented. At present, on one part of the huge area of this territory, the residential development project “Urban Residence” is completed.

Fig. 3. Former railway station Filialka
Source: http://www.hrapko.sk/www-eshop-rychlo-sk-hrapko/e-news/0/2/120

2. The former swimming pool Lido

The Lido swimming pool was established in 1924. It was one of the largest and most modern beach resorts in the former Czechoslovakia. It was located on the Petrzalka bank of the Danube (Fig. 4) in the area between the Old Bridge and the new Apollo Bridge. It worked until the early 80s of the 20th century. In the 1990s, plans were created for its renewal where it had to be part of a larger recreation area, but they have not been implemented. A large area of neglected territory in close proximity to free-time functions (park and shopping centre) has been unnoticed for almost 30 years, which has also caused its partial afforestation.

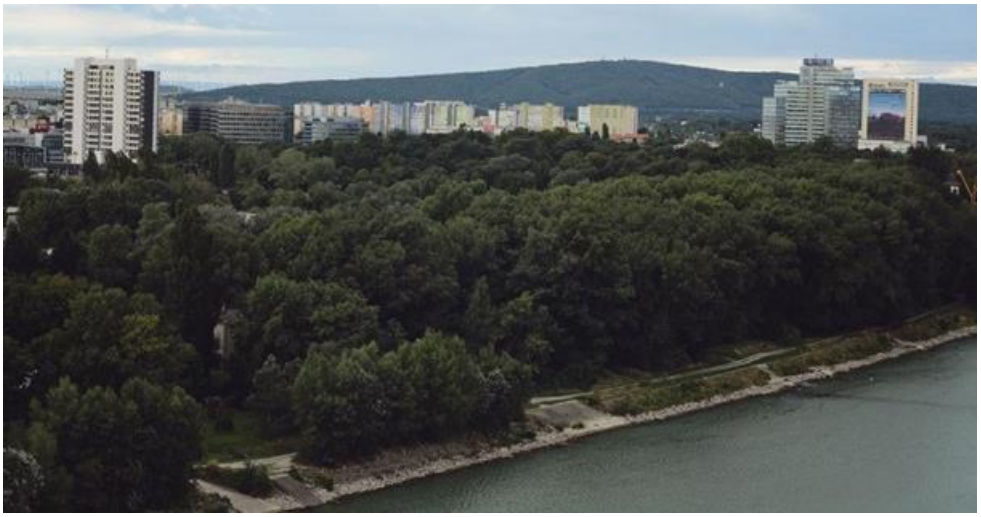

Fig. 4. The former swimming pool Lido
Source: https://www.etrend.sk/gallery/article/6-najcennejsich-rozvojovych-lokalit-bratislavy.html?photo=3

3. Heating plant on Landerer's Street

The building of heating plant was started in 1941 and completed it in 1944. The heating plant (Fig. 5) was part of Bratislava's industrial centre. It is a work of Dusan Jurkovic, who is considered the founder of the Slovak modern architecture. The heating plant has been included in the list of cultural monuments. At present, it has become part of a multifunctional complex with the city park, which is growing at this point. This is the last of the formerly preserved part of the former industrial zone.

Fig. 5. The Jurkovic's heating plant
Source: https://www.etrend.sk/gallery/article/culenova-od-zahy-hadid-ma-novy-nazov-sky-park.html?photo=10

4. The Winter port

The Winter port on the Danube (Fig. 6) was built at the end of the 19th century. It was once one of the largest ports in Central Europe, with more than 20 smaller factories in the 1970s. The current use of transhipment and wintering of ships is slowly falling. The port is today one of the last remnants of the oldest industrial zone in Bratislava. There are dozens of boats, cranes, but also a gas station, the Old House of the Ship-owners (National Cultural Monument), shipping pools or ship workshop from 40's with bridge crane and ship lift.

Fig. 6. The Winter port on the Danube
Source: http://ciernediery.sk/zimny-pristav-v-bratislave/

5. Jaskovy rad

It represents a long-term (about 40 years) unspoilt area in close proximity to the centre and the main station of the capital. This is the main link between Prazska Street and Pionierska Street with never realized plans for tunnel construction or extension of railway lines. The territory (Fig. 7) has been framed by old fences and various waste on it for many years.

Fig. 7. Abandoned territory of Jaskovy rad
Source: Google maps and authors

Successful brownfield land regeneration projects in Bratislava

Despite the fact that the city of Bratislava has not undergone an inventory of degraded and abandoned areas in recent years, we can mention a few examples of successful regeneration of brownfields in the city.

1. Project Eurovea

It is a development project built on the territory of the former brownfield, namely the former refinery Apollo (Figure 8), which was destroyed by the bombing of allied troops at the end of the Second World War. The territory after the bombing was heavily contaminated with oil and various petroleum products, so it remained unused and abandoned for over half a century. Until 2006, when it was reconstructed. This area lies on the right bank of the Danube River, near the historical centre of Bratislava. The 230,000-square-meter project includes offices, apartments, and the largest underground car park in Bratislava for 1,700 cars. Nearly two-thirds of Eurovea's area is greenery and public spaces, including the Danube promenade. The Eurovea complex also included the incorporation of a new building of the Slovak National Theatre into the project itself. Another specific feature of the Eurovea project was the implementation of effective flood protection measures for over EUR 1 million. The system forms an underground reinforced concrete wall for protection against thousands of years of water, including a mobile lamella construction to increase the protective barrier by an additional 50 cm. Currently, the construction of the second part of the Eurovea - "Eurovea II" project is planned to extend the entire complex by another 116 thousand square meters, bringing additional features such as residential, retail and administration. By combining both parts of the projects (Figure 9) there is a tendency for the creation of a new full-fledged city district.

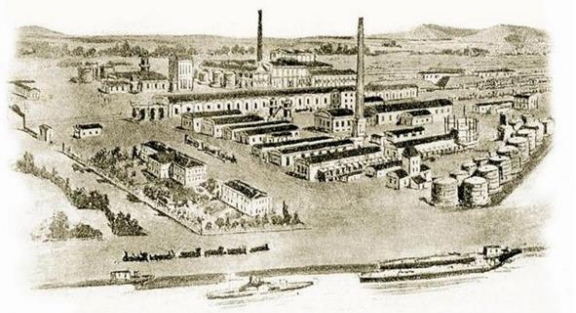

Fig. 8. Apollo refinery old painting
Source: http://energia.sk/fotogaleria/ropa-a-ropne-paliva/v-obrazoch-pribeh-rafinerie-apollo/10148/

Fig. 9. The Eurovea and Eurovea II projects as a new city district
Source: http://www.jtre.sk/projekty/eurovea-II

2. Mlynske Nivy Bus Station

The original bus station Mlynske Nivy (Fig. 10) was the largest bus station in Bratislava, the place of arrival and departure of inter-city buses within Slovakia and abroad. It was conveniently located for long distance transportation in the wider city centre. Construction began in 1979 and finished in 1983. In 2017, the developer began with its complete redevelopment, by setting up a replacement bus station in the vicinity. In addition to a station located in the former industrial zone, construction is being carried out on almost all of the surrounding land. Including regeneration of one of the main traffic arteries of Bratislava and its transformation into a spacious city boulevard. It is a redevelopment of the entire former industrial zone into a new, modern city district that, besides the new station (Fig. 11), will contain a residential, administrative and retail function. In the former industrial zone, there was a cable factory Kablo Bratislava (Fig. 12). Founded in 1895, the factory was engaged in the production of electro-technical materials, especially power cables and wires. All factory buildings were completely demolished between 2007 and 2008. The New Bus Station project will be completed in 2020 and the entire zone New Nivy in 2023.

Fig. 10. The original bus station Mlynske Nivy
Source: https://www.skyscrapercity.com/showthread.php?p=143167724

Fig. 11. New bus station Nivy
Source: https://www.etrend.sk/gallery/article/hb-reavis-zacne-rekonstruovat-mlynske-nivy-v-maji-ulicu-uplne-neuzavrie.html?photo=7

Fig. 12. Kablo Bratislava Factory
Source: https://www.asb.sk/fotogalerie/architektura/kablovka-vbratislave-fotoalbum/kablovka-vbratislave-1

Conclusions and proposals

The post-industrial heritage of the urban environment of the developed countries are brownfields of local, settlement and higher importance. Extensive premises, land and buildings of a productive nature in the lucrative inner city are burdens for the entire city and require special attention in land use planning and its regulation. It should be added that the development of brownfields also entails a variety of risks, particularly as a result of increased project construction costs. Therefore, developers often prefer construction on greenfields, which leads to a relatively dynamic occupation of agricultural land in the vicinity of Bratislava. Over the last few years, we are witnesses of an increasing land grabbing of vineyards at the expense of new construction.

The initiative for the transformation of brownfields would have to come out of the land owners as well. The natural motive is the effort to redevelop their own land. The situation is aggravated by unclear property and legal relations and, in many cases, also environmental burdens. Brownfields often negatively affect the neighbouring zones. They often discourage investors and reduce their business activities in the affected areas. Further impacts may be job cuts, a reduction in the value of neighbouring properties, reduced production rates and lower living standards. Brownfields may cause also lower environmental standards, can lead to the loss of a capable, young population and create social and environmental inequality.

Main proposals of authors are:

1. to develop an invetarisation of the brownfield territories

Slovakia, including Bratislava, still has no inventory of brownfields in its territory. Although currently the first steps of mapping these areas begun, the result of the ongoing situation is the absence of significant amounts of potential development areas of the city that are not reflected in the current land use plan of Bratislava.

2. ***clearly define strategic development goals of the city of Bratislava***

In addition, Bratislava does not have clearly defined strategic development goals in the long term. This results in a wild, non-conceptual construction activities where private developers have the main word. They realize their projects on the basis of their visions and ideas, without their activity being directed by the local government, as it does not have the mentioned strategic plans and objectives.

3. to establish a functional fee institute for development

New projects often have an undesirable impact on the traffic situation in the city, as communications and their features are under-estimated. Catastrophic is also the traffic-capacity assessment of large investment plans and unsustainable parking standards. These together cause that Bratislava is cluttered with cars, for which there is no place anymore and which, under the current system, only causes other serious problems for the city. Investments to infrastructure from the most new projects are very low and inadequate.

4. to establish a planning and conceptual organization unit

Bratislava and its government are lagging behind standards that are becoming common not only in cities on the west or north of us. These include a lack of parking policy, the absence of architectural competitions, the absence of a manual for creating public spaces and missing planning and conceptual organization unit. The qualitative contrast between the private and the public sector must be overcome as soon as possible, and this will be the biggest challenge for the upcoming period.

Acknowledgement

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Information about authors

Julius Golej, MSc., PhD., lecturer and researcher at the Institute of Management of Slovak University of Technology in Bratislava (STU in BA). Vazovova street no. 5, Bratislava, 812 43, Slovakia, e-mail: julius.golej@stuba.sk . His research is focused on real estate market, property development, land management and related technical-economic issues.

Miroslav Panik, MSc., PhD., lecturer and researcher at the Institute of Management of Slovak University of Technology in Bratislava (STU in BA). Vazovova street no. 5, Bratislava, 812 43, Slovakia, e-mail: mirosla_panik@stuba.sk . His research is focused on issues of real estate, especially on modeling of property prices.

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THE CHANGE OF FOREST AREA IN ALYTUS AND VILNIUS COUNTIES (LITHUANIA)

Giedre Ivaviciute
Aleksandras Stulginskis University, Kaunas Forestry and Environmental Engineering
University of Applied Sciences, Klaipeda State University of Applied Sciences

Abstract
The article presents the analysis of the current situation of the forest area in Alytus and Vilnius counties.
Comparative, analytical as well as statistical and logical analysis methods were used for the investigation.
The aim of the investigation is to carry out the analysis of the Alytus and Vilnius counties forest area during the period between the years 2006 and 2018.
The object of the investigation – Alytus and Vilnius counties forest area. Tasks of the investigation: 1. To describe the status quo of forest in Alytus and Vilnius counties. 2. To analyze and compare the forest area change in Alytus and Vilnius counties during the period between the years 2006 and 2018.
The study found that forests prevailing in Alytus and Vilnius Counties are 50-59 years old. It was determined that pine trees prevail in Alytus County (71.05 percent) and in Vilnius County (16.38 percent) as well. The type of ownership prevailing in both Alytus and Vilnius counties is the forests of state significance managed by forest enterprises, national parks and state reserves. In Alytus County, during the period between the years 2006 and 2018, the forest area decreased by 4123.16 ha or 1.55 percent, in Vilnius County increased by 9593.16 ha or 2,35 percent.
Key words: forest area, forest coverage, the type of ownership.

Introduction
Article relevance. Knowing the status and changes in forests is essential for evaluating biodiversity dynamics and making effective conservation action plans. It is also essential knowledge for public awareness and policy (Wang et. al. 2015).
Forests are complex and renewable resources that fulfill many different roles. Above all, forests protect and co-create other natural resources. They shape the landscape, create recreational opportunities and deliver health benefits for humans (Zrobek-Rozanska et. al., 2014).
Humans rely on healthy forests to supply energy, building materials, and food and to provide services such as storing carbon, hosting biodiversity, and regulating climate. Defining forest health integrates utilitarian and ecosystem measures of forest condition and function, implemented across a range of spatial scales (Trumbore et. al. 2015).
Forests influence local and global temperatures and the flow of heat (Morris et. al., 2017).
Forest change has broad implications for climate, ecology, hydrology and human wellbeing. Numerous observational and modeling studies have shown that deforestation and afforestation have significant impacts on climate through their direct biophysical effects and indirect effects on the carbon cycle (Li et. al., 2017). From logging, agricultural production and other economic activities, deforestation adds more atmospheric CO2 than the sum total of cars and trucks on the world's roads (Sustainability..., 2018). Therefore, Regional quantification of feasibility and effectiveness of forest strategies to mitigate climate change should integrate observations and mechanistic ecosystem process models with future climate, CO_2, disturbances from fire, and management (Law et.al., 2018).
It is known that climate change can affect forests by altering the frequency, intensity, duration, and timing of fire, drought, introduced species, insect and pathogen outbreaks, hurricanes, windstorms, ice storms, or landslides (Dale et. al., 2001). Climate change affects forests and their functioning directly, including key aspects such as net productivity, via altered abiotic conditions (Morin et. al., 2018).
Problem. Quantification of global forest change has been lacking despite the recognized importance of forest ecosystem services (Potapov et. al., 2013).
Although the forest area in the European Union is increasing, but global forest area changes are negative, it is therefore important to monitor the current state of forests and anticipate emerging threats. It has been established that due to anthropogenic or other activities, forests can degrade or

disappear. Forest degradation and deforestation are distinctly different processes. While deforestation involves the conversion of forests to another land cover types, degradation results when forests remain forests but lose their ability to provide ecosystem services or suffer major changes in species composition due to overexploitation, exotic species invasion, pollution, fires, or other factors (Sasaki N., 2009).

Historical baselines of forest cover are needed to understand the causes and consequences of recent changes and to assess the effectiveness of land-use policies (Kim et. al., 2014).

The human approach to the forest has changed in different periods. In ancient times, the woods were inhabited by humans, they were a source of survival as well as hunting areas. Later, when people began to engage in agriculture, the forest became an obstacle to agricultural development. Intensive deforestation began. Some European countries (the Netherlands, Ireland, the United Kingdom, Denmark), with their rapid development of agriculture, almost eliminated their forests. It did not beat Lithuania either.

At present, the most wooded countries in the European Union are Finland (73% of the total area), Sweden (69%), Slovenia (62%) and Latvia (54%). The forests of six Member States (Spain, Poland, France, Finland, Sweden and Germany) cover two thirds of Europe's forest area. A large variety of EU forest types reflects its climate diversity (northern forests, alpine coniferous forests, etc.). Their distribution, in particular, depends on climate, soil, altitude and topographic conditions. Only 4 percent of forest areas have not been changed by human activity; 8 percent are plantations, and all others belong to the "semi-natural" forest category, i.e. are formed by humans. By the way, European forests are mostly owned by private individuals (about 60% of the area), 40% are state forests (Ragonnaud, 2016).

Lithuanian forest resources are more numerous than those in Hungary, Slovakia, Croatia, Slovenia, and Switzerland. The forest area of the Republic of Lithuania is 3 to 6 times higher than in Albania, Ireland, Belgium, Denmark, Montenegro and the Netherlands.

According to the data of 2018, forests occupy 2167497.97 hectares in the Republic of Lithuania, and the country's forest coverage – 33.20 percent. The most forested are Alytus (48.38 %), Vilnius (43.03 %), Telšiai (36.25 %), Utena (35.12 %), and Tauragė (33.34 percent) counties (Nacionaline zemes..., 2006-2018).

The object of the investigation – Alytus and Vilnius counties forest area.

The aim of the investigation. To carry out the analysis of the Alytus and Vilnius counties forest area during the period between the years 2006 and 2018.

Tasks of the investigation:

1. To describe the status quo of forest in Alytus and Vilnius counties.
2. To analyze and compare the forest area change in Alytus and Vilnius counties during the period between the years 2006 and 2018.

Methodology of research and materials

Comparative, analytical as well as statistical and logical analysis methods were used for the investigation.

The article analyses work of foreign and Lithuanian scientists, published in scientific publications, conferences.

The land fund statistics of the Republic of Lithuania (Nacionaline zemes..., 2006-2018), graphically depicted in figures, were used for the fulfilment of the research of the change of damaged land in Alytus and Vilnius counties for the years 2006 - 2018.

The article analyzed and assessed the current state of the forest in the counties of Alytus and Vilnius, i.e. the prevailing tree species and age were determined, the distribution of forests by groups and ownership type was investigated.

The study provides the forest area change analysis in Alytus and Vilnius Counties. The 13 year period, i.e. the period between the years 2006 and 2018, was selected for the determination of the change. Statistics data were systematized, analyzed and expression of the percentage was calculated during the preparation of the research.

Discussion and results

In *Alytus County* forests in 2018 occupied the area of 262134.81 ha, i.e. 48.38 percent of the entire area of the county (Nacionaline zemes..., 2006-2018).

The largest part of the growing forests consists of forests 50-59 years old, they make up 16.89 percent, 60-69 years old forests make up 12.43 percent, 100 years old – 6.35 percent. Pine (71.05 percent) trees prevail in the Alytus County forests.

In the County, there mostly is Group IV or commercial forests (59.89 percent). Group I forests include forest reserves that make up 7.02 percent.

Analyzing data by type of ownership, state enterprises, national parks and state-owned forests managed by state reserves make up the largest part, i.e. 43.85 percent, private and other forests – 32.52 percent, and forests for restoration of ownership rights – 22.98 percent. The municipal forests of state significance make up 0.38 percent, forests of state significance managed by the Ministry of Transport and Communications make up 0.12 percent, non-state-owned areas managed by the Ministry of Transport and Communications make up 0.01 percent (Intelektuali..., 2018).

In *the Vilnius County*, forests make up even 43.03 %, it is the second one after Alytus County, the woodiness of which is extremely high and exceeds 40%. In the county in 2018, forests occupied 418658.45 hectares.

The prevailing tree species in the forest landscape are pine, which form 52.30 percent, as well as birch (15.15 percent) and fir trees (14.59 percent). Growing forests mainly are 50-59 years old (16.38 percent), 60-69 years old (13.61 percent) and 40-49 years old (12.02 percent).

Distribution of forests in Vilnius County by forest groups: Group I forest reserves – 0.38 percent, Group II special-purpose forests – 16.30 percent, Group III protective forests – 15.77 percent, Group IV commercial forests – 67.55 percent.

According to the type of ownership, the forests are divided into the following: forests of state significance owned by forest enterprises, national parks and state reserves make up 49.33%, forests intended for the restoration of ownership rights – 25.05%, private and other forests – 23.15%, forests of state significance owned by municipalities make up 1.37 percent, state forests belonging to the Ministry of National Defense and the Ministry of the Interior – 0.58 percent, forests of state importance managed by other legal entities – 0.23 percent, forests of state significance managed by the Ministry of Transport and Communications – 0.15 percent, forests managed by forest enterprises and proposed to be included into the areas belonging to the Ministry of the Interior make up 0.08%, forests of state significance proposed to be excluded from the areas belonging to the Ministry of the Interior make up 0.02%, non-state-owned areas belonging to municipalities – 0.01%, non-state-owned areas managed by forest enterprises – 0.01 percent (Intelektuali..., 2018).

In *Alytus County* during the period between the years 2006 and 2018 the forest area decreased by 4123.16 ha or 1.55 percent and in 2018 occupied 262134.81 ha (Fig. 1).

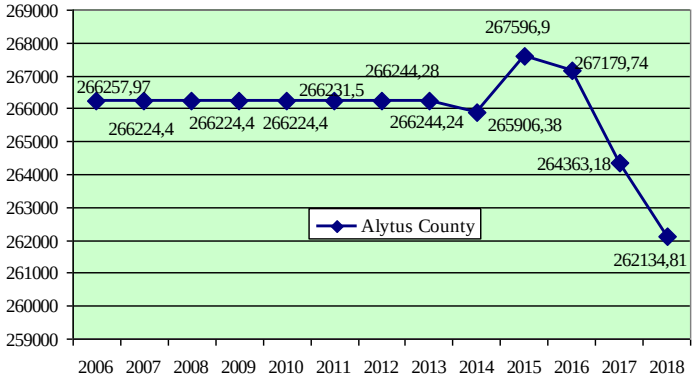

Fig. 1. Forest area change in Alytus County in ha during the years 2006-2018

The largest part of Alytus County forests is made up by forests growing in the municipality of Varėna district, which in 2018 occupied 148870.35 ha. The smallest forest area was noticed in Alytus city municipality (1192.48 ha).

During the period under review, forest areas in all municipalities increased, except for the Alytus municipality, in which forests fell by 60.22 ha or 4.81 percent and Varėna district municipality (4432.22 or 2.89 percent). Lazdijai district municipality has the largest forest development, the area has increased by 206.01 ha or 0,45 percent.
In *Vilnius County* during the analyzed period the forest area increased by 9593.16 ha or 2,35 percent. (Fig. 2).

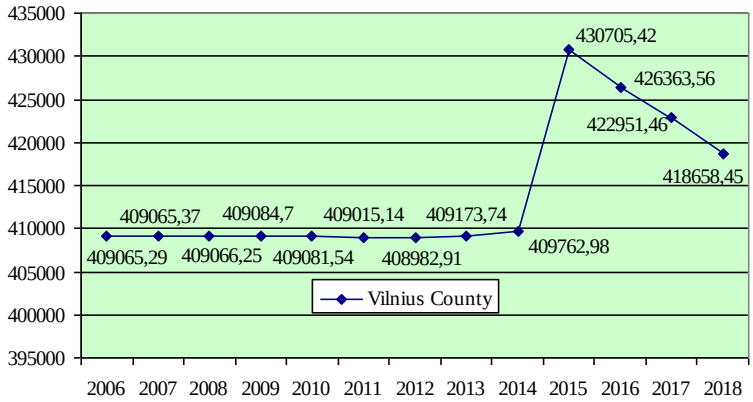

Fig. 2. Forest area change in Vilnius County in ha during the years 2006-2018

The largest forest area in 2018 was in Švenčionys district (97103.76 ha), the smallest – in the city of Vilnius (14348.83 ha).
During the years 2006-2018, forest areas in all municipalities increased, except for the Elektrėnai municipality, in which forests fell by 294.21 ha or 1.71 percent.
During the period between the years 2006 and 2018, the largest development took place in the district of Vilnius (3476.08 ha or 4.12 percent).
After the analysis of the change of the forests in the most wooded counties of the Republic of Lithuania in 2006-2018, it has been established that forests in Alytus County decreased by 4123.16 ha or 1.55%, however, the area under study in Vilnius County increased by 9593.16 ha or 2.35%.
During the period between the years 2006-2018 the forest area of the Republic of Lithuania increased by 67156.33 ha or 3.20%.
Tendencies. According to the data of the National Land Service under the Ministry of Agriculture, in 2018 in Alytus County there were 3112.32 hectares of unused land and land unfit for agriculture, of which 2516.84 hectares were not used for agriculture and 595.48 ha hectares of damaged land. In Vilnius County there were 11476.88 hectares of unused land and land unfit for agriculture. After afforestation of this land, Alytus county's forest coverage would increase by about 1.17 percent and will occupy 265,247.72 hectares and make up 48.96 percent. Vilnius county's forest coverage would increase and will occupy 430135.33 hectares and make up 44.21 percent.
The forest area was increasing due to the implementation of the forest improvement program, the promotion of plantation forests, the promotion of self-help to forest regeneration, participation in the Rural Development Program, and EU payments for this.
Forests are not static. Their structure and composition are constantly changing, different types of trees in the forests are germinating, growing and dying. The change in the forests is caused by a variety of natural causes, which are usually understood as "damaging" or "destroying" forests, as well as human anthropogenic activities. The socio-economic significance of forests is weighty, but not all of the countries appreciate their benefits.
Forests are lungs of our planet, which is why it is necessary to stop forest cutting, destruction and to carry out reforestation programs and projects.

Conclusions

1. After examining the forests according to their age, it was obtained that forests prevailing in Alytus and Vilnius Counties are 50-59 years old.

2. After analyzing the prevailing species of trees, it was determined that pine trees prevail in Alytus County (71.05 percent) and in Vilnius County (16.38 percent) as well.
3. The type of ownership prevailing in both Alytus (43.85 percent) and Vilnius (49.33) counties is the forests of state significance managed by forest enterprises, national parks and state reserves.
4. In Alytus County during the period between the years 2006 and 2018 the forest area decreased by 4123.16 ha or 1.55 percent, in Vilnius County increased by 9593.16 ha or 2,35 percent.
5. After afforestation hectares of unused land and land unfit for agriculture, it is a possibility to increase forest coverage in Alytus (from 48.38 to 48.96 percent) and Vilnius (from 43.03 to 44.21 percent) County.

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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., Lithuania. Tel. 8 – 37 75 23 72, e-mail: ivavice@gmail.com . Fields of interest: landscape architecture. Lecturer, Kaunas Forestry and Environmental Engineering University of Applied Sciences. Address: Liepų st. 1, Girionys, LT -53101, Kauno raj. Lithuania. e-mail: ivavice@gmail.com.

Lecturer, Klaipeda State University of Applied Sciences. Address: Jaunystės st. 1, LT-91274, Klaipėda, Lithuania. e-mail: ivavice@gmail.com .

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ASSESSMENT OF THE ROLE OF FOREST LAND IN SAMARA REGION AS ENVIRONMENTAL PROTECTION AND LAND DEGRADATION PREVENTION FACTOR

Gabibulla Khasaev[1], **Alexandr Vlasov**[1],
Dariya Vasilieva[1], **Velta Parsova**[2]
[1]Samara State University of Economics,
[2]Latvia University of Life Sciences and Technologies

Abstract
The article discusses the current state of forest land, the history of formation of large tracts of forest in the Samara region and analyses some of the results of implementation of target programs to improve the forest cover in the region under the Kyoto Protocol. This program was designed for the period from 2006 to 2015, but in 2009 was discontinued. However, large segment of assets was allocated and a number of works was carried out. Currently the objectives of the programme to increase the forest cover in the territory of Samara region through the creation of tracts of forest are not achieved. Tree and shrub plantations play an important role in reducing the activity of processes of erosion, prevent degradation and desertification. Therefore, the problem of increasing forest cover, especially in the steppe zone of the region, to the level of the preindustrial era remains relevant and requires science-based measures for their solution.
Key words: environmental management, forest cover, forest land, forests, tract of forest

Introduction

According to the FAO Global Forest Resources Assessment, the Russian Federation is the world leader in total area of forests, since it has more than 20% of the world's forests. The total area of the forest land is about 69% of the total land area in Russia (together with inland waters), while 78% of forest area of Russia are located in its Asian part and 22% - in the European-Ural part.

In general, there is a positive dynamics of the total forest area in Russia. Since 1956 the area of forest-land has increased by 20% and by the end of 2016 it amounted to 794.5 million hectares. The increase of area of forest land mainly occurred due to overgrowing of agricultural and reserve land with low-value leaf trees (willow, grey alder, birch) species. The non-forested area in Russia has decreased from 1956 to 40 million hectares. Perhaps this is also related to global warming, as the boreal zone has reduced the period of natural forest regeneration by 1-2 years, the vegetation period has increased by 10-15 days, and the boundary of forest land has progressed significantly to the north (by 50-100 km, especially on the banks and valleys of rivers) (State report…, 2017). Forest land of the territory of the Russia, i.e. the ratio of the area covered by forest vegetation to the total area of the country has not changed and is 46%. On the territory of the country, forests are unevenly distributed, depending on climatic and anthropogenic factors. The highest proportion of forest land is located in Irkutsk region (83%), Primorsky Krai (77%), Kostroma region (74%), Komi Republic (73%). Low proportion of forest cover is recorded in the Republic of Kalmykia (0.2%), Stavropol Krai, Astrakhan and Rostov region (about 2%).

All the forest stock land in Russia is owned by the state and cannot be transferred to private ownership. Forests are divided into three groups:

- I group - protective (water protection, protective strips, anti-erosion forests, etc.) forests;
- II group - forests in urban area (with high population density), having protective and limited production significance;
- III group - forests in wooded areas, having production significance (Forest Code, 2006).

The land of I group can be leased for the placement of recreational facilities (recreation centres, tourist bases, etc.). There it is forbidden to cut forests, build buildings with a foundation and require strict compliance with environmental standards (Vlasov A.G., Voronin V.V., Vasilieva D.I., 2013).

Forests play an important role as an environmental factor, as well as a source of valuable natural resources. The ability of natural systems to absorb greenhouse gases is limited. Therefore, the ever increasing anthropogenic emissions of these gases lead to a steady increase in their concentration in the atmosphere and to global warming (Melekhov I.S., 1989; Pchelin V.I., 2007).
According to UN FAO (GULR 2015) estimates, carbon reserves in the world are about 360 billion tons, of which 14% are concentrated in the forests of Russia. The high role of forest vegetation in a warming climate is a global environmental problem, especially relevant for the territory of Russia: if global warming has a speed of about 0.18° C for every 10 years, then Russia warms 2.5 times faster - 0.45° C over 10 years (State report…, 2017).

Methodology of research and materials

In addition to the environment-forming function, forests are important for reducing the rate of destruction of land by processes of water and wind erosion. This problem is acute in the territory of low-forest or forestless steppe regions, to which the Samara region belongs (Atlas…, 2018). Practically complete inconsistency of the land in the steppe zone led to a catastrophic increase in the activity of erosion processes. The present state and changes in the land of forest stock of Samara region was studied. The materials of actual state reports on the status and use of land of the Russian Federation and the Samara region, reports of relevant ministries, the results of program for increasing the forest cover in the Samara region, which took place during the implementation of the activities of the Kyoto Protocol were analysed (Report…, 2016; State report…, 2007; State registration…, 2008; Consolidated project…, 1985; Strategy…, 2006, Concept …, 2003).

Discussions and results

In the Samara region forests take up about 757 thousand hectares or 13% of the total region's area, therefore it belongs to the regions with low forest cover (Averina L.V., Voronin V.V., Vlasov A.G., Vasilieva D.I., 2014). All forests of the Samara region are classified as protective. Especially valuable forests (national parks, nature monuments, state forest belts) occupy 20% of the forest area in the region; forests that perform recreational, sanitary and hygienic functions (green areas of cities) - 19%; restricted forest areas along rivers and roads - 14%; forests, performing mainly field-protective functions - 47% (Voronin V.V., Vlasov A.G., Vasilieva D.I., 2013) (Fig. 1).

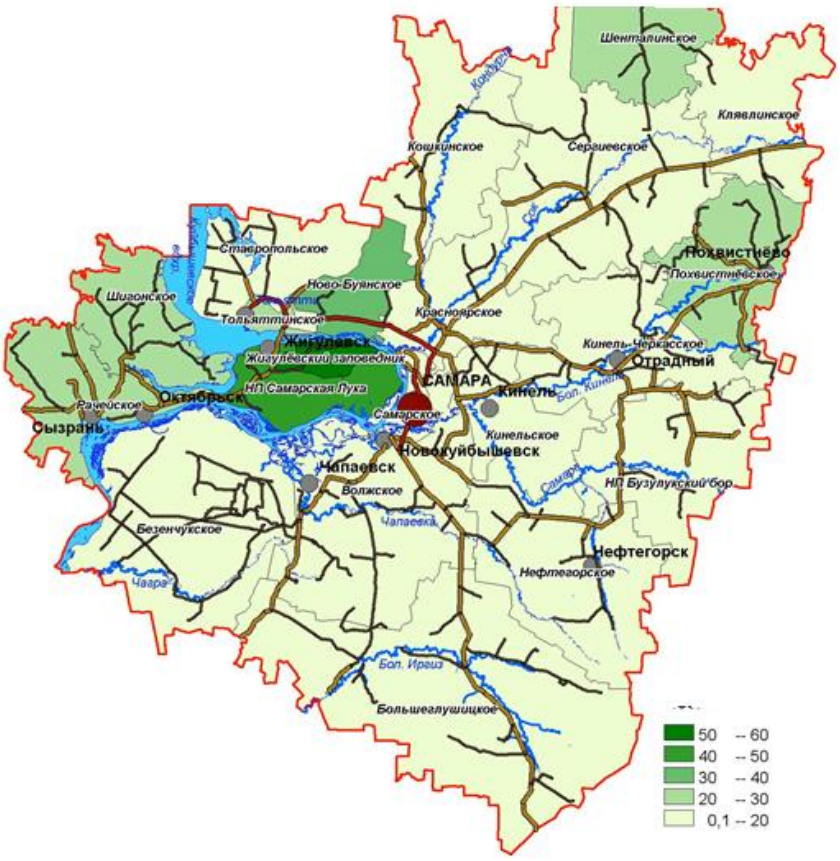

Fig. 1. Extent of afforestation in the Samara region

The territory occupied by forests in the Samara region includes:

- forests located on the forest stock land - 583 thousand hectares;
- forests located on the land of specially protected natural objects - 141 thousand hectares (Buzuluksky Bor, Samarskaya Luka National Park, Zhigulevsky Reserve);
- urban forests - 10 thousand hectares;
- forests of agricultural enterprises - 24 thousand hectares

The forests are distributed unevenly in the steppe and forest-steppe zones of the region (Kupriyanov N.V., Veretennikov S.S., Shishov V.V., 1995). The greatest forest cover (about 30%) is observed on the right-bank forest-steppe part. On the Zhiguli Hills the forests cover about 70%, on the left-bank forest-steppe zone of the region, located north of the river Samara the forest cover is lower - about 20%. Forests here are located on the watersheds, floodplain forests are also widespread. The smallest forest area is located on the zones of southern and dry steppe of the Samara region (Alekseevsky, Bolsheglushitsky, Bolshechernigovsky, Krasnoarmeisky, Pestravsky districts), where the forest cover is insignificant and makes about 2% (Melekhov I.S. (1989); State registration… (2008); Consolidated project… (1985). There are no significant tracts of forest, small forest areas are found only in floodplains of rivers.

According to the order of the Ministry of Agriculture of Russia No. 37 of 04.02.2009 “On approval of the list of forest areas of the Russian Federation”, the forest stock of the Samara Region belongs to the forest-steppe zone (18 municipal districts) and to the steppe zone (9 municipal districts) of the European part of Russia (Fig. 2).

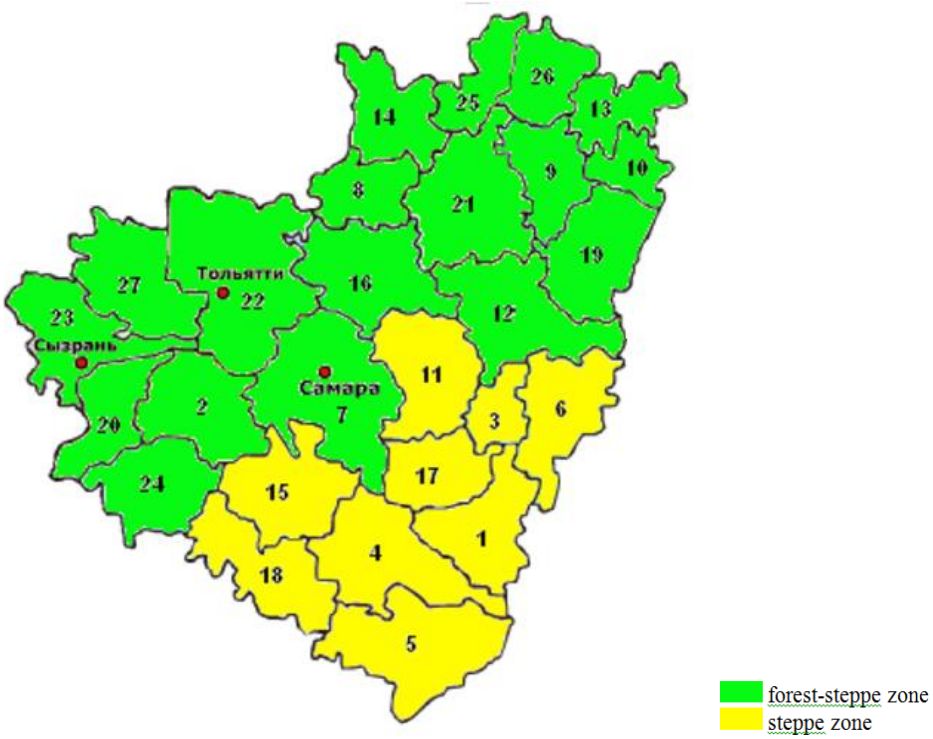

Fig. 2. Forest zoning of the Samara region

Prevailing tree species in forests of Samara region are - oak (27%), linden (20%), aspen (19%), pine (14%), birch (9%). Other species include maple, ash, elm, poplar, etc. The age structure of forests was distributed as follows: young - 23%; middle-aged - 47%; ripen-aged - 13%; ripe-aged - 17%. The total stock of forest stands was 57 million m^3, including 9 million m^3 of mature and over-mature. The overall average increase is about 2 million m^3. The average reserve of mature and over-mature trees per 1 ha is 177 m^3, of which coniferous - 312 m^3, hard forest - 137 m^3, soft-leaved trees - 215 m^3.

In Samara region compact tracts of forest are located in the right bank of Volga river on the Zhiguli Hill and in the northern part of the region - in the forestry companies (former *leshozes*). On the banks of the river Volga, Samara, the rivers Big and Small Kinel, Soka, Kondurchi as narrow strips expand floodplain forests.

On the border with the Orenburg region is the widely known Buzuluksky Bor (now - a national park, a federal protected area). The total area of this national park is 112 thousand hectares, including 54 thousand ha in the Samara region. In addition, in the Samara region there are two more protected areas of federal importance - the Zhigulevsky State Nature Reserve (23 thousand hectares) and the national nature park "Samarskaya Luka" (128 thousand hectares).

Attempts to increase the forest cover of the territory in the Samara region were undertaken at the end of the XIX century (Uspensky E.I., 1987). This was done in order to reduce the processes of wind erosion, because forest belts reduce the wind speed. Therefore, the protective forest belts were planted taking into account the prevailing wind direction. After the creation of forest belts in the territory of the region, the number of dust storms has decreased and the land hazard by wind erosion has decreased. In the period from 1889 to 1906 under supervision of scientist N.Genko in Samara province in Volga river valley about 17 protective forest belts with total area more than 8 thousand hectares were arranged.

They represented forest belts with a width of 639 m, located in broken lines of various lengths (up to 25 km) along the most elevated parts of the watersheds of the tributaries of the Volga - the Sok and Padovki rivers (Shilan stripes); the rivers of Samara and Chapaevka (Dubovo-Umet and Teplovskie stripes) and the Chapaevka and Chagry rivers (the Kamyshinskaya, Bezenchuk and Vladimirsky stripes). At the present, these forest belts have been preserved in good condition with a diverse forest stands, they are capable for natural renewal. The second generation of forest has grown as a result of

self-seeding. They represent a valuable result of the past steppe afforestation in the Trans-Volga region and nowdays are protected areas of regional importance.
In 1894-1897 under supervision of agronomist Grodsky forest belts were arranged on the area of more than 60 hectares, which also today belong to the regional protected areas (Zagreev V.V., Sukhikh V.I., Shvidenko A.Z. et al., 1992).
An important stage for the development of forest amelioration, solving problems of combating drought and erosion in agro-nature use in the Samara region was the creation in 1930 of forest amelioration station in the Middle Volga zone, which since 1936 became known as the Volga agroforestry experimental station (hereinafter - AGLOS) with subordination to the All-Union Scientific agroforestry research institute (Zakamsky V.A., Andreev N.V., 2005). The zone of activity of AGLOS was an extensive region of the Middle Volga region - steppe zone with predominantly chernozem soils. The main tasks of AGLOS were:

- improving the microclimate on the fields in the system of forest belts, increasing yields and sustainability of crops;
- development of a complex of anti-erosion measures for effective control of erosion processes and productive use of eroded land;
- development of rational ways of conducting business in forest cultures and studying the water protection and protective role of forest plantations;
- introduction and acclimatization into newly created plantations of most valuable, productive and resistant forest species;
- economic justification of agroforestry and forestry measures, development of the most progressive forms and methods of organization of work.

In the post-war period the USSR developed and implemented a plan for the creation of protective forest plantations, the introduction of grass-field crop rotations, the construction of ponds and reservoirs to ensure high yields in the steppe and forest-steppe regions of the European part of the USSR. In the territory of the Samara (former Kuybyshev) region for improvement of the state of the land in 1949-1965 the program “Protective stands on all areas of the region” was embodied. According to this plan in Samara region on ravines, beams and watersheds, on sands and in the state forest stock 244 thousand hectares of forests were planted, including:

- 57 thousand hectares on the land of state forest stock;
- 15 thousand hectares on the land of collective farms;
- 32 thousand hectares on the land of state agriculture enterprises.

In each state forest and agriculture enterprise, and collective farm, the work was carried out to harvest forest seeds, cultivate planting material and create protective forest plantations. In addition, in 1949-1953, the fixation and afforestation of mobile sands was carried out. The role of forest vegetation is very important in the absorption of CO_2, release of O_2, impact on the climate, reduction of wind and water erosion, etc. Currently, one of the global environmental problems is the warming of the climate, associated with an increase of concentration of CO_2 and other greenhouse gases in the atmosphere. To solve this problem, Framework Convention on Climate Change of United Nations was adopted, which set the goal of stabilizing the concentration of greenhouse gases in the atmosphere at a level that would prevent a dangerous anthropogenic impact on the climate system. The Kyoto Protocol became the first step towards the implementation of the greenhouse gas stabilization program in the atmosphere. In 2004, it was ratified by Russia, and a market-based approach to solving environmental problems began - the preparation for trading greenhouse gas emissions with the provision of funds for growing forests to absorb carbon dioxide (Voronin V.V., Vlasov A.G., Vasilieva D.I., Most E.S., 2013, 2014). After inclusion in the Kyoto Protocol the law of the Samara Region No. 83-GD of 11.07.2006 was adopted. This law approved the target program “Increase of forest cover within the framework of implementation of the goals of Kyoto Protocol, protection of forests in the Samara region for 2006 - 2015” (hereinafter - the Program). The objectives of the Program were as follows:

- improving the environmental situation in the Samara region;
- increase of forest areas of the region in the framework of the implementation of the goals of the Kyoto Protocol to reduce the greenhouse effect through deposition from the atmosphere of carbon dioxide and the accumulation of carbon in the ecosystem;

- creation of specially protected natural areas of regional importance;
- increase of forest areas by 20% and increase of forest cover of the region to 15%;
- ensuring reliable and effective protection of soils from erosion.

The achievement of these goals was facilitated by the solution of a number of problems:

- conservation and enhancement of forest plantations in the Samara region;
- afforestation on an area of 30 thousand hectares;
- creation of protective forest plantations on the area of 110 thousand hectares;
- creation of a complex of protective forest belts;
- restoration of protective functions of existing forest belts.

The program was supposed to create protective forest facilities in the southern and south-eastern parts of the Samara region, in particular the "forest bridge" Buzuluksky Bor – Kazakhstan of long-lasting, valuable tree species, designed to become a barrier for dry winds, to protect the land from adverse natural factors. This afforestation was proposed to be implemented through the creation of specially protected natural areas of regional importance, which are of great environmental and scientific importance, on the land outside the forest stock and unfit for agricultural production.

Within the framework of the Program, it was planned to create various types of protective forest plantations: strips, in the form of pins, curtains, tracts, and plantations from fast-growing tree species, which should significantly enhance the aesthetic appeal of landscapes in the Samara region, and also provide the population with timber and by-products of the forest. The implementation of the complex of protective forest plantations during the Program would prevent the weakening and drying up of existing and newly created protective plantations. It is necessary to create water conservation plantations that absorb a large amount of filtration water, transfer the surface overflow into the subsoil, reduce soil erosion from flat flushing with flood waters and summer showers, protect the banks from wave erosion.

At present, it is possible to sum up some results of the implementation of the first stages of this Program. Its unconditional importance for solving both global and regional environmental problems It should be noted. The increase of forest cover in the Samara region to the level of the end of the 18th and early 19^{th} centuries, when during the period of general surveying in 1786-1835 about 28% of the territory was occupied by forests would lead to a significant increase in the absorption of CO_2 from the atmosphere. In addition, forests contribute in the accumulation of moisture in the soil, decrease in surface water overflow and increase in the underground water, which leads to the accumulation of groundwater in the soil and to decrease the leaching of the soil, to increase of soil fertility, etc.

Analysis of the current state of the plantations planted in 2006-2008 in the framework of the Program shows their current unsatisfactory condition. Planted seedlings are not able to take root and the plans to create forest stands from them in the form of protective forest belts, afforestation of the banks of small rivers did not take place. A possible reason was the absence of a scientifically grounded approach to the problem of providing the territory of the Samara region with planting material, in particular, unadapted seedlings from the northern regions of the European territory of the country (Tatarstan, Perm Krai), which are unsuitable for planting in the steppe zone of the Samara region. At the same time in the territory of the Samara region, there are their own forest seed plantations and nurseries, including coniferous species (*Pínus sylvestris*). The experience of AGLOS demonstrates that one of the most frequent reasons for the failed efforts to create forest plantations in the steppe is the wrong choice of breeds for their creation. Forests have long associated the productivity and viability of forest plantations with geographical origin and hereditary properties of seeds. It is practically impossible to grow forest plantations in an arid steppe zone from the planting material of the forest zone. Adapted to the steppe conditions are, for example, pine forests growing here, which are a valuable seed base for steppe afforestation. In the steppe regions of the country, plants that are resistant to unfavorable conditions of the steppe, characterized by a more economical use of moisture, salt tolerance, capable of effectively using a huge stream of solar radiation, high summer temperatures, strong wind and other unfavourable factors, should be selected for the cultivation of protective forest plantations. Another important reason for failures is incorrect agricultural technology in creating of protective forest plantations. Shortcomings and mistakes in agrotechnics usually took place due to undeep plowing of the soil (by 20-22 cm), application of spring plowing instead of the

recommended fallows, incorrect selection of plant species without considering the compliance of their biological properties to forest-growing conditions, the use of bad quality planting material, insufficient care about conditions of soil. Lack of care for young plants, overgrowing of fields by weeds, which take away the moisture necessary for young trees, lead to their rapid extinction.

Conclusions and proposals

The target program “Increase of forest cover within the framework of the implementation of the goals of Kyoto Protocol, protection of forests in the Samara region for 2006 - 2015”, adopted in 2006, was aimed at very important measures of environmental importance. But the analysis of the results of the implementation of this program shows that the allocated financial resources did not reach their goal, since the planting material for creating the plantations proved to be unviable, unsuited to the climatic and soil conditions of the steppe zone.

However, it is advisable to continue the activities of the Program taking into account soil and climatic conditions and using adapted planting material, which will ensure effective growth of plantations.

In order to achieve optimal forest cover in the Samara region, it is necessary to increase the amount of forest planting, using for this purpose the existing land reserve - ravines, river banks and various inconveniences.

The processes of wind and water erosion are widespread in the territory of the Samara region, the total area of eroded land exceeds 1 million hectares, of which heavily eroded land occupies 360 thousand hectares or 7% of the territory of the region.

The average annual flushing of the soil is 3-5 m^3 per hectare, the annual losses of highly humus fine soil reach 5-8 million tons, while contamination of small rivers, ponds and reservoirs occur.

Forest plantations play an important role in reducing the activity of erosion processes, preventing land degradation and desertification, so increasing the forest cover in the Samara region is an important and urgent task.

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Information about authors

Habibulla Khasaev. Doctor of Economic Sciences, Prof., Rector of Samara State University of Economics. Address: Russia, 443090, Samara, Soviet Army street 141, of Latvia University of Life Sciences and Technologies. Address: 19, Akademijas str., Jelgava, LV-3001, phone +7 (846)-933-88-88, e-mail: rector@sseu.ru

Alexander Vlasov. PhD, Head of the Department of Land management and cadastre of Samara State University of Economics. Address: Russia, 443090, Samara, Soviet Army street 141, of Latvia University of Life Sciences and Technologies. Address: 19, Akademijas str., Jelgava, LV-3001, phone +7(937) 799-08-86, e-mail: vasilievadi@mail.ru

Darya Vasilieva. PhD, Associate Professor of the Department of Land management and cadastre of Samara State University of Economics. Address: Russia, 443090, Samara, Soviet Army street 141, of Latvia University of Life Sciences and Technologies. Address: 19, Akademijas str., Jelgava, LV-3001, phone +7(927) 200-30-78, e-mail: vasilievadi@mail.ru

Velta Parsova. Dr.oec., professor, Department of Land Management and Geodesy of Latvia University of Life Sciences and Technologies. Address: 19, Akademijas str., Jelgava, LV-3001, phone: +371 29118285, e-mail: velta@parsova.lv

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ASSESMENT OF ECONOMIC EFFECTS OF MOSCOW PROGRAMME OF RENOVATION

Elizaveta Kheifetz
Financial University under the Government of the Russian Federation

Abstract
Renovation is seen in the context of an urbanist as a form of large-scale dispersed urban space reorganization. To date, in countries with developed economies, the share of renovation works has increased in the structure of construction from 35% to 60%.
In this article, the content of the main stages of renovation is detailed: the definition of the scope, planning, financing and implementation. Reflects the experience and tasks of the Moscow Government on the renovation of the quarters of the existing buildings. Since the city renovation projects are aimed at achieving the optimal combination of social, residential and commercial functions, the complex reconstruction of the city has non-economic and economic effects. Varying the key parameters influences the calculation of the project economy. The most economical indicators of the project depend on the coefficients of renovation and relocation, the cost of construction and the price of sales. To increase the additions in Moscow budget and other economic effects from the project implementation, it is necessary to increase the renovation ratio and the selling price and / or reduce the construction cost and resettlement ratio.
Key words: Moscow urban economics, Moscow renovation, Moscow redevelopment

Introduction

Renovation of the existing buildings is one of the most important town-planning tasks, connected with large-scale changes in the field of urban planning. Any metropolis is faced with the accumulating need to update the territories, infrastructure, architecture, urban systems. According to a study by international consulting company McKinsey, in the world about 330 million urban households live in unfavorable housing conditions or are in so financially distressed circumstances because of spending on housing that they are forced to deny themselves basic needs (Woetzel, 2014). Global renovation projects are increasingly becoming the engine of urban development around the world.
The preservation of the balance of historical heritage and the opportunity to move further in its development is the most important task facing the city authorities in the run-up to the implementation of the renovation program, one of the most socially and economically significant in housing construction.
The Moscow government is implementing a program for the resettlement and demolition of five-story houses "Demolished" series in the last 20 years. The unique experience of resettlement of inhabitants and demolition of houses is accumulated. In total, 5 177 residential houses (c. 18 million sqm) were included in the renovation program of the "demolished" series. The current program will start in 2018.
However, the bulk of the housing stock, built in the 1950s and 1960s, is still problematic at present. In Moscow, the majority of the five-story buildings of the industrial period of housing construction are morally and physically obsolete: collapsing foundations, divergent joints of wall panels, worn out engineering communications, irreparable repairs, and failed heating systems. Such houses have substantial actual wear (most - more than 40%), as well as they are morally obsolete (small kitchens, no lift, not adapted for low mobility groups, etc.). Major repairs for most of these houses are inexpedient. Moreover, overhaul is a temporary measure that does not improve the quality of housing. Residential quarters, designed 40-50 years ago, do not meet modern requirements for effective use of urban areas and comfortable living of citizens.
The scale of the renovation program for the dilapidated housing stock in Moscow assumes the demolition of 5,177 houses from the 1950s to the 1960s (16.1 million square meters), the resettlement of 1 million inhabitants and the erection of about 30.0 million square meters of new housing. This project covers more than 7% of Moscow's housing stock and can become one of the most ambitious renovation projects in the world. In addition to solving the "housing issue", the program is designed to

ensure the complexity of development, to implement new principles of integrated improvement and operation of the urban environment.
Organizationally, the renovation in the blocks of existing buildings is a "Wave" process: first start homes are erected, then resettlement of residents of demolished houses is carried out, demolition and new construction are carried out on the vacated sites. At the same time, some apartments in new houses are used for resettlement, and the rest is sold on the market over time.
Experts examining the issues of urban renewal highlight four key stages in the framework of renovation projects: the definition of scope, planning, financing and implementation. Each stage includes a set of unique tools that local authorities can use for system planning and management of the renovation process. In addition to the four stages, the three main objects involved in the project are identified: land, community and the environment.
The definition of the scope of change corresponds to the evaluation stage. The process of urban reorganization, both for the city as a whole and for a specific land area, begins with a comprehensive assessment of the current situation and the development of strategic decisions (Kievskiy, Grishutin, Kievskiy, 2017). At this stage, an analytical foundation is laid, tooling is formed and the parties involved in the project are identified. There is a perspective evaluation and goal setting, as well as a retrospective analysis that takes into account the history of the city and its unique "DNA".
Formation of the concept of interaction of the parties involved corresponds to the planning stage. While the stage of defining the scope of the project provides an analytical basis and a comprehensive rationale for the regeneration project, a long-term vision and context is established at the planning stage. When forming a vision of the project, it is necessary to take into account the inevitable changes and risks of different phases of market cycles. Effective structured planning allows balancing interaction between the public, private and public sectors. The planning system combines a long-term vision with a clear regulation process. This approach allows us to give the necessary confidence to invest and take risks to the private sector, and also convinces the public that social goals will be achieved, and not solely subject to market dictates. At the planning stage, all the major factors of the regeneration project, including land, community interests and environmental problems, must be taken into account.
Stimulation of private financing corresponds to the stage of budget allocation. Whether the initiative to renovate cities by the public or private sector has been proposed affects the types of financing instruments that can be made available to its lead sponsor. Large-scale projects for the renovation of cities are complex and require significant resources (Chulkov, Gazaryan, Kuzina, 2014). Not all cities have the resources to finance the costs of such major initiatives in full. Partnership with the private sector is significant to cover costs, as well as to distribute risks and to balance technical capabilities. Many factors affect the methods used to finance initiatives to renovate cities. The most important factor is the legal and institutional context with regard to control over financial management, in particular the ability to raise and distribute income. To finance the renovation of cities, there are two groups of instruments: financial instruments and regulatory instruments. Financial instruments include direct financing of the regeneration project. The regulatory tools use the powers of the city to stimulate the participation of the private sector.
An example of this type of instrument is tax and non-tax incentives, zoning, land use rules and transfer of development rights (Shul'zhenko, Kievskiy, Volkov, 2016).
In this article, the aim of the research is to estimate the renovation impact on Moscow city budget and developers' financials as the key objective of the research. During the analysis, the author forecasted potential scenario of Moscow real estate market development assuming renovation programm will be realized. Forecasted results are based on standard DCF model with the number of assumptions (renovation ratio etc.). It is also worth noting, that before the current research there was no complex and complicated finacial forecast of real estate developer’s finances and potential benefits for the Moscow budget.

Methodology of research and materials

Evolution from ideas to action refers to the stage of realization. The implementation phase involves the implementation of the concept of long-term changes in financial, contractual and institutional relations between the public and private sectors. This stage includes the formation of a stable

organizational structure of the project, involves the development of sound contracts to translate the concept into a material partnership between the public and private sectors. Public administration can be the most important factor in the implementation phase. Since the renovation process is long-term, it involves the transformation of the usual urban processes, which entails certain risks, the leadership of the city authorities is important for managing the process of change, with a view to consolidating society, so that all interested parties feel involved in the process, understand its significance for the future of the city.

Another important indicator of success at the implementation stage is the compliance with the terms of the project, the expected project cycle and milestones, taking into account the uncertainty factor (Gusakova, Pavlov, 2016). Then follows the phasing and breakdown of a large project into manageble components.

Also an essential element of the implementation mechanism is the definition of the optimal institutional structure for the conduct of the project and the distribution of the powers of the various actors. This affects the structure of contracts, the transfer of services and the sustainability of the project.

Projects for the renovation of the city are aimed at achieving an optimal combination of residential, social and commercial functions (Kievskiy, Kievskaya, Mareev, 2015). The effects of complex renovation can be divided into two groups: non-economic and economic.

The group of non-economic effects includes:

- Reducing the degree of deterioration of residential development;
- Improvement of housing conditions of the population;
- Improvement of social infrastructure in the neighborhoods in which renovations are taking place;
- Improved energy efficiency. Renovation quarters are laying new standards of quality: reducing the thermal conductivity of walls, roofs, the use of effective ventilation principles, the use of new designs of balconies and double-glazed windows.

As an economic effect, there is a flow of cash (net funds). The flow of real money is defined as the difference between the inflow and outflow of cash in each period of the project. To analyze the effectiveness of various scenarios of the project for the renovation of built-up areas, the following main criteria are used:

- Net present value (or Net present value, NPV) is an indicator that represents the difference between all the cash inflows and outflows that are given to the current time point (the moment when the investment project was evaluated). NPV shows the amount of cash that the investor expects to receive from the project, after the cash inflows have paid off its initial investment costs and periodic cash outflows associated with the project.
- Internal rate of return (IRR) - the interest rate at which the net present value (net present value - NPV) is 0. The criterion with which to compare the IRR is the opportunity cost of capital for these investments (for example, rates on bank deposits as an alternative way of investing funds).

Consider the impact of key parameters of the renovation project on economic indicators.

We will accept for evaluation the following approximate parameters (key and variable) of renovation programs in Moscow (see table 1).

Table 1

Key parameters of renovation

Item	Unit	Amount
Renovation ratio	x	2.30
Resettlement ratio	x	1.30
Construction cost	RUB/sq m	65 000
Construction period	Years	1
Sale price for apartments	RUB/sq m	160 000

Source: Author estimates, Rosstat, Government of Moscow

Discussion and results

Renovation program will have outcomes in two fields: social and economic (Tikhomirov et al, 2015). It is too complicated to analyze whole range of social effects due to many factors, which influence this area. However, economic results of this program can be estimated more properly due to limited

range of general assumptions. Please see below the outputs of financial overview of the Moscow renovation program.
Table 2 demonstrates key operating and financial outcomes of the program. Main operating indicators are volumes of demolition (previously declared by Moscow authorities), construction (preliminary numbers, subject for approvals for each project and Moscow district) and resettlement (previously declared by Moscow authorities).
Assumptions related to construction costs and sales prices are based on current and forecasted market conditions.
Due to fixed positive margin between construction costs and proceeds from sale, the only factor that has strong impact on financial results of the program is the construction volume.
Calculations indicate that renovation ratio of less than 2.0x leads to non-significant financial results. Due to developers have to reimburse demolished volume plus 30% premium for free they need to have more additional volume available for sale on market terms. That is why Moscow authorities have to accept high renovation ratio to cover all expenses related to the program and arise addition inflows in the budget via income and property tax related to new property volumes.
Calculations provided below prove that renovation program leads to positive economic effects. The main idea of the calculation below is that developer's payback and financial results (as well as government budget) depend on renovation ratio. That means that if the renovation ratio will be estimated less than 2 points, than the renovation project is economically unprofitable and money from developed spaces for sale will not meet the expences for construction, because a part of the developed spaces will go free of charge.
Varying the key parameters has an impact on social outcomes and the calculation of the project economy. Social outcomes depend on the resettlement ratio and the renovation factor.

Conclusions and proposals

The process of changing the urban space and the appearance of residential areas of Moscow is one of the main achievements of today's urban policy. The work is conducted not with appearance, but with the environment of the districts themselves. Comfortable living environment implies a clear structure of residential education with the delimitation of private and public areas and the placement of all elements of the residential environment within a clear planning structure. Private and public spaces ensure the interconnection of all elements of the structure of the residential area (urban block, block and microdistrict) and increase the efficiency of the use of the territories by streamlining the placement of all elements of the residential environment.
Well-located and properly maintained housing built on a renovation program, will solve the most important social problems of the city.
Due to the fact, that within the framework of renovation, housing will be built where people will have access to jobs and priority services, and provided effective management and services are provided, it is possible to achieve an increase in housing capitalization for citizens who are included in the program.
Also, the deployment in Moscow of a program for large-scale renovation of residential areas, involving significant amounts of new construction, will give a new impetus to the development of the construction industry as a whole, as well as related economic sectors (including machine building).

Table 2

Key performance indicators of Moscow renovation program

Item	Unit	Total	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Operating metrics																		
Demolition volume	m sqm	18	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
Cumulative	m sqm		1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0	13.2	14.4	15.6	16.8	18.0	18.0
Construction volume	m sqm	41	0.0	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Resettlement volume	m sqm	23	0.0	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Cumulative	m sqm		0.0	1.6	3.1	4.7	6.2	7.8	9.4	10.9	12.5	14.0	15.6	17.2	18.7	20.3	21.8	23.4
Sales volume	m sqm	18	0.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Cumulative	m sqm		0.0	1.2	2.4	3.6	4.8	6.0	7.2	8.4	9.6	10.8	12.0	13.2	14.4	15.6	16.8	18.0
Developer economics																		
Revenue	RUBbn	3 998	0	200	208	216	225	234	243	253	263	273	284	296	307	320	332	346
Sale price	kRUB/sqm		160	166	173	180	187	195	202	211	219	228	237	246	256	266	277	288
CPI RUS	%			4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Expenses	RUBbn	3 437	0	185	190	196	202	208	214	221	227	234	241	248	256	263	271	279
Construction cost	kRUB/sqm		65	67	69	71	73	75	78	80	82	85	87	90	93	95	98	101
PPI RUS	%			3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Profit before tax	RUBbn	562	0	15	17	20	23	26	29	32	36	39	43	47	52	56	61	66
Income tax	RUBbn	112	0	3	3	4	5	5	6	6	7	8	9	9	10	11	12	13
Tax rate	%		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Net income	RUBbn	449	0	12	14	16	18	20	23	26	28	31	34	38	41	45	49	53
Additions to Moscow budget	RUBbn	120	0	3	4	4	5	6	6	7	8	8	9	10	11	12	13	14
Income tax from developers	RUBbn	112	0	3	3	4	5	5	6	6	7	8	9	9	10	11	12	13
Property tax from additional area	RUBbn	8		0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Additional volume	m sqm			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Property tax rate	%		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Source: Author estimates

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Information about author

Elizaveta Kheifetz, Master of Economics, PhD-candidate, Financial University under the Government of the Russian Federation. Moscow, +7 905 777 98 07, liza.kheifetz@yandex.ru . Fields of interest – urban economics, cadastral management, real estate valuation

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TECHNOLOGY OF GEODETIC CONTROL AT RAILWAY CONSTRUCTION STAGES

Vilma Kriauciunaite-Neklejonoviene[1, 2], Donatas Rekus[1,2], Giedrius Balevicius[2], Oleg Kolbovskij[2]
[1] Kaunas University of Technology, [2] Aleksandras Stulginskis University

Abstract
Railway tracks require more thorough maintenance and analysis than regular roads for cars. Defects are here noticed and recorded by using special equipment. Construction of railway roads and their exploitation requires optimal accuracy and monitoring of surveying. It is related to maximum allowed speed of trains, the environment, transport and human safety. In order to highlight complex problems of railway road exploitation, the evaluation of railway roads was conducted. Problem areas of railway maintenance were identified. Their monitoring needs to be improved by applying geodetic devices for surveying. Comparing analogous surveying conducted using EM140 machine with that of geodetic equipment, one can see the advantage of geodetic surveying. Technical gaps in the surveying process, data storage and procession were evaluated as well. It was discovered that maintenance and monitoring works should be pursued more frequently using high accuracy geodetic equipment.
Key words: railway, geodetic surveying, accuracy of surveying, EM140.

Introduction

Not only does geodetic surveying enable one to identify the location of the object or compile topographic maps, but also to analyse, evaluate and observe new and old engineering equipment. According to V. Ramūnas (2013), railway quality depends on employment of appropriate substances and application of innovative technologies. An important moment is observation and evaluation of railway road condition. Railway tracks require more accurate maintenance and analysis than regular roads for cars. Defects in regular roads can be noticed and recorded by simple inspection without using any special equipment but rather marking it in the survey. As Š. Prokopimas states (2017), quality requirements for arranging railway infrastructure objects are always included in the primary conditions of the project and they must be observed within limits of allowed deviations and tolerance throughout the whole process of construction and exploitation (works of rubber ballast compaction and accurate railway road tamping to the project position). Precise arrangement of railway roads in the project position, observing the deadlines of works by maintaining high quality indices, etc. call for contemporary surveying and observation technologies allowing functional and immediate inspection and regulation of railway road condition throughout construction and exploitation period.

The research on organization and optimization of railway road inspection and repair was analysed by A. R. Andrade (2008), S. Jovanovic (2004), C. A. Grimes (1995) D. Larson (2004), B. Aursudkij, G. R. McDowell, A. C. Collop (2009) and other numerous authors. I. Gailienė, I. Podagėlis (2008) designed very important evaluation where strength characteristics of Lithuanian railway lines upper construction were defined. J. Lackenby (2006), B. Aursudkij (2007), S. F. Brown et al. (2004), Skrinskas et al. (2010) conducted relevant research. Contemporary construction and exploitation of railway infrastructure objects requires maximum accuracy of surveying in order to increase the speed of trains. Exploitation of modern railway roads requires high responsibility of works and more careful monitoring.

The article deals with construction, regulation and monitoring works of railway roads. Such works have been reviewed little so far because high accuracy geodetic equipment has not been used and single format data has not been saved. In addition, one needs to perceive that there are not many specialists in the field. Numerous previous surveying cases involved a different surveying technology (string method or the one using special accessories), which did not ensure maximum accuracy and did not provide conditions for storing sufficient data. Different enterprises conducted the majority of more serious regulation and monitoring works. Thus, the research is important for highlighting

complex problems of railway road exploitations, which have been reviewed and structured little so far.
Research object: Investigation and control geodetic works in the railway territory
Aim and objectives:
The aim is to evaluate differences of the technological process and control technology by conducting geodetic investigation in railway objects.
1. Analyse and evaluate differences, assumptions and occurring problems of the technological process by conducting railway geometric investigations.
2. Define optimal frequency of geodetic road supervision works (to observe geometry) and appropriate methods.

Methodology of research and materials
Research (surveying) was conducted in certain stretches of railway infrastructure. Only higher categories (I and II) roads, which need more careful supervision, were analysed in the research. More stringent requirements due to higher maximum speeds allowed are applied for them. Only roads between stations were selected because more favourable conditions affect their state and they are characterized by greater lengths. Selection criteria and five objects that match the collected data analysis are displayed in table 1.

Table 1

Display of railway road stretches selected for the research

	Selection criteria	**Other conditions**
Selected stretch	At least 1 km long;	All stretches must have undergone management (repair) process;
	Surveyed at least twice	
	Surveyed during different periods	
	No repair works during the research not to disturb the analysis data.	
Data	Systems of coordinates and heights must correspond	
	Geometry and vertical profile data have survived	To make comparisons
	Primary project and surveying data can be found	
Used equipment	Trimble SPS930, TopconHiper SR and Trimble GEDO CE 2. Homogeneous and calibrated. Calibrated before conducting geodetic surveying.	Steady correction of devices is essential, especially in winter and summer when the temperature differences inside and outside are highly noticeable.
5 objects were selected:	1. ***K*** – ***L*** 1 km I and II category road; 2. ***P*** – ***K*** 2.8 km II category road; 3. ***P*** – ***R***– ***J*** 1.20 km I category road; 4. ***Pr*** – ***P*** 2.40 km II category road; 5. ***V*** – ***Ž*** 1.30 km II category road.	

Trimble SPS930 electronic tachymeter was used in the research for complicated surveying and monitoring of constructions, railways, tunnels, etc. Multifunctional GNSS receiver TopconHiper SR and surveying trolley Trimble GEDO CE 2 were employed. Trimble GEDO CE 2 is employed for gauge geometry, size control and railway infrastructure. The trolley can survey roads which have gauges of different width by changing certain sections (1000 mm, 1067 mm, 1435 mm, 1520 mm, 1600 mm, 1668 mm, 1676 mm, etc. according to special commission). The width of the gauge is surveyed. Its error gap ranges from –20 mm to +60 mm. The error of the gauge width is ±0.3 mm. The width of the gauge is surveyed by entering the accurate surveyed distance (location), which is the starting point for calculation of subsequent surveying difference regarding the direction of press wheels. The distinction of the platform arrow is ±10° or ±265 mm. The accuracy of the platform is ±0.5 mm (after point surveying). The platform is calculated according to the sensor where one can enter certain meanings or by turning the trolley twice during surveying and thus obtaining the average

value, which is the subsequent starting point for evaluating the platform change according to the width of the gauge and inclination angle. Moreover, software GEDO Office, AutoCAD Civil 3D, Geosecma was used. The surveying equipment employed was sufficiently accurate if used correctly, inspected and adjusted steadily. The equipment was checked and calibrated before starting geodetic surveying works following the requirements

The document regulating the use of railway, the basis of using 1520 m width gauge, the main surveying processes of constructions, equipment and rolling stock as well as requirements, maintenance standards, and principles of train traffic and signaling is Regulations of the Technical Use of Railways (RTUR).

The technological process of surveying all railway stretches is concisely shown in Fig. 1.

Fig. 1. Technological process of surveying road stretches.

In order to pursue works, it is crucial to ask for vigilance warnings for trains concerning surveying by indicating the kilometers (points of works) and the anticipated period of works; during the preparation period temporary geodetic points are arranged and their surveying is conducted using GNSS receiver. Geodetic surveying (see Fig. 2) is conducted in the following way:

- Coordination of two primary surveying stations using tachymeter and GNSS receiver within the distance of 500 metres.
- Having built tachymeter on ST1, THE direction towards ST is entered and repetitive surveying is conducted. Thus the error of the distance is eliminated, which can be received by GNSS surveying;
- The distance to Rep1 is surveyed and railway surveying is conducted – 250 metres to both sides from the tachymeter are calculated, thus forming the section of 500 metres for railway surveying. During surveying the direction is checked every 250 metres (in the middle of surveying near the tachymeter and at the end of surveying at the control point) by turning the tachymeter to the already surveyed ST2 at the distance of 500 metres. If the direction does not correspond, it is restored and surveying is repeated;
- Tachymeter is then brought to ST2. The distance to ST1 is surveyed and the direction and distances to Rep2 and ST3 are surveyed as well. The difference of surveying values (X, Y, Z) is checked in surveying correspondence points;
- Surveying is proceeded up to the final point in such a way.

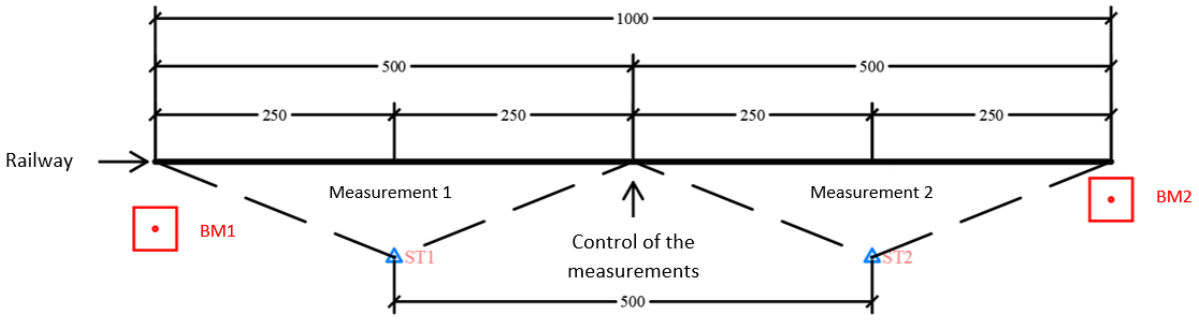

Fig. 2. The scheme of geodetic surveying technology

Bench marks are arranged every kilometer. Two steady tachymeter stops ST1 and ST2 are equipped between them. In extreme cases, when it is very hot, shorter distances are retained between bench marks. The weather being hot, the number of surveying stops increases. Bench marks closest to tachymeter stops are surveyed. The distance not exceeding 500 metres between bench marks is

retained. All data surveyed by tachymeters is transformed by changing the location and the altitude of tachymeter stops as well as by aligning hanging geodetic traverse.
Designing of road reconstruction is pursued using GEOSECMA software. Previously designed horizontal and vertical profiles were used in the research by entering their data and comparing it to the data of recent surveying.

Discussions and results

Requirements for railway condition, its maintenance and repair works are very strict because transportation of cargo and people is a very responsible process. In order to ensure railway traffic security, as well as environmental protection and reduction of risk factors for employees, strict rules and requirements are inevitable. Rules of designing railway stations define requirements which must be observed when designing new and reconstructing existing gauges of 1520m in width in railway stations within the territory of the republic of Lithuania: in such railway lines where maximum speed limits for trains are allowed: for passenger locomotives – up to 160 km/h, for freight locomotives – up to 120 km/h, which is relevant according to the stretches selected (Įmonės…, 2011). Projects of new and reconstructed railway stations are designed under the guidance of territory planning documents, railway transport code of the republic of Lithuania, Regulations of the Technical Use of Railways, construction technical regulations, Standard building safety and purpose documents, hygiene norms, other legal acts. The main and primary goal is appropriate maintenance and service of railway roads.
One of important and little analysed stages of railway maintenance is identifying the state of the road according to the level, gauges and location in the plan. It must be systematically checked by transfer carriage by decoding recordings in the tape and evaluating deviations on the basis of road evaluation standards. This stage is roughly illustrated in Fig. 3. It is a stage of works when road control machine EM140, moving on the railroad identifies defects or possibly damaged spots.

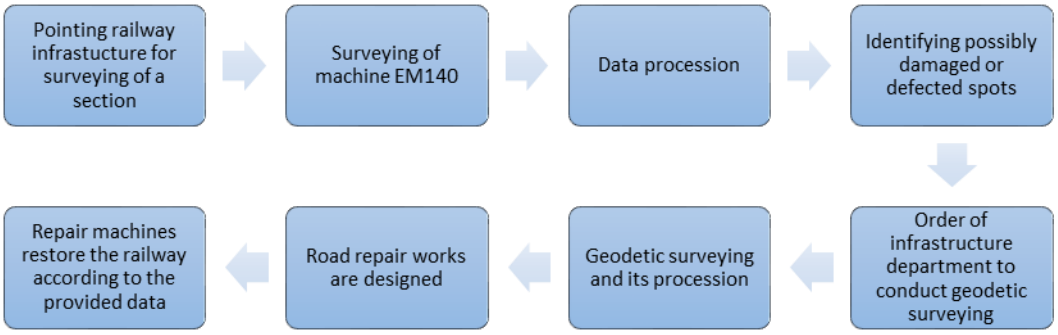

Fig. 3. Stages of railway maintenance works to identify the state of the road according to the level, width of gauges and location in the plan

EM140 stores data in the closed data base, which is evaluated by responsible individuals (Savaeigio kelio…, 2012) of railway infrastructure. Having found defected spots of the road geometry, the order to conduct geodetic surveying is issued. On the basis of geodetic surveying findings, repair works are projected and conducted by road track tamping machines (09-32 CSM, 09-16 CSM, UNIMAT 08-475 4S), i.e. the road is repaired with regard to possibilities.
Geodetic surveying enables one to receive similar final data to that of road surveying machines EM140, 09-32 CSM, 09-16 CSM, UNIMAT 08-475 4S. However, methods of surveying data analysis and evaluation of findings significantly differ. Surveying machines conduct surveying (Geležinkelio...,2000) with regard to peculiarities of equipment and its possibilities, i.e. they identify differences when the distance is at least 18 metres. Meanwhile findings of geodetic surveying reveal differences even more frequently than every 18 meters and reflect also the changes from the starting point and/or geometry arrangement in the space during the analysed period. Data analysis obtained from surveying machines causes problems when evaluating road planning data and more abrupt width of inclination. Analysis of geodetic surveying does not have limitations of track evaluation. Geodetic equipment allows getting point surveying (when the road is surveyed every 5 meters). Data of all are used. They are evaluated as the whole unity (straight lines, traverse and curve segments). Overall total

deviation of the road is defined more precisely. Surveying machines cannot evaluate this fact. Thus, road surveying machine EM140, which declares high accuracy, can evaluate only the possibility of train passing in practice but it in any way does not identify total subsidence of the road or road deviations.

The aim of the research was to identify road deviation from the project data and compare geometry differences during different periods of time. All surveying was conducted before undertaking repair works. After surveying roads were restored to the project position. Systematized data provides maximum deviations of every stretch during the surveying period (table 2).

Table 2.

Maximum deviations in all stretches

Stretch	**Surveying data**	**Deviation from the original project, mm**			
		Horizontal deviation (– to the left; + to the right) from the project	**Vertical deviation (+ is missing from the project)**	**Width of gauges**	**Platforms**
K–L 1 km I and II class road;	2016-08-23 2016-11-14	I class II class – 1/+1 –2/+2 –7/–1 –7/–2	I class II class +51 +38 +34 +38	I class II class –4/+0 –1/+2 –3/+2 –0/+4	I class II class –4/+8 –21/+0 –5/+6 –23/+0
P–K 3 km II class road;	2014-09-04 2017-07-19	–167/+73 –203/+81	+113 +113	–4/+9 –4/+8	–8/+10 –5/+6
P–R–J 1.20 km I class road;	2014-04-03 2017-10-02	–182/+161 –183/+161	+144 +104	–6/+2 –7/+4	–5/+4 –8/+8
Pr–P 2.40 km II class road;	2014-09-17 2017-10-26	–190/+155 –95/+182	+91 +41	–5/+5 –2/+4	–5/+9 –0/+8
V–Ž 2.40 km II class road;	2015-11-25 2017-05-25	–170/+42 –150/+73	+156 +110	–9/-2 –7/+5	–9/+2 –8/+11

Horizontal deviation shows how much road axis has deviated from the project road axis (for instance, the deviation is -167 mm; it means that the road needs to be moved to the right by 167 mm, i.e. 83.5 mm, because at that time in the surveying place it has been distanced to the left). Vertical deviation shows how much the road needs to be lifted (for example, +51 the gauge reveals the discrepancy in mm of the distance between two railheads (it is supposed to be 1520 mm). The platform shows how much one rail is higher than the other one.

By evaluating identified deviations, the criteria are taken into consideration (road gauges for geometry), set for surveying machine EM-140 (see table 3). According to these criteria, degree of deviations and maximum deviation limit of crucial speed reduction is defined. If the size of errors has reached IV degree of deviations, the speed of transport is supposed to be reduced down to a lower category. If deviations have reached IV degree and the road speed is reduced to 15 km/h, the road is closed. Currently the main way to conduct road geometry analysis is surveying by road machine. The machine defines the necessity to repair the railroad accurately enough in order to ensure appropriate railway traffic. Nevertheless, the obtained results do not provide the opportunity to evaluate the total change of railway condition or notice homogeneous subsidence of the road. The instruction of road geometric parameters evaluation K/259 (Savaeigio..., 2016) provides the limits that can be used analysing differences of short road segments (see table 3) but it is not suitable for evaluation of long segment deviations.

According to the findings of conducted surveying (see table 2), 3 stretches which have I degree deviation and 2 stretches having III degree deviation (tables 2-3) have been identified. The obtained data shows that the limits for width of gauges have not been exceeded. Such a tendency cannot be noticed even regarding differences of time periods. One can claim that 2 stretches have approached a must-repair stage in certain places or maximum projected speed must be reduced. However, they still meet compulsory criteria in order to maintain the necessary maximum speed and can be further exploited as roads of categories I and II. In general, road deviations depend on precision of the

construction, which is ensured during the production process, rather than on the season or the period between road repair works.

Table 3.

Limits of railway road gauge width and location in the plan, limits of pits and deviations. (Savaeigio... , 2016)

Degree of deviation	Limits of railroad															
	Width of gauges				Location in the plan				Pits				Deviations			
	Road category and defined speed under deviations, mm															
	I		II		I		II		I		II		I		II	
	140/90		120/80		140/90		120/80		140/90		120/80		140/90		120/80	
	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
	8	4	8	4	5	5	5	5	8	4	8	4	5	5	5	5
	14	6	14	6	7	7	12	12	14	6	14	6	7	7	12	12
	16	8	16	8	12	12	17	17	16	8	16	8	12	12	17	17
	>16	<8	>16	<8	>12	<12	>17	<17	>16	<8	>16	<8	>12	<12	>17	<17

Evaluating the planning road situation, 18 m length road segments are evaluated with help of surveying machines. Such analysis ensures train passage and correspondence of the road speed to the criteria. However, it cannot identify real road state correspondence to the original project. Road surveying machines are oriented towards analysis of the road state with regard to the perspective of a moving vehicle (because it analyses the state of the road when it is being used).

According to the data analysis, it is seen that sudden cases of road gauge damage in railway have been rare and mostly happen in the summer period. In such a way the road is closed and immediate repair works are pursued. In the research, all evaluated stretches did not exceed the established geometry requirements for assurance of certain speed, taking into consideration the possibility for trains to run. General deviations of road geometry were observed rather than single road deformations. Geometry changes have significant impact when curves are being evaluated. However, none of them did not decrease up to the point when the speed of the train must be reduced. On the other hand, if comparing the restored road geometry with initial project data, discrepancies can be noticed. In this case, the limit of discrepancies was highly exceeded. As a result, the problem arises when evaluating such situations, namely, actual road characteristics show that the road is suitable for exploitation. However, the road does not meet the initial geometry and is suitable for use only due to additional reserved distances. When evaluating maximum discrepancies to the project, one can see the values exceeding the momentum of 150 mm, which, regarding exploitation characteristics of the train, in practice limits the possibility to manage with one tamping (road repair). In order to conduct correction of the horizontal profile adequately, it is best to use momenta not exceeding 100 mm.

The majority of roads exceed practical characteristics of one tamping. The only road that has retained its characteristics was tamped every 2 months while all other roads after 1.5 years of exploitation required repair works again. Having exceeded 1.5 years' period, roads typically require repair and, thus, one can claim that it is crucial to organize surveying more often than the period mentioned (see table 2).

Evaluating the change of longitudinal profile, frequent pits were found. The analysis helped to notice that railway road construction tends to subside in points of inclination intersections.

Regarding time, profile and designing tendencies, it has been found that even under similar exploitation conditions certain places have tendencies for pits to form. This situation is best evaluated by conducting geodetic surveying. After surveying, the data is used to find a solution to the problem. It allows defining accurate height and frequency of railway tamping. Geodetic surveying in this case not only defines the size of the pit more precisely but also ensures complete restoration. Surveying and repair machines can record only larger pits because they have no possibilities to survey them using the laser or the string. When defects are evaluated according to the table by the road machine, the surveying distance is 5.4 metres. Analysing at such a distance III and IV degree road deviations were identified. It means that the speed must be reduced for roads of category IV whereas repair

works have to be planned for category III roads. 2.5 months after the last correction of the road, the need for repair was identified. By analysing other stretches, it was discovered that after 3 years damaged stretches containing the same aforementioned defects emerged. Although the road is still suitable for exploitation, the speed in its segments has to be reduced. Thus, additional risk forms because the road loses qualities of speed and stability.

When evaluating the state of the road on the basis of platform discrepancy with the project, the average 8 mm platform discrepancy was identified while following the standards in straight stretches it is supposed not to exceed 6 mm. Taking into consideration the general situation, the highest deviations occur at intervals and have no common dependence for the whole stretch but rather emerge in single spots. Regarding the periods of time, all the stretches that were analysed were close or even slightly exceeded level IV of the deviation (see table 4). One can claim that is reasonable to observe the road state more frequently than 1.5 years despite the fact that road exploitation is still possible. There were cases when monitoring showed that even after 3 years of exploitation no repair works were necessary. K – L road segment is exceptional where II category road even after repair works regained the platform of emergency condition within the period of 2 months. Therefore, repeated surveying and monitoring were indispensable. Nevertheless, such cases are rare and they depend on the state of slopes or ground compaction.

According to Prokopimas (2017), "quality of road construction and maintenance works as well as production scope and ability to organize industrial activity in compact traffic zones directly depends on operative actions such as road surveying, presentation of accurate digital information and repair works. Digital project data and accurate information of the current geodetic surveying in railway ensures the road building according to the geometry parameters observing tolerance limits and traffic security requirements".

Having reviewed the obtained data, it was found that analysis of railway road construction was not sufficient. The shortage of archive data of the previously conducted surveying was found. It could be used for monitoring and maintenance. Road surveying equipment in the train can roughly identify the state of the road and ensure road safety. However, it cannot evaluate the state of the whole road. Steady and renewed regulations are essential for road state observation and repair. It is suggested to pursue railway surveying straight after road repair and 2-3 months after so that steadiness of road state could be evaluated. Regular schedule of geodetic surveying supervision should be designed whereas if needed, surveying could be more frequent. Road surveying should be conducted once per year on average. The most significant problems are observed after 2 months. Currently the road is supervised by identifying the defects by surveying machine. Afterwards geodetic surveying is conducted on the basis of data analysis. Such a solution allows ensuring minimum compulsory maintenance but it does not provide the possibility to create more favourable conditions for repair and analysis. Thus, there is a problem to design road repair schedule and work usually is organized urgently rather than planning in advance. Not only is the state of the stretch different but also each stretch kilometer wears differently. In each situation, one has to make individual decisions.

Summary. All things considered, one can claim that the state of roads tends to deteriorate although it does not depend on time. It is more affected by the initial project, road exploitation and quality of repair works. In order to ensure fully-fledged supervision of the road state, it is important to conduct surveying more frequently by using geodetic equipment. In such a way, not only the possibility of train passing could be evaluated but also initial road characteristics could be preserved and their original place could be restored. The advantages of control surveying in railway road stretches are as follows:

1. Designing databases;
2. Acceleration of designing works;
3. Possibility to design the precise management schedule;
4. Possibility to calculate railway maintenance costs more accurately;
5. Assurance of safety in railway roads;
6. Identifying causes of limitations of railway road exploitation;
7. More accurate application of railway road modernization and technical solution technology.

Having conducted research and evaluated its findings, there is a suggestion to pursue surveying straight after repair works. The proximate surveying should be organized no later than after 2-3 years

to check the tendencies of road state change (road deviations from the initial state). Subsequent actions could be surveying at least once per year. If the state of the road is steady during the first months, surveying could be conducted once per year. If higher deviations are observed, more frequent surveying would allow detect causes of damage and repair the road until defects do not significantly affect road exploitation.

Conclusions and proposals

1. The width of the gauge is the least changing factor, which is characterized by rare, more individual and short sections (−7/+9). Replacement of the road platform has more significant impact, which is harder to detect without special equipment though it is of crucial importance in order to ensure safety for trains moving at high speeds, especially in curves. In rare cases higher replacement of the platform occurs related to railway bed or the state of the pad (−8/+11). Scheduled tracks and repair of vertical profile require steady supervision as it changes most often and needs correction of 100-200 mm horizontal profile, 100 mm vertical profile, which exceeds the limits of regular one-time correction.
2. The main problems faced are as follows: shortage of regulations defining precise requirements applied for the width of 1520 mm gauges in roads and regulating the procedure of geodetic surveying and parameters, which are used to evaluate the road and actions; geodetic surveying conducted at the wrong time and the tendency to solve problems when the limits of deviations and errors have been exceeded; the lack of specialists in narrow specialization; the lack of favourable conditions for data collection and storage.
3. It is suggested to conduct more frequent surveying of the road straight after repair works. In order to test the tendencies of road state change the subsequent surveying should be planned and conducted no later than in 2-3 months. Regular schedule of geodetic surveying supervision should be designed. If necessary, surveying could be organized more frequently. Otherwise surveying is supposed to be conducted on average once per year.

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Information about authors

Vilma Kriaučiūnaitė-Neklejonovienė. Lecturer, doctor. Kaunas University of Technology, Faculty of Civil Engineering and Architecture. Address: Studentų str. 48, Lt - 51367, Kaunas. e-mail: vilma.kriauciunaite@ktu.lt. / 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. Fields of interest: geodetic surveying, land-use management.

Donatas Rekus. 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. Associate professor, doctor. Kaunas University of Technology, Faculty of Civil Engineering and Architecture. Address: Studentų str. 48, Lt - 51367, Kaunas. e-mail: donatas.rekus@ktu.lt Fields of interest: calibration of geodetic instruments, height measurements

Giedrius Balevičius. Lecturer. Aleksandras Stulginskis University, Institute of Land Manage.ment and Geomatics, Faculty of Land and Water Management. Address: Universiteto str. 10, LT – 53361 Akademija, Kaunas. Ph. (37) 752372. e-mail: giedrius.balevicius@asu.lt , Fields of interest: geodetic instruments, accuracy of surveying, land-use management.

Oleg Kolbovskij. Master student of Institute of Land Use Planning and Geomatics, Water and Land Management faculty, Aleksandras Stulginskis University, Lithuania. Address: Universiteto str. 10, LT – 53361 Akademija, Kaunas reg. e-mail: olegkolbovskij@gmail.com , Fields of interest: geodetic surveying, accuracy of surveying.

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SIMILAR AND DIFFERENT ASPECTS OF SPATIAL DEVELOPMENT PLANNING IN LATVIA AND ENGLAND

Irena Kukule, Vivita Pukite, Vita Cintina
Latvia University of Life Sciences and Technologies

Abstract
Spatial sustainable development planning and providing is a very responsible process. During the process, many spatial development planning documents for specific different time periods on different planning levels are being developed. However, there are only slight differences between the spatial development planning in many European countries where few of them can notice more than the others. Latvia and England, two European Union countries, which had some significant changes in legislation regarding spatial development planning in 2011, were selected for the comparison.
The research aims to evaluate similar and different aspects of spatial development planning in Latvia and England. To achieve the aim, the information on spatial development planning tendencies in both countries, legislation, development order of planning documents and other aspects. The result is a comparison of different and similar aspects of spatial development planning in Latvia and England.
Keywords: spatial development planning, sustainable development

Introduction

The providing and furtherance of Spatial sustainable development are one of the main aims of any country. In this case, spatial development planning can be understood as the process of the planning of spatial development. This process results in long-term and middle-term spatial development planning documents for a specific period accordingly to spatial development planning levels.
There are only slight differences between the spatial development planning in many European countries, few of them are more noticeable, where we can mention England as one of the examples. On 2011 there was a reform with some significant changes in the spatial development planning system, where one of them was a transition from three-level to two-level spatial development planning system along with replacing a significant part of legislation regarding spatial development planning. In Latvia also 2011 was a year of changes because on 1st December 2011 new "Spatial development planning law" came to force. In addition to spatial development planning legislation, several new planning document types as spatial development planning strategy, development programmes, and thematic plans are prescribed by the law.
Sustainable development is defined in *Our Common Future* (also known as Brundtland Report, 1987), a report by United Nation's (UN) World Commission on Environment and Development, and widely used internationally since the UN conference "Environment and Development" in Rio de Janeiro, Brazil, 1992. Sustainable development in the report is explained as *development that meets the needs of the present without compromising the ability of future generations to meet their own needs*. Also indicating that mainly it consists of three components – environmental protection, economic development and social progress (Figure 1) – where they all can develop and act independently and meanwhile also interacting without being in contradiction with or degrading any of other components. For example, economic development must not degrade environment or worsen quality of life (Ilgtspejiga attistiba (n.d.); Our Common Future, 1987).

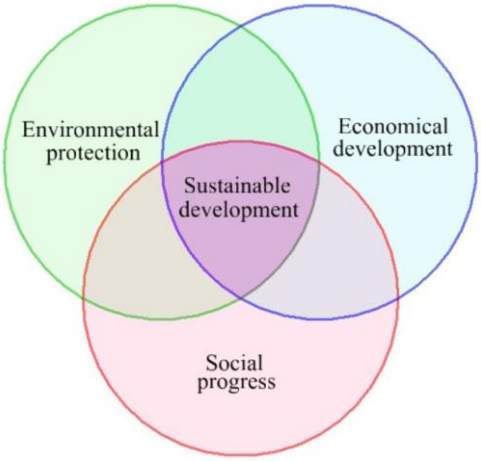

Fig. 1. Sustainable development components
Source: Created by authors

The research aims to evaluate similar and different aspects of spatial development planning in Latvia and England. To achieve the aim Latvia (EU Member State since 2004) and England as a part from The United Kingdom (EU Member State since 1973) were selected for the research. In the research, there are compared the information on spatial development planning tendencies in countries, legislation, development order of planning documents and other aspects.
The result is a comparison of legislation regarding spatial development planning in both countries, about the planning process and different and similar aspects of them.

A methodology of research and materials

The current direction of spatial development planning in Latvia started only after the collapse of the Soviet Union when Latvia regained its independence in 1991 because the political system changed and many changes arose in country's economic activities. The establishment of the Ministry of Environmental Protection and Regional Development in 1993 must be considered as the first significant step towards country's sustainable and balanced development. The primary task and function of the Ministry was the development and implementation of regional policy (Ieskats vesture, (n.d.)).
Latvia joining European Union (EU) in 2004 must be considered as one of the next significant steps in spatial development planning in Latvia. The country had to start following EU directives, standards and other documents binding to EU countries for different economic activities, spheres, and processes including spatial development planning. Today there are laws and other regulations which states what the processes are, how they must be accomplished, what are the outcomes and what documents should be developed in the process among all that what principles must be respected when developing planning documents (Spatial Development Planning Law, 2011).
While Latvia joined EU only on 2004, the United Kingdom (UK) joined EU on 1973 which is more than 30 years before Latvia, and that means it started following EU directives and other documents sooner and had a different pace in developing spatial development planning. However, researching the UK focusing only on England, it was found that the most considerable changes in spatial development planning in England started after the United Nations accepted *Agenda 21* in 1992 in Rio, which affected the progress of spatial development planning on a global scale (Cave et al., 2013).
Before the more significant modifications in English spatial development planning system in 2011 and 2012, the initial planning policy document of the government of the United Kingdom was *Planning Policy Statements*, where spatial planning was divided thematically by sectors. Additionally, there was *Regional Spatial strategy* determining spatial development policy in all regions of England (9 in total), but local authorities developed *Local Development Framework* (Figure 2).
Figure 2 shows that since 2011 there are only two spatial development planning levels in England and the regional planning level was removed, but instead, the *Neighbourhood Plan* was introduced.

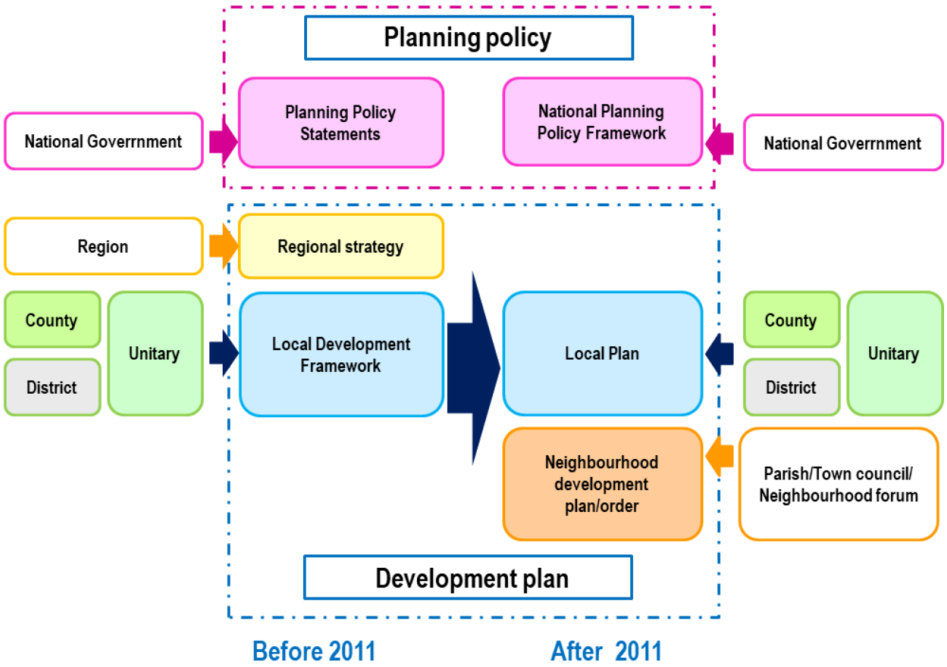

Fig. 2. Spatial development planning in England before and after 2011
Source: Created by authors from the data of the research „An Overview of Spatial Policy in Asian and European Countries."

There are three planning levels in Latvia – national, regional (5 planning regions) and local (119 municipalities) planning levels with development of multiple planning documents in each of them (table 1). There are three planning documents on a national level - *Latvian Sustainable Development Strategy*, *National Development Plan* and *Maritime Spatial Plan*. When developing regional and local level planning documents such as Sustainable Development Strategies or Development Programmes or Plans, the hierarchy of planning levels must be taken into account, which means that need to follow the directions and conditions described in hierarchically higher level planning document (Spatial Development Planning Law, 2011).

Discussions and results
Comparing the developed planning documents in both countries on each planning level, in table 1 it is shown that in Latvia there are at least three planning documents on each planning level while in England it is just *National Planning Policy Framework* on the national level and two plans and *Core Strategy* for 15 years period on local level. Apart from Latvian planning documents of national planning level, *the National Planning Policy Framework* serves only as a guideline in developing *Local Plan*, *Neighbourhood Plan* and *Core Strategy* (National Planning Policy Framework, 2012). While *Local Plan* and *Neighbourhood Plan* are laid-out plans, *Core Strategy* is a document where the aims of the territory's development for next 15 years are described.

Table 1

Planning documents in Latvia and England

Planning level	Latvia	England
National	• Latvian Sustainable Development Strategy • National Development Plan • Maritime Spatial Plan	• National Planning Policy Framework
Regional	• Regional Sustainable Development Strategy • Regional Development Programme • Thematic Plans	---
Local	• Sustainable Development Strategy • Development Programme • Territorial Plan • Local Plans • Detailed Plans • Thematic Plans	• Core Strategy • Local Plan • Neighbourhood Plan

But not only the number of planning levels and the number of documents on each level are different in both countries, but also the development process of spatial development documents on a local level. For example, comparing the development process of *Local Plan* in England and the development process of *Territorial Plans* and *Local Plans* in Latvia, it was noticed that in England public involvement in the planning process is available in more planning steps than in Latvia (Figure 3, Figure 4).

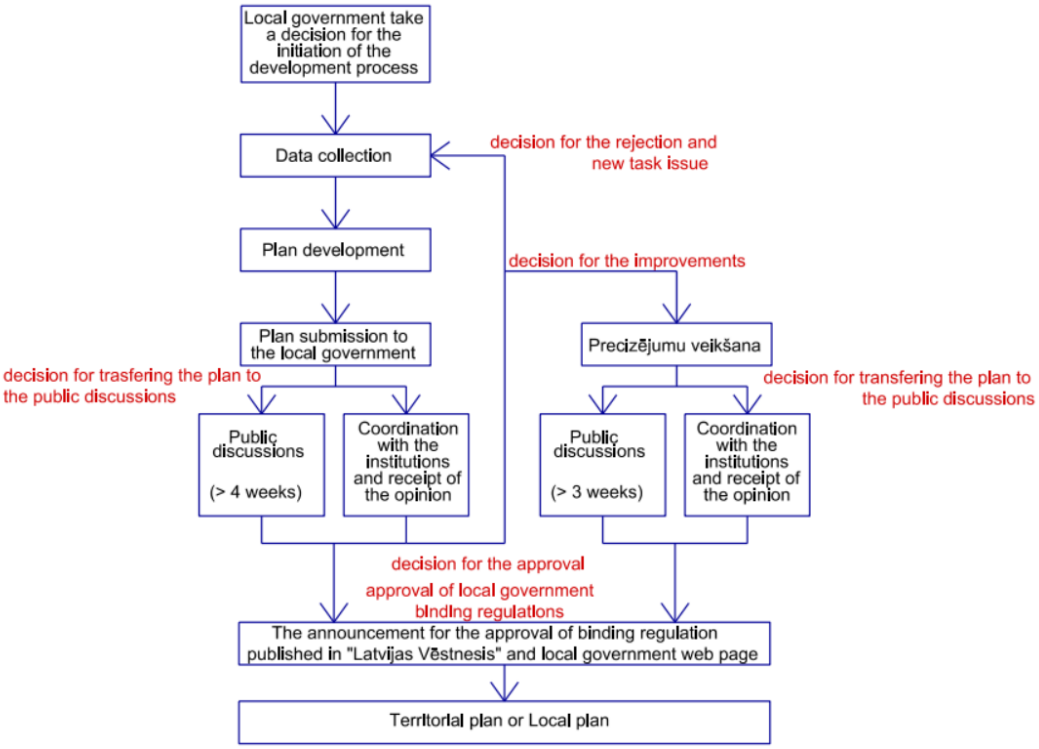

Fig. 3. The development process of Local Plan and Territorial Plan in Latvia
Source: Created by authors from Latvian laws and regulations

Even though the public involvement is possible in both spatial development planning, in Latvia, it is possible for few weeks on steps 5 and 8 (Figure 3), while in England it is possible on steps 1, 2, 4, 6 and 8 (Figure 4).

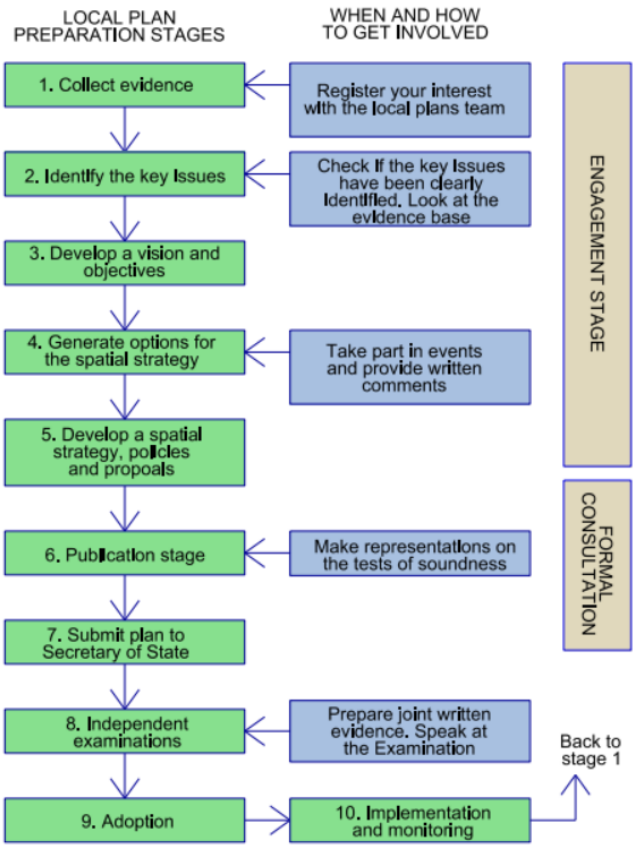

Fig. 4. The development process of Local Plan in England
Source: Created by authors from Guidance: Local plans, 2016

There are also many principles that must be considered in spatial development planning in both countries. The principles described in *the National Planning Policy Framework* and the legislation in Latvia are similar, mostly pointing out that *economic*, *cultural*, *social* and *environmental* aspects should be harmonized. They also describe that interests of different industries and spheres should be coordinated, regional development planning priorities of different planning levels should be hierarchically coordinated and the planned solutions' influence on surrounding areas and the environment evaluated (Spatial Development Planning Law, 2011; National Planning Policy Framework, 2012).

The vital importance of the *economic aspect* of the spatial development planning is directed to the questions regarding land as the primary planning object and its the most effective usage economically (Larsson, 2006). In order to ensure the prosperity and needs of people, the promotion of economic development is practically the most critical precondition. It is because to provide the needs of people maximally, firstly, they need to live in an economically secure and stable environment, and the main components of such environment are developed infrastructure and sectors of an economic system (Lektauers, Trusins, Trusina, 2010). In order to promote sustainable development in Latvia and other EU countries, EU funding is attracted and realized in many different development support programs, for example, as for rural territories, tourism, and business development.

Evaluating the *cultural aspect* in Latvia, it was noted that great accent is being put on preservation, renovation, and maintenance of cultural and historical objects. These objects are excellent instruments in tourism development and also for preservation of cultural heritage of the area, which, based on the country's architecture and unique landscapes, promotes the preservation of national identity (Antrop, 2005). However, cultural heritage in rural areas and cities may be different. In rural areas, it is essential to prevent open landscape's deterioration by overgrowing with forests and have a tendency to preserve hedges, masonry walls, natural pastures and other natural objects, which shows the magnificence of the former countryside. In the preservation of city landscapes there are different

values, for example, separate historical buildings, constructions or parks, very often they can be several residential districts (Larsson, 2006).

The environmental aspect is considered as the most crucial spatial planning and development aspect. It is because environment firstly is a union of natural, anthropogenic and social factors (Environmental Protection Law, 2006), which makes it very important in sustainable territorial development because it has a significant influence on people's desire to stay and live in that area. The dominant factors in cities and rural territories are different, but the influence on the landscape and people's living condition very often is easily noticeable.

For a very long time, the aim to preserve and improve environment was suffering from too little attention, especially, if it conflicted with economic interests. However, during the last few decades the situation on a global scale has been changed significantly, and nowadays one of the main problems with particular importance in spatial development are the consequences from the too frivolous attitude towards the environment (Larsson, 2006).

The social aspect is also significant and sometimes even especially accented spatial development planning aspect (Chazdon, Lott, 2010). Social aspects are environment created for human's needs, and it includes healthcare, education, culture, active lifestyle, social work and services, and security, which all together are the most critical issues of social aspect, but it is essential to have people's participation in the development of the territory (Cimdins, 2015).

Population's well-being manifests with improving living standards, different available services, including transport, recreational territory, and public building. All improvements from viewing this and other aspects are closely related to land (Larsson, 2006).

As examples from Latvia there are projects accepted in 2012 and 2015 and many other projects, in order to develop sports and cultural squares, to develop new and upgrade existing tourism routes, and many more, but all of them with full or partial funding from EU. In order to attract more finances for tourism, a unique support programme regarding tourism development for 2014-2020 has been developed. Great importance is being put on investments in researching and development, mostly to increase capacity for innovation and also capability to create new products and services, because then the opportunities of international competition for Latvia would increase. A significant problem in Latvia at the moment is increased numbers of unemployment, but it is considered to reduce the number with developing new industries with an accumulated essential knowledge as financial service, transit, and logistics (National Development Plan, 2012).

As examples from England, there are multiple projects of sustainable development in England's National Parks since 2003. Also, there is a specially founded Sustainable Development Fund which supports with funding many environmental, mostly water, hydrology or water technics related sustainable development local projects.

Conclusions and proposals

1. 2011 was a year of significant changes in the spatial development planning of Latvia and England because new "Spatial development planning law" with several new spatial development planning documents prescribed by the law came to force in Latvia, while England had a reform of spatial development planning system.
2. In comparison, the development of planning documents in Latvia is more complicated than in England, because there are multiple types of planning documents on all planning levels in Latvia, while in England there is only one planning document on national planning level and only two types of planning documents on the local planning level.
3. In comparison, the people in England can get involved in the development process of the local level planning documents more easily than in Latvia because the public participation is allowed from the initiation to the moment of public discussions, while in Latvia all the objections and suggestions are allowed only during the process of public discussions.
4. In both Latvia and England, spatial development planning must follow the principles, which points out that economic, cultural, environmental and social aspect must be harmonized, that interests of different industries must be coordinated and that influence on the environment must be evaluated.

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Information about authors:

Irena Kukule, Mg.sc.ing., lecturer, Latvia University of Life Sciences and Technologies, Faculty of Environment and Civil Engineering, Department of Land Management and Geodesy. Akademijas iela 19, Jelgava, Latvia, e-mail: irena.kukule@inbox.lv

Vivita Pukite, Dr.oec., associate professor, Latvia University of Life Sciences and Technologies, Faculty of Environment and Civil Engineering, Department of Land Management and Geodesy. Akademijas iela 19, Jelgava, Latvia, e-mail: vivita.pukite@llu.lv Fields of interest: geospatial information systems, land use, real estate valuation.

Vita Cintina, Mg.sc.ing., doctoral student, lecturer, Latvia University of Life Sciences and Technologies, Faculty of Environment and Civil Engineering, Department of Land Management and Geodesy. Akademijas iela 19, Jelgava, Latvia, e-mail: vita.cintina@llu.lv Fields of interest: spatial planning, remote sensing, geospatial information systems.

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THE CONCEPT OF LAND PLOT AS A COMBINATION OF SMART CONTRACTS: A VISION FOR CREATING BLOCKCHAIN CADASTRE

Andrii Martyn
National University of Life and Environmental Sciences of Ukraine

Abstract
The key features of the blockchain databases, such as decentralization, distribution, security, and record of the history of all transactions, create significant prospects for their application in the field of cadastre and real estate registration activities, including creation of the global real estate cadastre infrastructure, which will be able to go beyond national legal systems and jurisdictions. The conceptual approach to registration of land plots as spatial objects using blockchain technology is proposed. The land plot should be considered as a combination of smart contracts between landowners, surveyors, appraisers, notaries and other persons. The subject of such contracts will be the description and establishment of spatial (plot boundaries, territorial zones, etc.) and other (property rights and encumbrances, monetary valuation, soil bonitet, etc.) characteristics of land plots. The classification of such smart contracts reliability is also presented.
Key words: land cadastre, land plot, blockchain, smart contract, global cadastre.

Introduction

In recent years, it becomes clear that the blockchain technology may have a much wider application than the crypto-currency market. Key features of databases based on blockchain technology, in particular: shared databases, multiple writers, distributed trust, disintermediation, transaction dependency, timestamping, transaction rules, validation, scalability etc., cause significant prospects for their application in the field of cadastral and property registration activities. In particular, today it is possible to model scenarios, in which the state will no longer perform the function of a guarantor of rights to real estate, as well as establish technical and organizational grounds for launching a global cadastral system, which will go beyond national legal systems and jurisdictions. At the same time, many researchers pay attention to the multiple risks related with the transition to blockchain technology implementation in land registration.

Study conducted by the European University Institute (EUI) and European Private Law Forum (2005) indicates that various systems of real estate registration in Europe often are divided between five basic "legal families": Common Law; Civil Law of the countries of the Napoleonic Code; Civil Law of Germany (or of Central Europe); Civil Law of the former Communist countries; Law in the Scandinavian countries. Lodde (2016) conclude, that distinguishing factors between the five families listed above are numerous, but there are five that most readily facilitate the comparison: the organization of the registry; the content of the registration; the substantial effects of registration; the protection (or non-protection) of good faith; the effects toward third parties. In most of the European systems, the structure of the "property sheet" is made up of three parts: (1) description of the property, usually identified with a unique number; (2) ownership of the property; (3) the rights of others on the property, burdens and mortgages.

Real property registration systems of developed countries, as a rule, remain quite traditional and sensitive to changes. At the same time, their "immutability", perhaps, should be regarded as one of the conditions for public trust in their services over the centuries. It should be noted that none of the European countries has fully implemented the registration of real property rights for real estate on the technology of distributed databases.

The concept of a land registry built on the blockchain technology basis is particularly attractive for developing countries or countries conducting land reforms, where cadastral systems are not conservative or at the stage of technological and information development. The state cannot always be considered a reliable guarantor of real estate rights, since officials are often prone to traditional "paper" registration technologies, there is always the possibility of losing the registration data due to negligence, emergency situations, war, etc. Unfair government officials and registrars for whom

registration procedures create a broad field of corruption are becoming a problem for poor countries. Often, at the stage of registering real property rights, the state is trying to interfere in market transactions and limit the economic freedoms of entrepreneurs and citizens.

For example, in Ukraine, where the cadastral system is still in development, the government's decision in 2016 to introduce blockchain technology in the State Land Cadastre has generated considerable enthusiasm in society and the professional environment. In conditions, when paper documents on real estate registration in parts of the country (Crimea, Sevastopol, certain areas of Donetsk and Lugansk regions) are lost or inaccessible due to military occupation, the transfer of the cadastral system to technology, which can guarantee the storage of records of property rights to land and other real estate in a distributed database seems to be a rather tempting idea. Unfortunately, the actual implementation of the blockchain cadastre in Ukraine did not go further than specifying a hash-tag in the cadastre certificates, which could be used only for verifying the validity of the document, while the land cadastre database itself is still kept in traditional form and has not become distributed.

Vos, Lemmen and Beentjes (2017) point out, that compared with a 'classic land registration system', blockchain may even provide some additional certainty. Because of the shared databases there is security of back-ups. Trust is added by cryptographic proof and a decentralized database, especially in the case the current administrator (registrar) is not trusted. It might save costs because of remediation of intermediaries (notaries or licensed conveyancers) or administrators (registrars). Therefore, it can be judged as an alternative for the classical land registers. But without the cooperation of legal and geodetic professionals, who indicate the legal and geodetic meaning and its implications, the use of blockchain might not be applicable in the right way and might even backfire in the absence of knowledgeable (legal and geodetic) council. Implementation of such techniques could result in unforeseen circumstances.

Barbieri et.al. (2017) conclude that in judicial matters blockchain raises serious security concerns, promotes tax fraud and money laundering and itself does not offer any solutions for document and data storage, data transport and data protection, issue of certificates and the transfer of ownership to users, genuine authentication of users, preservation of evidence and encryption, protection against key loss and sustainable management. So, from today's perspective, blockchain technology seems to be useful only in the context of machine-to-machine communication, because of the high affinity of the blockchain for standards: the more participants and transaction types exist, the more complex the adoption of new standards becomes.

Peiró and Martinez García (2017) considering the legal aspects of the use of blockchain in land registers, note that the transfer of land rights is not similar to the transfer of shares, since the rights to land are more complex.

It should be noted that the existing studies are largely focused on the use of blockchain technology, first of all, when registering property rights (titles) for land plots. However, many researchers note that the role of a surveyor, who is responsible for describing the spatial characteristics of real estate, as well as the role of a registrar or a notary, certifying the legality of the transaction, does not find sufficient reflection in the concept of the blockchain land registry.

Thus, the conceptual approaches to blockchain registration of land parcels as spatial objects, in the formation of which not only landowners or land users take part, but also land surveyors, appraisers and other specialists carrying out a description of spatial and other characteristics of land plots, remain practically unexplored.

Methodology of research and materials

The purpose of the study was to define a conceptual approach to describing the characteristics of a land plot when maintaining a land registry using the blockchain technology. Technical aspects of blockchain land registry were not considered, but the article operates with the generally accepted concept of this technology as continuously growing list of records, called blocks, which are linked and secured using cryptography. Each block typically contains a cryptographic hash of the previous block, a timestamp, and transaction data. The concept of a smart contract in this article is taken as a computer protocol intended to digitally facilitate, verify, or enforce the negotiation or performance of a contract. Smart contracts allow the performance of credible transactions without third parties. These

transactions are trackable and irreversible. In the course of the research, an attempt was made to introduce the new concept of the “land plot” as a set of smart contracts, at the conclusion of which a fixation of various characteristics of the real property is made.
It should also be noted that the registration system based on blockchain technology can in fact be considered as a further extension of the type of land registration systems based on the registration of deeds (documents), since the system will register transactions (contracts) regarding land plot.

Discussions and results
It is worth noting that the use of blockchain technology for the registration of real estate will require, first of all, an introduction of a new definition of the concept of "land plot" as a set of smart contracts, the subject of which is the establishment of spatial (boundaries of land, restrictions, lands, servitudes, etc.) and others (monetary value, soil yield class, market value, etc.) characteristics of land plots. Smart contract (hereinafter – SC) is a computer protocol that simplifies, verifies, ensures compliance with the negotiation or execution of the contract. Signatories (parties) of such SC should be: (1) owners (users) of land plots; (2) owners (users) of adjacent land plots; (3) competent engineers carrying out a geodetic description of the boundaries (surveyors); (4) competent specialists who establish other characteristics of the land plot (for example, notaries, appraisers, soil scientists, hydrologists, geologists, etc.) (Fig. 1).

Fig. 1. The conceptual model of interaction of participants of the land plot related smart contracts.

In an ideal situation, the boundary of a land plot should be considered as the result of a multilateral SC, which outlines a standardized geodetic description of the boundary between the land plot and neighboring plots signed by the electronic digital signature of the land surveyor and the signatures of the landowner and owners of adjacent land plots. Taking into account that consensus on all spatial characteristics of a land plot may take a long time, spatial characteristics of land plots should be recorded using SC with different levels of reliability – from the most primitive to the most perfect ones.
A separate issue will also be the procedure for the initial recognition of land plot ownership. Obviously, at the initial stage of the functioning of the new registration system, this function can be assigned to a group of special persons – notaries or state registrars who will nominally sign the first ("zero") SC, confirming the existence of rights of owner to the land plot, based on existing title documents at the time of the first registration in the blockchain database.
Five different levels of reliability of the SC related with registration of the land plots and their properties can be offered. Information on land plots registered with SCs with a higher level of reliability, respectively, should have priority in the event of conflicts or disputes.

Level I: Description of the boundaries of the land plot is absent

In fact, contract should be considered "zero" SC, if it is concluded between the owner and the person who certifies with his signature the primary registration of the existing right (notary or registrar). The basis for the primary registration of the right should be the title documents available to the owner, on the basis of which his rights are confirmed. Thus, the "zero" contract serves, first of all, for the confirmation of the title to the land plot. This contract, in addition to ascertaining the existence of the right to a real estate object, may also provide a payment of the services of a person confirming ownership.

Level II: Description of the boundaries of the land plot is absent, but location of the land plot is described as a point object

SC is signed between the owner of the land plot by the land surveyor who described the geographical location of the land plot with the coordinates of its centroid. This type of SC may provide payment for the services of the land surveyor. Such a way of identifying the location of land plots can be considered as one of the most primitive, but for countries with low incomes, even such a simple spatial identification of a land plot can be a mass solution for the initial filling of land registry data.

Geographical identification of the land plot can be specified later by signing new SCs with the land surveyor, on the basis of which a new block with updated information about the coordinates of the centroid of the land plot will be added to the blockchain.

Land plots registered with a second level of reliability on the coordinates of the centroid will in fact correspond to the concept of a "point cadastre" (Antwi et.al., 2012).

Level III: Boundary of land plots is described as a line(s)

In this case, the subject of the SC is the establishment of a boundary between two neighboring land plots. The boundary is described in the form of a polyline(s) with known coordinates of the turning points, as well as an indication of the accuracy with which they were determined. In this case, the subject of the SC is the establishment of a boundary between two neighboring land plots. The boundary is described in the form of a polyline with known coordinates of the turning points, as well as an indication of the accuracy with which they were determined. The contract is signed by the land surveyor, who established the border, as well as the owner of the land plot.

In fact, in this case the border can be established "unilaterally". Of course, the land surveyor, within the limits of his competence, must identify the existing boundaries of the land plot on the terrain, if such boundaries are fixed by landmarks. At the same time, the existence of land plots, boundaries of which are not identified on the ground is quite possible (for example, plots allocated as land shares in the process of land reform within the boundaries of the field).

Level IV: Boundary of the land plot is described as the line agreed by the neighboring landowners

In this case, the boundary between two land plots is established by the land surveyor as a polyline in a manner similar to the third level of reliability. But the main feature of a SC is now multilateralism: it must be signed by the land surveyor, who established the border, and both adjacent landowners, whose land plots share this border.

It can be noted, that in this case the contract will in fact perform the function of coordinating the border between neighbors. Of course, further changes to the boundary established in this way can occur solely by mutual agreement of the owners of adjacent land plots.

A prerequisite for such a delimitation is also the presence of registered property rights for the neighbor's plot. A block with geographic information about an agreed by SC boundary line between parcels should be added to the blockchain on both land plots.

Level V: The boundary of the land plot is described as a polygon

This level of reliability of registration, in fact, is not connected with the signing of additional SCs, but it reflects the state of registration of the land plot, under which contracts corresponding to the fourth level of reliability are concluded with all owners of adjacent land plots. Thus, the set of polylines of individual boundaries conditionally turns into a closed polygon.

The SC may also envisage the entry into force after verification of the spatial (geodetic) parameters of the land plot by another land surveyor or group of land surveyors, which may be considered as an additional way to increase confidence in the information to be recorded.

When transferring rights to a land plot, its spatial characteristics, recognized by the previous owner, will be preserved, and their change will require the conclusion of appropriate new SCs. Fixing other characteristics of a land plot (for example, a monetary valuation of a plot, boundaries of land, soil cover, etc.) should be considered as the subject of landowner's SCs with competent specialists, which provide relevant data.

One of the traditional functions of land registers is the guarantee of property rights and the resolution of disputes, which requires, first of all, retrospective information on all actions that took place with rights to the land plot and its borders. Taking into account the distribution and publicity of the land registry, the management of which is carried out on the basis of the detachment, it can perform such a function quite effectively.

An interesting option arising from the development of a distributed land registry on the basis of a blockchain is the possibility of creating a global cadastre that will no longer depend on national legislation and jurisdictions. Sooner or later, before mankind there will be a need to register real rights to immovable property (or objects equated to immovable property) located beyond the surface of the Earth and state borders, and for this purpose the blockchain property registry will be very convenient. Undoubtedly, this is a very distant prospect, but this is not an excuse for the scientific community to postpone consideration of these possibilities.

It should also be noted that the registration system based on blockchain technology can be viewed as a further continuation of the type of land registration systems based on the registration of deeds (documents), since the system will actually register transactions that are subject to rights to the land plot or its characteristics.

The development of distributed land registers can take place both with the support of the state (when it considers the blockchain-cadastre as a way to reduce government costs) and when it counteracts (when the state does not want to lose monopoly control over the registration of property rights). In the second case, an interesting option may be the creation of special organizations or companies that will perform the function of a nominal owner of real estate in accordance with the national legislation of the country in which it is located. In turn, the actual right to own or use land plots can be provided on the basis of the registration data provided by the "non-state" distributed land registry.

Conclusions and proposals

The creation of distributed land registries (cadasters) based on blockchain technology still raises concerns among many experts in the field of law, land administration and cadastral systems. At the same time, the possibilities of this technology inspire many researchers to find new ways of reliable registration of property rights for real estate.

The key idea of this research is to consider the land plot as a set of "smart contracts" between the landowner and land surveyors, notaries, appraisers and other specialists whose work creates an array of information about the land parcel as a real estate object.

The proposed approach can be considered as one of the first attempts to define a concept on the basis of which it is possible to develop a decentralized blockchain infrastructure not only for registration of transactions with real estate, but also spatial and other characteristics of real estate as objects of property rights. In the long run, this will allow governments to deprive not only the functions of the registrar of real rights to real estate, but also the functions of administering the cadastre of real estate, reducing the taxpayers costs.

Further studies may be devoted to the development of unified formats for describing information on land plots within the framework of a distributed land registry. Also, the technical feasibility of effective operation of such registries should be assessed based on the volume of the database, the number of transactions conducted, and the quality of the cadastral data. Further research is also needed to improve the means of identifying the owner of real estate, prevent fraud, and control the accuracy of geospatial data.

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Information about author

Andrii Martyn, Dr.Hab. in Economics, Assoc. Prof., Head of the Land-Use Planning Department, National University of Life and Environmental Sciences of Ukraine. Address: Office 117, 17 Valylkivska str., Kyiv, 03040, Ukraine; phone: +380672745061; e-mail: martyn@nubip.edu.ua . Fields of interest: land administration, spatial planning, land market regulation, cadastre systems.

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THE CITTASLOW MOVEMENT IN RURAL AREAS – A CASE STUDY OF A VILLAGE IN THE POLISH REGION OF WARMIA AND MAZURY

Katarzyna Pietrzyk
University of Warmia and Mazury

Abstract
The international Cittaslow movement brings together towns that promote the slow life philosophy. The concept has been developed in response to the increasing pace of life and the adverse effects of globalization. According to the members of Cittaslow, the organization contributes to the sustainable development of their regions and to improvement of the quality of life. In view of the benefits of Cittaslow membership confirmed by research studies, the question arises whether the concept of Cittaslow could also be introduced in rural areas. This paper seeks to answer the above question. The study involved an analysis of the Cittaslow membership criteria (Cittaslow goals) and a survey conducted among the inhabitants of the Warmian village of Żabi Róg. The results of the study were used to test the research hypothesis and to assess the quality of life in the analyzed area.
Keywords: rural areas, quality of life, slow life, Cittaslow

Introduction

The slow life concept has been gaining increasing popularity in the 21st century. A fast-paced life and a multitude of responsibilities have disrupted the harmony of human existence. A need was born for an idea that would remedy these problems while preserving a high standard of living. The slow life philosophy draws upon centuries of tradition in various cultures and religions (Buddhism, Christianity) to promote the idea of modern life that is based on mindfulness, inner reflection, richness of simplicity, modern solutions that respect tradition, culture, the natural environment and sustainable development. Mostly slow life organizations focus their activities in large cities and highly urbanized areas that are most susceptible to negative consequences of globalization. However, the slow life movement has not been sufficiently adapted to the specific needs of rural areas (Botta 2016).

The main aim of the research was to show whether the Cittaslow concept can also be implemented in rural areas. The village was analyzed on the basis of a modified and expanded certification procedure for Cittaslow candidates. At the same time, this study is an attempt to evaluate the quality of life in a village in the Polish Region of Warmia and Mazury based on the criteria for Cittaslow accreditation, which is an intermediate goal. The outcomes were compared with the results of a local community survey to determine whether the fundamental principles of the slow life movement can be adapted to rural areas, and to evaluate the perceived standard of living in the village of Żabi Róg. The analysis of the type has never been conducted in Poland or in other countries, and the present study is the first attempt to transfer the Cittaslow concept to rural areas.

Rural areas

In the second half of the 20th century the rural area was defined as the area of the state with low population density, whither dominate agricultural activity also forestry and fishing. Which was often identified with the use of land, leaving aside the social aspect - this concept was quickly considered wrong. This is strongly emphasized by the present research, which consider the rural area as a complex phenomenon with many features. In the 1990s you could easily see approaches close to nowadays, the rural area was considered to be an area outside the city border, which is distinguished by a number of different or similar statistical indicators, for example: population density, agrarian structure, occupational activity rates, etc. (Bański i Stola 2002). Today, it is emphasized that defining a rural area requires flexibility, and any definition at the time of creation may become obsolete or incomplete. It is accurate to say that there is a "discourse to recognize them as a multifunctional

space, taking into account both the features of the diversification of the functional structure of the local economy and human communities" (Stanny 2014, p. 128).

The aforementioned changes in rural areas in the 21st century will occur in a very dynamic way. It is difficult to determine what direction they will take, because there are many global and local trends in the world. They have a significant impact on the shape of the Polish countryside. The orientation most often presented is focused on counteracting the basic problems of modern times, such as disorders of demographic structure, social problems, monofunctionality, deficiencies in social and technical infrastructure (Bański 2013a). Not only the phenomenon of globalization causing excessive competitiveness, discrimination of rural areas outside the suburban zone, but also the development of agricultural technology, Internet networks, increasing the pool of external subsidies, and scientific and technical solutions is still a major impact on the rural areas. It is related to the need to adapt Polish rural areas to global trends, especially economic ones. Uniformity of the world leads to the necessity of finding unique features of the region, original food products. This is how the next trend is shaped: localization characterized by adapting modern solutions and technologies to the potential and resources of a given place. In recent years more and more often this trend can be found in the Polish countryside, where the local population, its value, culture and history are appreciated. Recent publications emphasize that the best solution is to combine the two trends described above, and both their positive and negative features are a developmental stimulant. Researchers particularly stress the negative transformations and their effects, environmental and climate disasters. The surface of natural spaces is reduced in favor of anthropogenic ones, but the concept of primary landscape has no reference in reality. At the same time, increasing social awareness causes the formation of pro-ecological organizations, repeated use of raw materials, renewable energy sources, renewal of forgotten plants, breeding of endangered animal species and many other activities. Trends and directions of changes are many more, and how the future will look like we will learn only after some time (Banski 2013b).

Methodology of research and materials

The village of Żabi Róg is situated in the Polish Region of Warmia and Mazury, Ostróda county, Morąg municipality (Fig. 1). According to German historical sources, the village was founded in 1340. Its name has changed for multiple times over the centuries, from Złoty Róg to Róg, Górniki and, ultimately, Żabi Róg in 1947 (*Pociąg do przeszłości …2008*).

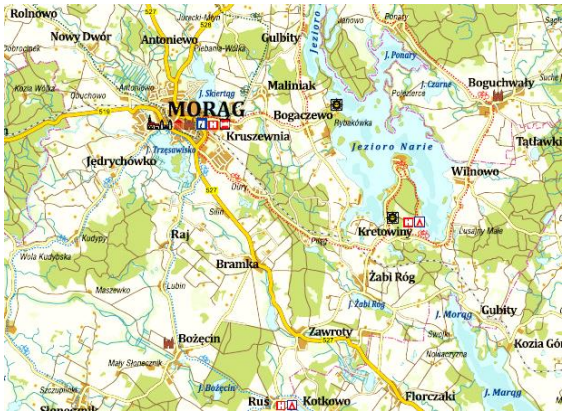


Fig. 1. Location of the village of Żabi Róg
Source: Renewal Plan for Żabi Róg Village for 2014-2020. (2013)

Żabi Rog is the largest village in the Morag municipality with an estimated population of 1,200 people. The village has a railway station, and it is also connected with the regional cities by a network of county and regional roads. Żabi Róg is surrounded by picturesque forests and lakes, Lake Żabie is situated in the Centre of the village. There are several farms in the village, but agricultural production is not the main source of income in the area due to poor geomorphological conditions (*Renewal Plan* for… 2014).

It is worth mentioning how land use planning works in the area of the village of Żabi Róg. The first planning document that allows you to keep harmony in the area of the village is "Study of conditions and directions of spatial development of the commune of Morąg. Area of the City and Rural Areas". It covers the whole area of the village, defines the basic principles of spatial policy of the region, and its findings are binding for the authorities when creating new local zoning plans. The second extremely important document is Resolution No. VI / 44/11 of February 24, 2011, regarding the adoption of a local zoning plan for the commune of Morąg within the geodesic area of Żabi Róg. The plan covers as much as 45.5% of the area of the village of Żabi Róg, the remaining 54.5% (land not covered by the plan) are mainly agricultural, forest and meadow areas. This enables the maintenance of spatial order in the central part of the village, stimulates the proper development of social and technical infrastructure. Analyzing the graphic part (Fig. 2) of the local plan for the village of Żabi Róg, the dominance of agricultural land can be observed (129.22 ha), a significant role is played by farm buildings, farms and horticultural farms (81.11 ha), single-family housing, service areas (61.70 ha) and forests (44.98 ha). The smallest area was allocated for cultural services, areas of technical infrastructure and water supply.

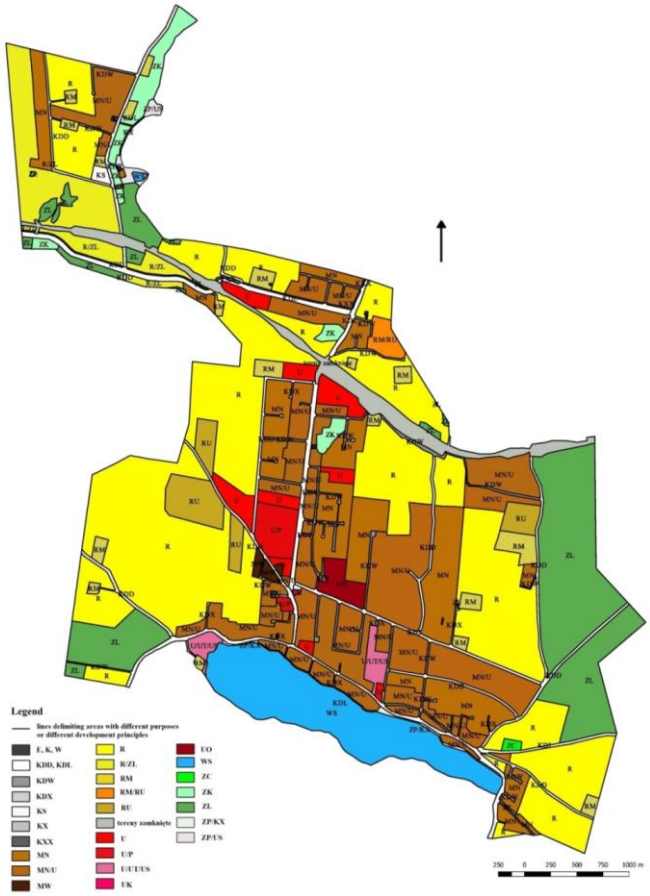


Fig. 2. Local spatial development plan for the village of Żabi Róg

Legend: E-areas of technical infrastructure–electrical power engineering; K-areas of technical infrastructure–sewerage; KDD-areas of public access roads; KDL-areas of public local roads; KDW-areas of internal roads; KDX-areas of pedestrian and footpath; KS-parking; KX-areas of pedestrian routes; KXX-areas of walking and cycling routes; MN- areas of single-family housing; MN/U areas of single-family housing/areas of service development; MW-areas of multi-family housing; R-agricultural areas; R/ZL- agricultural areas with the possibility of afforestation; RM- areas of farm buildings on farms, farms and horticulture; RM/RU- areas of farm buildings on farms, farms and horticulture as well as production areas on farm and fishing farms; RU- areas for production services on farms, farms, horticultural and forest and fishing farms; U- areas of service development; U/P- areas of service development/areas of production facilities, warehouses and warehouses; U/UT/US-areas for service development/tourism areas/areas for sports and recreation services; UK- areas of cultural services; UO-areas of education services; W-areas of technical infrastructure – waterworks; WS- areas of surface water inland;

ZC-cemetery; ZK-natural and landscape greenery; ZL-forests; ZP/KX-greenery areas and walking routes; ZP/US – greenery areas, sports and recreation.

An attempt was made in this study to determine whether rural residents adhere to the slow life philosophy and whether villages should be incorporated into a slow life organization. The local standard of living was evaluated with the use of the self-assessment procedure for Cittaslow candidates applicable to Polish cities. The results of the evaluation were analyzed to determine whether the Cittaslow network should be expanded to include rural areas or whether the slow life concept should be transposed to the rural setting as part of a separate organization such as *Villageslow*. A separate rural organization would have to develop its own charter because the Cittaslow International Charter applies only to urban areas. The results of the assessment were also used to discuss the possible charter of a slow village organization in areas relating to membership fees, support for village administrators in the certification procedure, and candidate admission criteria. The quality of life was evaluated based on the modified self-assessment process for Cittaslow applicants. The potential candidate in this case would be the village of Żabi Róg which should score at least 50% in the evaluation, but unlike in the Cittaslow network, none of the criteria were obligatory. The above provision has been introduced on account of the fact that Polish rural areas differ considerably in their level of development. Separate groups and criteria have been introduced in the self-assessment process for rural areas. According to the Cittaslow charter, cities are evaluated based on 72 criteria in 7 policy areas. The rural accreditation requirements have been adapted to local needs, and the introduced modifications are presented in Table 1. The modified classification process for rural area consists of 40 criteria divided into 6 policy areas.

Table 1

Cittaslow accreditation criteria modified for rural areas

Policy area	Criteria	Policy area	Criteria
I. Energy and the environment	Air quality conservation	II. Infrastructure	Efficient cycle paths
	Water quality conservation and water consumption		Length and quality of roads
	Selective waste collection, landfills, composting bins		Quality of public transport
	Wastewater treatment		Elimination of architectural barriers
	Energy conservation		Access to public services
	Reduction of visible pollution, traffic, noise		Access to basic services (shops, schools)
	Preservation of biodiversity		Employment, unemployment, commuting
III. Quality of rural life	Initiatives promoting rural development	IV. Agriculture, tourism and craftsmanship	Development of organic farming
	Support for families and development programs		Promotional of traditional work methods and occupations
	Sustainable land use		Use of local products
	Internet access		Taste education and promotion of local products
	Creation of spaces for the commercialization of local products		Preservation and appreciation of local cultural events
			Additional hotel/restaurant capacity (diversity)
V. Hospitality, awareness and training	Hospitality and warm welcome	VI. Social cohesion	Social problems – low percentage
	Increasing the awareness of operators and traders		Degraded ad devastated areas
	Slow routes (cycling, historical, etc.)		Integration of persons with disabilities
	Health education (combatting obesity)		Youth status
	Local initiatives		Reduction of poverty
	Cooperation with other organizations		Community building
	Support for Cittaslow campaigns		Political participation
	Use of the Cittaslow logo on headed paper (in the future)		Youth activity centers

Source: made by the authors based on the Cittaslow International Charter 2017

The self-assessment procedure for Cittaslow candidates is long and detailed. Therefore, a grading scale was developed for the needs of this study. In the proposed system, candidates that do not meet a given requirement are also evaluated for their growth potential and the efforts undertaken to achieve specific goals. Every criterion was analyzed and validated based on the documents and information obtained from the Morąg Town and Municipality Office or other public institutions. The grading scale was adapted to the needs of the study based on the fulfillment of every criterion: the criterion has been met (+), the criterion can be met (0), the criterion has not been met (-), data not available (nd).
The second research method was a survey, and a dedicated questionnaire was developed to survey the opinions of Żabi Róg residents. The surveyed population consisted of 25 persons who accounted for around 2% of the local population. The questionnaires were hand delivered to members of the local community and were completed anonymously by the respondents. The questionnaire contained 9 open-ended questions written in casual language (Apanowicz 2002).

Discussions and results

The quality of life in the village of Żabi Róg was evaluated based on a modified self-assessment procedure for Cittaslow candidates (Table 1). The evaluation was conducted based on 40 criteria divided into 6 policy areas. The results were presented separately for each of the 6 policy areas as well as cumulatively for the village of Żabi Róg to provide a detailed overview of the criteria where the village did and did not meet the 50% threshold.
Energy and environmental policies were the first analyzed area (Fig. 3) with 7 criteria relating to the availability and quality of the local utility networks (water supply, sewage disposal, power grid, municipal heating, gas supply). Air and water quality, biodiversity, pollution, noise and waste management were evaluated in the environmental dimension.

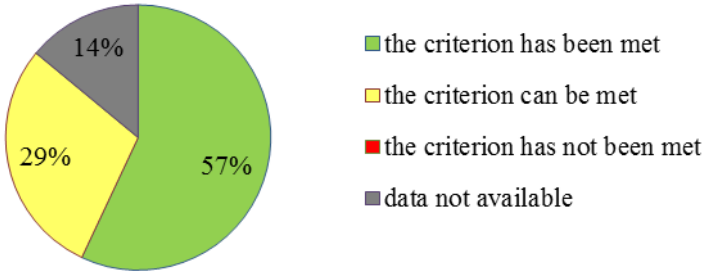


Fig. 3. Score in the energy and environmental policy area

The analyzed village met 57% of the requirements (4 out of 7) in the energy and the environment policy area. Żabi Róg has a sewage network, a water supply network and a biological wastewater treatment plant. Only several households in the outskirts of the village do not have access to public utilities (criteria: Wastewater treatment, Water quality conservation and water consumption). Municipal authorities initiated biodiversity protection measures, they manage Lake Żabie, regularly stock the lake and prohibit boat fishing. The village is surrounded by forests, and the land-use types indicated in the local zoning plan include forests, public greens and agricultural areas (criterion: Preservation of biodiversity). All households have an access to the power grid, and energy conservation campaigns are conducted locally (criterion: Energy conservation). The following two criteria can be met because the village has a high energy and environmental potential. The municipality has the required resources, procedures, structures and facilities for fulfilling the described requirements. Household waste is collected on selected days of the week and is processed by a professional operator in Morąg. Many households have composting bins. There are no selective waste collection schemes, and the local residents are reluctant to sort waste (criterion: Selective waste collection, landfills, composting bins). Traffic is low, the village can be accessed by several roads, and it is situated in the proximity of a regional road that shifts some of traffic away from local roads. Information about traffic noise was not available. There are no polluting businesses in Żabi Róg. The village is not connected to a municipal heating network, and households are equipped with largely

outdated coal-fired furnaces which contribute to local pollution (criterion: Reduction of visible pollution, traffic and noise). Data on air quality and air protection were not available.
Rural areas require efficient infrastructure policies (Fig. 4). In the infrastructure policy area, the village was analyzed based on 7 criteria relating to the labor market, unemployment, roads, pavements, public transport and architectural barriers. Easy access to public and social services contributes to social cohesion in rural areas.

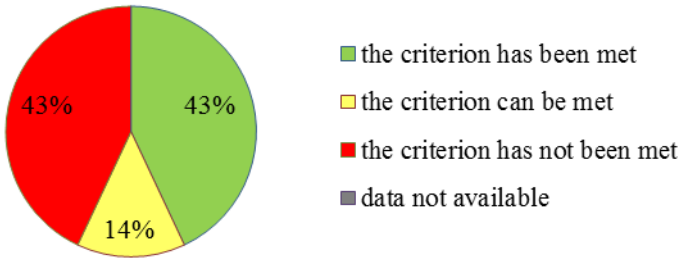


Fig. 4. Score in the infrastructure policy area

The *Renewal Plan for Żabi Róg Village* (2014) indicates that the village has not met the criteria relating to employment, unemployment and commuting. The village has a thriving labor market in comparison with the surrounding areas, but most businesses are construction companies, carpentry companies, gravel mines and food retailers. There are 6 medium-sized farms in Żabi Róg. Not all residents are able to find work locally, and many of them are employed in the nearby cities of Olsztyn and Ostróda. Commuting is difficult because the village is situated around 1 km away from a railway station, and public transport is slow due to the poor condition of local roads. Unemployment is relatively high, and around 160 residents were unemployed at the time of the study. The village has low infrastructure standards, in particular in the area of transport. There are no paved cycle paths, and several foot paths and cycle paths have been trodden in the local fields. Paved sidewalks are in very poor condition, they are overgrown with grass, uneven and very narrow. They are found only in the central part of the village, usually on one side of the street only, with high curbs and no ramps (criterion: Elimination of architectural barriers). The length and quality of roads is a criterion that could be improved and fully met in the future. The village is conveniently located in the proximity of regional road No. 527. Żabi Róg can be accessed by several county roads which are in poor condition and do not have a paved shoulder. The remaining 3 criteria have been met. The local residents have satisfactory access to public transport, the village has a railway station with a regular timetable, and there are privately operated buses to Morąg and Olsztyn. Żabi Róg has a large primary school for both local residents and children from the surrounding villages. The local residents have access to basic services, several shops and a church. Public services are available in the town of Morąg which is situated around 10 km from the analyzed village.
The following 5 criteria (Fig. 5) were evaluated in the quality of rural life policy area which has a positive impact on many aspects of community life. The relevant activities include the promotion of local attractions and products. Promotional measures contribute to an improvement in the quality of life and support local families. Internet access is also an important requirement in the 21st century.

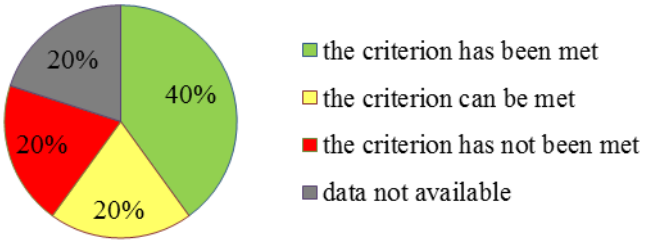


Fig. 5. Score in the quality of rural life policy area

The local authorities undertake various initiatives to promote local attractions and products. Information brochures are published, the village has a music band, its own anthem, songs and ballads commemorating local traditions and heritage. Workshops and festivals are frequently organized, and the inhabitants eagerly promote the region and regional products in local markets, local customs festivals, culture and food fairs. Żabi Róg meets the land-use criterion. The local zoning plan was developed in 2011, and the village has a satisfactory agrarian structure. The criterion relating to the creation of spaces for the commercialization of local products can be met. Commercial facilities could be created in rural community centres, the local school and shops. At present, local products are sold only during municipal fairs. There are no dedicated measures and projects to support families and local development. The residents are entitled only to standard welfare. Żabi Róg has only wireless Internet access.

Agriculture, tourism and craftsmanship play very important roles not only in rural development, but in the entire slow life philosophy. These activities promote local agriculture and local produce. The development of tourism in Żabi Róg was evaluated based on its hotel and restaurant capacity.

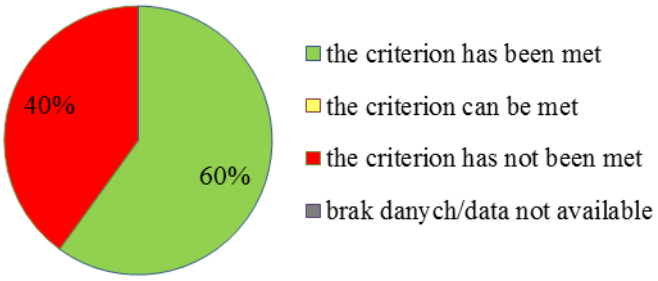


Fig. 6. Score in the **agriculture, tourism and craftsmanship policy area**

The criterion relating to the development of organic farming cannot be presently met for a number of reasons. Żabi Róg has a small number of farms that produce mostly cereal crops, and the local inhabitants are reluctant to work in agriculture. Tourist facilities are very limited. The village has only one guest house (Stara Szkoła) and no restaurants or bars. The remaining criteria have been met (Fig. 6). The local residents regularly organize cultural events, theater trips and concerts. They attend municipal fairs and events, such as the Harvest Festival, and celebrate local holidays. Community members use and promote local products, and craft artists create handmade objects.

Hospitality, awareness and training constituted the fifth evaluated policy area. The surveyed respondents were asked to voice their opinions about local organizations, cooperation with other organizations, health education, and customer service standards in retail and tourism (Fig. 7).

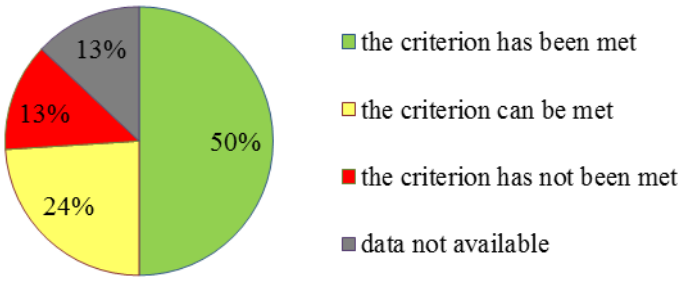


Fig. 7. Score in the **hospitality, awareness and training** policy area

The fifth policy area was difficult to assess due to scant data and the fact that many criteria had to be evaluated subjectively by the author. The local guest house (Stara Szkoła) has high customer service ratings on the Internet. The author (who is not a resident of Żabi Róg) has been served politely and competently in all local shops. Community members organize many local events such as bonfires, New Year's parties, carnival events, family fairs, Saint John's and Saint Andrew's Eve celebrations, Secret Santa gift exchanges, state holiday celebrations and trips to cultural institutions. The village

has two community centres and a library. Żabi Róg collaborates with various organizations, including the Rural Support Foundation, municipal authorities in Morąg and other rural institutions. The local residents would gladly support Cittaslow campaigns; therefore, this criterion is likely to be met in the future. The slow routes criterion has not been met, and the progress made in the area of health education could not be analyzed due to the lack of data.
Social cohesion can be analyzed in various contexts in relation to different age groups, professional groups and social groups.

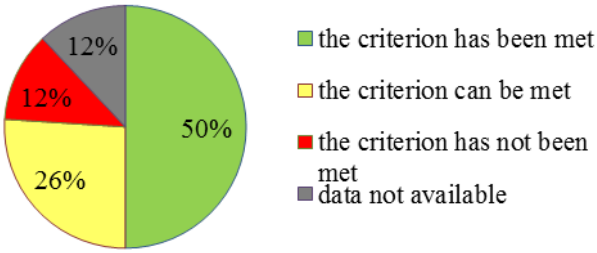


Fig. 8. Score in the social cohesion policy area

A half of the criteria in the social cohesion policy area have been met (Fig. 8). The residents of Żabi Róg frequently stage local initiatives, which significantly contribute to social cohesion. They are eager to join interest groups and bands. The village runs two community centres that are open to both young children (with supervision) and adolescents. The local residents participate in political life, vote in elections, and voter turnout is usually high during village elections. There are no damaged or devastated areas in the village. Several old buildings and the railway station require upgrading. The criteria that can be met in the future include a low percentage of social problems, integration of persons with disabilities, and reduction of poverty. The prevalence of social problems is low in Żabi Róg, and most of them can be remedied through dedicated support programs. Most of the problems are associated with poverty, unemployment, low coping skills and alcohol abuse. The progress in integrating people with disabilities is difficult to assess due to the absence of quantitative data. The only criterion that cannot be met is an improvement in the youth status after graduation.
Żabi Róg should meet at least 50% of the criteria to be eligible for membership in a slow life organization. The analyzed village scored exactly 50% in the evaluation. The following 20% requirements can be met, which is a promising outcome for local development and improvement in the quality of life. Żabi Róg did not meet 20% of criteria, mainly in the areas of infrastructure as well as agriculture, tourism and craftsmanship. Data relating to compliance with 4 criteria (10% of the evaluated elements) were not available.
The survey involved 25 local residents who were asked to express their opinions about the village and potential membership in a slow life organization in an anonymous questionnaire (Table 2).

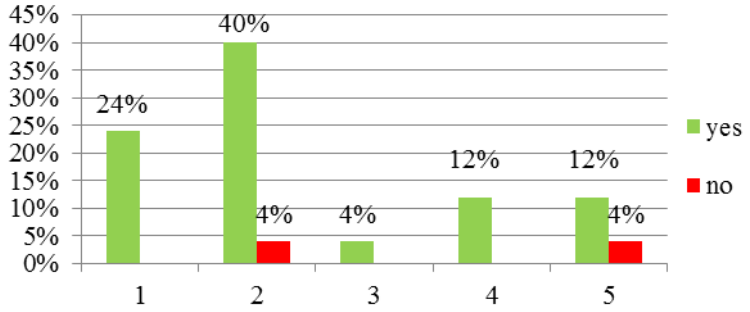
Table 2

Respondents' age and gender

Gender and age	Number of people	Percentage	Number of people	Percentage
Women aged <18 years	0	0%	17	68%
Women aged 18-50 years	6	24%		
Women aged > 50 years	11	44%		
Men aged <18 years	1	4%	8	32%
Men aged 18-50 years	3	12%		
Men aged > 50 years	4	16%		
Total	25	100%	25	100%

At the beginning of the questionnaire, the respondents were asked to state their age and gender. The majority of the surveyed subjects were women (68%) who were more eager to participate in the study than men. Respondents younger than 18 years were least numerous, probably because the questionnaires were handed out during school hours. The above can also be attributed to the fact that

pensioners account for a large proportion of the local population. The questionnaire was developed to elicit opinions about the quality of local life without previous knowledge of the slow life philosophy. In successive parts of the questionnaire, the surveyed subjects were provided with a brief description about the main goals of the slow life movement, and were asked whether Żabi Róg could benefit from membership in such an organization. In the first question (Fig. 9), the respondents were asked whether Żabi Róg was a village with a high quality of life and a culture of good living.



1. Women aged 18-50 years, 2. Women aged >50 years, 3. Men aged < 18 years, 4. Men aged 18-50 years, 5. Men aged >50 years

Fig. 9. Respondents' opinions about the quality of life in Żabi Róg village

Nearly all respondents (92%) were of the opinion that Żabi Róg was a friendly place to live. These answers constitute valuable inputs because the above opinion was expressed by permanent residents of the analyzed village.

The questions addressing the village's compliance with slow life criteria emphasized the importance of local initiatives. The surveyed residents were asked to voice their opinions on community involvement. Only 56% of the surveyed subjects recognized the importance of community involvement. Surprisingly, 24% of the respondents were not aware that their neighbors had been involved in local initiatives. The above could be attributed to the fact that community initiatives in the village attracted regular groups of local activists. However, the respondents were aware that many local initiatives, community integration events, leisure time events and promotional activities were being organized in Żabi Róg. Thirteen respondents were able to identify 1 to 5 initiatives, 11 subjects – 5 to 10 initiatives, and one respondent – more than 10 initiatives.

The question probing the respondents' familiarity with the slow life concept preceded the definition of the slow life philosophy to verify whether the movement was as popular in rural areas as in cities (Table 3).

Table 3

Familiarity with slow life and slow food concepts and the Cittaslow movement

Gender and age	Familiarity with slow life and slow food concepts and the Cittaslow movement	
	Yes	No
Women aged <18 years	0%	0%
Women aged 18 - 50 years	8%	16%
Women aged > 50 years	12%	32%
Men aged <18 years	0%	4%
Men aged 18 - 50 years	4%	8%
Men aged > 50 years	4%	12%
Total	28%	72%

More than 70% of the respondents were not familiar with the slow life philosophy, which indicates that this concept is not popular in rural areas. The majority of the subjects who had heard of the slow life movement were women older than 50 years. Having read the short note describing the main goals of the slow life movement, 84% of the respondents agreed that Żabi Róg could benefit from membership in a slow life organization similar to the Cittaslow Association. Fourteen subjects were of the opinion that Żabi Róg meets the criteria required for membership in a slow life organization.

The remaining 11 respondents were unable to answer this question and concluded that they needed more information about the slow life philosophy.
The respondents' opinions regarding the possible benefits of membership in a slow life organization are presented in Table 4.

Table 4

Benefits of membership in a slow life organization

No.	Benefits of membership in a slow life organization for Żabi Róg	Respondents
1.	Promotional advantages/Enhanced promotion of the member village	21
2.	"Slow" influx of tourists into the village	11
3.	Improved quality of the natural environment	13
4.	Promotion of natural and environmentally-friendly food preparation techniques/Promotion of regional and traditional cuisine	3
5.	Promotion of the village's cultural heritage and local traditions	13
6.	Improving the quality of life in the village	13
7.	Increasing environmental awareness among the inhabitants	8
8.	Promoting the culture of hospitality in the village of Żabi Róg	16
9.	Sustaining a sense of place and local identity	17
10.	There are no benefits of membership	2

The surveyed subjects recognized various benefits of membership in a slow life organization. Twenty-one respondents were in favor of enhanced regional promotion. Surprisingly, 16 respondents were of the opinion that Żabi Róg could benefit from improvements in the culture of hospitality.

Conclusions and Proposals

This study evaluated the quality of life in the village of Żabi Róg based on compliance with the Cittaslow criteria and the opinions expressed by the local residents who participated in a questionnaire survey. The village has both strengths and weaknesses which are presented in Figures 3-9. For the needs of the study, the Cittaslow accreditation procedure has been adapted to the specific features of rural areas, and the results indicate that the Cittaslow movement could be expanded or that a separate slow life organization uniting rural areas could be established. However, the Cittaslow charter would have to be modified to achieve this goal. Villages are weakly populated, and they do not have city rights; therefore, population limits would have to be eliminated from the accreditation process for rural areas. The membership fees for rural areas would have to be considerably lowered or eliminated because the financial aspects of membership could discourage villages from joining the slow life movement. The accreditation procedure could pose a significant burden for village administrators who should be provided with significant support during the process. The village and its administrator should receive professional assistance in the process of filling out application documents. The assistant should reside in the village during the entire classification process. The present study marks the first stage of research which will be continued in other rural areas.

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Information about author

Katarzyna Pietrzyk, University of Warmia and Mazury in Olsztyn, Faculty of Geodesy, Geospatial and Civil Engineering, Department of Real Estate Resources, ul. Prawocheńskiego 15, 10-720 Olsztyn, katarzyna.pietrzyk@uwm.edu.pl

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PROBLEM OF DETERMINING A GEOID

Olga Pisetskaya[1], Alexander Yarmolenko[2]
Belarusian State Agricultural Academy[1], Novgorod State University named after Yaroslav the Wise/ Belarusian State Agricultural Academy[2]

Abstract
The issue of the study of the problem of determining the geoid and quasi-geoid models is considered. Development of methods for constructing an exact geoid model using different dimensions.
Analysis of the calculation of normal heights using satellite measurements, construction of geoid and quasi-geoid models by different methods is performed.
Based on the results of the analytical review of existing methods for determining the geoid, it was proposed to use various data (geodetic heights, mixed gravity anomalies, anomalous potential) to construct this model, which allows building a model of a geoid with millimetre accuracy. The possibility of using the collocation method is considered.
The task is to develop a methodology for constructing a geoid model using a network of low density gravity points and using pure and mixed gravity anomalies, which allows us to solve the problem of finding potential by solving the Laplace equation or using wavelets.
Key words: geoid, anomalies of heights, local quasi-geoid, gravimetric network, collocation method.

Introduction

The purpose of this article is to analyze the state of the study of the problem of determining the models of a geoid and quasi-geoid on a local territory and to identify the direction of construction of an adequately accurate model.
Main article objects are as follows:
1. To study the possibilities and features of calculating the normal heights according to the results of satellite measurements.
2. To analyze the construction of geoid and quasi-geoid models using different methods.
3. To set specific tasks to solve the problem of determining a geoid by using available measurements on the earth's surface.

Methodology of research and materials

In practice, various methods of constructing geoid models are encountered: astronomical and geodesic, gravimetric; joint use of GNSS measurements and leveling networks; joint use of gravimetry and satellite altimetry; satellite gradiometry (Gofman-Vellengof, 2007).
The possibility of using one or another method depends on the availability of input data, in which all available accurate geodetic measurements can be taken. Special attention is paid to the results of satellite leveling.

Discussions of results

The heights obtained from the materials of geometric leveling refer to the system of normal heights. The result of satellite measurements are geodetic heights. Using the results of satellite leveling, the normal height is determined as the difference between the geodetic height and the height of the quasi-geoid (Lazarev, Samochkin, 1980).
In (Kravchuk, 2010), a technique for calculating normal altitudes by interpolation method with reference points with known differences of geodetic and normal heights according to the results of satellite measurements without gravimetric surveys is considered.
But when moving from the general earth coordinate system to a national reference coordinate system, the problem of converting them to combined points arises. In geodetic networks there are distortions in their position caused by various causes, in addition to random errors of the points. Therefore, the calculated transformation parameters will also be burdened with such errors. In addition, it is

necessary to take into account the error in the radius of curvature of the first vertical, which will be present in the calculated normal heights (Kravchuk, 2010).

The possibility of determining a quasi-geoid on the territory of Vietnam is being investigated in (Neiman, Fam Hoang Lan, 2010). The results of calculating the orthometric height (H_p) based on the geopotential number (C_p).

$$H_P = \frac{C_P}{\bar{g}}, \tag{1}$$

where $\bar{g}$ denotes the average value of the modulus of gravity, obtained from geometric leveling and gravimetric measurements.

$$\bar{g} = \frac{1}{H_P} \int_L^{(P)} g dH, \tag{2}$$

where L denotes the point of intersection of the curvilinear vector line of the real gravity potential with the geoid surface,

P denotes a point on the earth's surface.

In this article, it is noted that the position of the vector line of a real geopotential and the value of the gravity on it can be indicated approximately, which leads to approximations of the orthometric heights, and precise calculations can be made only in the framework of a certain model of the geopotential (the normal potential U), observing a number of conditions:

1) the modulus of real gravity g is replaced by the modulus of normal gravity γ;

2) the point of intersection of the vector line of the normal potential with the surface of the ellipsoid is taken as the starting point;

3) the end point is selected on the same vector line so that the geopotential number remains unchanged.

Thus, in this work there is also no strict solution to the problem of heights due to the impossibility of the strict determination of $\bar{g}$.

These conditions lead to the conclusion that in order to calculate the height anomaly, it is necessary to know the normal field and the perturbing potential, as well as the potential value on the surface that is assumed to be the geoid. In this case, it is necessary that the initial data for modeling with sufficient density uniformly cover the entire Earth. If we use anomalies of heights computed from gravimetric data, we get a global quasi-geoid corresponding to the general earth ellipsoid and the level surface that best approximates the averaged topographic sea surface.

The normal height H_P^γ can be obtained from the following formula:

$$h_P = H_P^\gamma + \zeta_P, \tag{3}$$

where h_p denotes the geodetic height determined by GPS/GLONASS,

ζ_P denotes gravimetric anomaly of height.

The set of points obtained by this method determines a single system of heights and is its carrier. At the same time, the leveling networks are a high-precision means of propagation of the system of normal heights relative to the whole set of points. Here, the scale factor of the heights is deformed and the displacement of the resulting local quasi-geoid relative to the corresponding global surface by a certain amount (Neiman, Fam Hoang Lan, 2010). It is noted that it is necessary to amend the geodetic heights determined relative to the reference ellipsoid, which differs from the general earth's when using this method.

The results given in (Neiman , Fam Hoang Lan, 2010) are verified under the condition of a certain correspondence between the anomalies of geometric and gravimetric altitudes, which clarifies the reference altitude surface. This correction (calibration) leads to changes in gravity anomalies, and, as

a consequence, to changes in elevation anomalies. It should be noted that the territory of Vietnam was divided into 30 regions and each covariance model was used for each region. To determine the gravimetric anomalies, the ground values of gravity anomalies in free air were used. It is indicated that the development of gravimetry and leveling is necessary to determine a local quasi-geoid.

Work (Vu Hong Kuong, 2013) reflects the results of calculations and their accuracy characteristics with the conclusion about the expediency of using the gravitational model of EGM2008 to introduce clarity into the quasi-geoid in the study area. It should be noted that for the construction of a model of gravity anomalies in Vietnam, the results of long-term ground-based measurements of gravity on land were used (Vu Hong Kuong, 2013), in addition to the use of satellite altimetry data. The average quadratic deviation of the definition of the height of the geoid of this model was approximately 0.4 m, which indicates the need for further research on the construction of models of the Earth's gravitational field for the territory of Vietnam. The task is to create an algorithm for calculating the pure gravity anomalies (Δg) and altitude anomalies (ζ) for the study area, which will allow us to refine the model using ground and satellite measurements, as well as calculate anomalies of heights and gravity at any point by using method of interpolation (Vu Hong Kuong, 2013).

In (Ha Min Hoa, 2015), the problems of equalizing the state high-rise networks of I and II classes for obtaining a geoid model by converting the measured excesses in the difference of geopotential values (dC_{ij}) in the normal gravitational field of the ellipsoid are considered:

$$dC_{ij} = \left[\bar{\gamma}_{ij} - 0.1543 \cdot 10^{-6} \bar{H}_{ij} + \left(g - \gamma\right)_{ij} \right] h_{ij}, \tag{4}$$

where $\bar{\gamma}_{ij}$ denotes the average value of the acceleration of normal gravity between *i* and *j* marks,

$\bar{H}_{ij}$ denotes the average normal height,

$\left(g - \gamma\right)_{ij}$ denotes the average value of the anomalies of gravity between *i* and *j* marks,

h_{ij} denotes the measured excess between *i* and j marks in the real gravitational field of the Earth (Ha Min Hoa, 2015).

But the measured excess is in the middle tidal system, but it should correspond to the zero tidal system, which requires the δdC_{ij} amendment to the difference of the geopotential values *of* dC_{ij}:

$$\delta dC_{ij} = -0.28841\left(\sin^2 B_j - \sin^2 B_i\right) - 0.00195\left(\sin^4 B_j - \sin^4 B_i\right), \tag{5}$$

where B_i, B_j denotes geodesic latitudes of *i* and *j* marks.

In this article, it is noted that when using a geoid, it is possible to increase the accuracy of a local quasi-geoid, the gravitational field of the Earth on a local territory, which will improve the state high-altitude system of the local territory (Ha Min Hoa, 2015).

Construction of a geoid model using satellite observations at the points of leveling and gravimetric networks with the known orthometric heights obtained from leveling in the materials of the article for building a geoid model on the territory of the Republic of Benin (Gosmin M. Iessuru, 2015) is considered. It is indicated that in the territory of the Republic of Benin the heights of a geoid were obtained at certain chaotically located points of the leveling network. They were required to restore the surface of the geoid to the entire territory of the country. The accuracy of such a geoid will depend on the degree of coincidence of the field of application of the mathematical dependence used and the location of the control points, the properties of the mathematical dependence, the location of the reference points, and the accuracy of the initial data (Gosmin M. Iessuru, 2015).

The solution of the problem was carried out by the method of spline approximation of a function of two variables using splines with a differential quality functional. The advantage of this method lies in sufficiently accurate results with a low density of reference points, with the exception of sharp peaks

or dips in the restored function. The solution involved the leveling and gravimetric points (Gosmin M. Iessuru, 2015).
On the territory of the Republic of Belarus, the methodology for creating a local model of quasi-geoid heights using a geometric method based on global gravity models of the Earth with the use of satellite observations is investigated. The technique was tested on the territory of Minsk and its environs without using gravimetric data (Larionov, Rudnickaya, 2016).
In this case, the essence of the geometric method consisted in the optimal combination of dissimilar heights in order to perform the detailed elaboration and correction of the global model of quasi-geoid heights by the mean-square collocation method. The main task of collocation is the prediction of a continuous surface using discrete observations. The mathematical model used by the function represented by the equation:

$$l = Ax + t + n\ , \tag{6}$$

where l denotes is the vector of measurements,
Ax denotes parametric model,
t denotes signal vector at measurement points,
n denotes noise vector at the measurement points.
The algorithm of computations is implemented in the materials of the article (Larionov, Rudnickaya, 2016).
The results of the studies indicated that the calculated deviations of normal heights using this model give more accurate results relative to the same data obtained by the results of calculations using the model of EGM2008. It was experimentally established that the creation of elevation models quasi-geoid on the territory of the Republic of Belarus with an accuracy corresponding to modern requirements requires a sufficiently dense network of points with known geodetic and normal heights that is impractical to perform and for the possibility of using this model it is necessary to develop a gravimetric network on the territory of the Republic (Larionov, Rudnickaya, 2016).
But there are other possible solutions of the problem for determining a geoid.
1-st task. For the simplicity of the theory of analysis, it is necessary to represent the potential not only in the form of spherical functions or their analogs (substitutes): spherical functions; basic functions of various kinds (radial, spline functions, etc. (Neiman , Sugaipova, 2016); polynomials, etc., but also in the matrix form. Assuming that the observation of gravity anomalies is performed in a discrete space, that is, if the coefficients of the expansion of the potential or another potential function in terms of spherical (spherical) functions in the form of the vector *a* and the observation vector *g* are given, then we can write that

$$a = W \times g\ , \tag{7}$$

where W denotes the matrix of the transformation of the vector *g* into the vector *a*.
There must be a reverse transition

$$g = F \times a\ , \tag{8}$$

where F denotes the inverse of W.
For example, if *g* is the anomaly of gravity, then *a* are the coefficients of the expansion of T anomalous potential according to the above-mentioned anomalies:

$$T = a_1 \times g_1 + a_2 \times g_2 + ... + a_n \times g_n\ . \tag{9}$$

At the same time, it is necessary to perform the estimation of the accuracy of the potential presented in this way.

2-nd task. When studying the gravitational field of the Earth, there are performed the determinations of such quantities as:
- mixed anomalies;
- pure anomalies;
- differences in normal and geodetic heights;
- derivatives of gravity anomalies: components of deviations of plumb lines;
- second derivatives of the potential.

Then, having a common algorithm (7)-(9), one can express any potential function in a convenient form. A special case of such a problem is the presence of a set of points, on the part of which Δg pure gravity anomalies are measured, and on the other part – mixed anomalies (fig. 1).

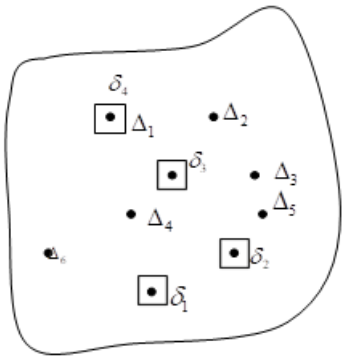

Fig. 1. Points with dimensions

As a result, on the given N_Δ set for points the boundary condition will be correct

$$\frac{\partial T}{\partial h} = \Delta g \,, \tag{10}$$

and for the points N_δ the boundary condition will be

$$\frac{\partial T}{\partial h} + \frac{2T}{R} = \delta g \,, \tag{11}$$

where N_Δ denotes number of points at which pure anomalies are measured,
N_δ denotes number of points at which mixed anomalies are measured.
For the whole set of points

$$N = N_\Delta + N_\delta \tag{12}$$

it is necessary to solve the Laplace equation

$$\nabla T = 0 \,, \tag{13}$$

where

$$\nabla T = \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} + \frac{\partial^2 T}{\partial z^2} = 0 \cdot \tag{14}$$

In a particular case, when the corresponding measurements are made at the same point (for example, δ_4 and Δ_1, Fig.1), after substitution (10) in (11) we get

$$\Delta g + \frac{2T}{R} = \delta g \,, \tag{15}$$

or

$$\frac{2T}{R} = \delta g - \Delta g \,. \tag{16}$$

Since the mixed anomaly is

$$\delta g = g_M - \gamma_P \,, \tag{17}$$

and when measuring g_M at the point M, the value of γ_P is calculated at the point of P,

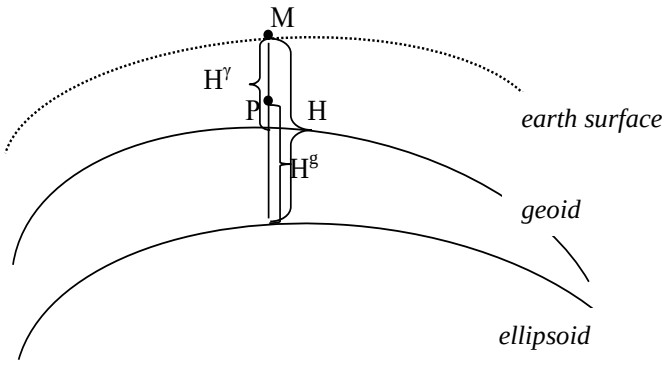

Fig. 2. Surfaces of relevance

and

$$\Delta g = g_M - \gamma_M \,, \tag{18}$$

then, after substituting (17), (18), in (16), we have

$$\frac{\partial T}{\partial h} = \left(g_M - \gamma_P\right) - \left(g_M - \gamma_M\right), \tag{19}$$

and then

$$\frac{\partial T}{\partial h} = -\gamma_P + \gamma_M \,. \tag{20}$$

Then the problem of finding the potential leads to solving the Laplace equation with the boundary condition (20).

3-rd task. The task, partially solved by Russian scientists Neiman Yu. M. and Sugaipova L. S. (Neiman, Sugaipova, 2016).
The essence of the problem lies in the fact that it is possible to represent the potential (or its derivatives) not only in the form of ball (spherical) functions, but also by a combination of functions, for example, up to a certain harmonic, the expansion of the potential is carried out according to spherical functions, and after it to harmonics of an arbitrary degree – the expansion can be performed by radial basis functions, or even wavelets.
In our opinion since the combined representation of the potential is a complication of the theory, it should be constructed on the basis of the matrix approach (7) - (9).
In this case, you need to solve the following subtasks:

1) To develop an algorithm for solving this problem;
2) To estimate the accuracy of the solution; to determine the conditions under which the accuracy of such a solution will be no lower than the standard approach for spherical functions.

The advantages of such a combined approach are proved by scientists Neiman Yu. M. and Sugaipova L. S. by the so-called frequency localization, which is clearly inherent in wavelets. For example, if we consider Table 1, the largest frequency of the wavelet expansion is inherent in the third stage of the W_3 wavelet transformation.

Table 1

The wavelet decomposition

№	measurements	W_0	W_1	W_2	W_3
1	4	4.7	-0.5	-1.2	+1.0
2	2	4.7	-0.5	-1.2	-1.0
3	5	4.7	-0.5	+0.8	-0.5
4	6	4.7	-0.5	+0.8	+0.5
5	7	4.7	+0.5	+0.3	+1.5
6	4	4.7	+0.5	+0.3	-1.5
7	1	4.7	+0.5	-0.2	-4.0
8	9	4.7	+0.5	-0.2	+4.0

But this example shows that the disadvantage of the wavelet expansion is the discrepancy between frequency localization and amplitude. Thus, in the third stage of the wavelet expansion in this example, the highest amplitudes (4 – according to module) of the wavelet expansion correspond to the highest frequencies. And if we remove the component of the expansion with the highest frequencies, then the largest amplitudes are also removed, which leads to a gross distortion of the original signal.

However, in Fourier series, which are actually the basis of spherical (or ball) functions, one can in principle find synchronization of the localization both in frequency and in amplitude. In Fourier series, high frequencies correspond to low amplitudes. Accordingly, the high-frequency components can be removed without a significant change in the original signal (column "Measurements").

In Fourier series, high frequencies coincide with low amplitudes. Therefore, spherical functions are convenient in application, because high degrees of expansion can be discarded, knowing that low amplitudes correspond to them, which cannot be done in wavelets.

Thereby it is necessary to solve the following subtasks:

1. The detailed development of algorithms for combined representation of a potential function based on the approach (7) - (9);
2. The search for the possibility of applying these algorithms in practice with obtaining final results of a given accuracy.

Conclusions and proposals

1. In the dissertation (Piseckaya, 2007) it is proved that at a density of pure anomalies of gravity one point per 10 square kilometers one can determine the height of a global geoid (quasi-geoid) over an ellipsoid with an accuracy of 3 mm. But such density is necessary for the mentioned anomalies throughout the Earth, which is by now unattainable. But subject to the availability of data of geometric leveling, geodetic heights, and other precise geodetic measurements (mixed anomalies of gravity, anomalous potential, etc.) in the local territory, it is possible to determine the heights of the geoid over the ellipsoid with a given millimetric accuracy.
2. It is also necessary to generalize the problem of interpolating geoid heights over an ellipsoid using the model of EGM2008 through applying the collocation method, taking into account that inhomogeneous data are known in a limited area. For example, the anomalies of heights ζ are known in the series of the points, and the deviation of the plumb line ξ, η, the gravity anomalies, the excess between the points (at normal, geodetic heights), and the anomalous potential are known for the remaining part.

3. It should be noted that the construction of a local system of heights using the collocation method is carried out by approximating linear equations, but it is possible to use polynomials (Abakushina, 2016). This operation - adaptation of EGM2008 model to the local area, called calibration, is performed on the difference between the measured and calculated heights, but it is possible to use it based on other data given at the beginning of this paragraph.
4. Due to the lack of initial data (in this case gravimetric), the use of approximating functions (spherical, ball) on a global scale can lead to distortion of results (smoothing). Therefore, according to the suggestion of Professor Yu. M. Neumann, it is necessary to develop such a technique for constructing an accurate geoid, in which gravimetric measurements made with a low density of points would not have a negative effect on the results obtained using measurements made in areas with high density of gravimetric points. In this case, other approximating functions other than spherical and ball functions may be used.

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Information about the authors

Olga Pisetskaya, PhD, Dean of the Faculty of Land Management, Belarusian State Agricultural Academy, Republic of Belarus, Leninsky Boulevard, 4, Gorki, Mogilev region, +375-22-33-79644, e-mail: piseckaja@tut.by. Geodesy

Alexander Yarmolenko, Doctor of Technical Sciences, Professor, Novgorod State University named after Yaroslav the Wise/ Belarusian State Agricultural Academy, Republic of Belarus, Leninsky Boulevard, 4, Gorki, Mogilev region, 8- 911-611-47-62, e-mail: yarmolenko_alex@mail.ru . Geodesy

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ENVIRONMENTAL POLICY AND LAND MANAGEMENT IN RURAL AREAS OF UKRAINE

Nataliia Stoiko, Nadiia Kryshenyk, Olha Soltys, Oksana Cherechon
Lviv National Agrarian University

Abstract
The research studies the issue of ecological stability of rural territories that is the most important component of the national environmental policy of Ukraine. A special attention is paid to degradation of arable lands as the main ecological problem of land management. On the example of Lviv region, the authors calculated the index of ecological nonconformity of current use of arable lands, proving a considerable excess of permissible ploughing of lands in the region. The carried analysis confirms that no measures were performed concerning land protection, including conservation that in the recent years. In this context it is necessary to improve land resources management on the basis of sustainable development. Integration is considered to be the main principle of land resources management. The research proves that solution of ecological problems of land management requires achievement of a set of coordinated targets concerning development of rural territories, land resources management and national environmental policy based on the principles of suitable development. The targets include: planning of land use outside settled areas on the landscape and ecological basis; land inventory; formation of the land bank of agricultural lands; development and support of alternative kinds of activity on rural area; development of an efficient mechanism to encourage performance of land protection measures; improvement of environmental responsibility of population and development of ecological education.
The methodological basis of the research is the concept of sustainable development, which expects support for a continuous character of development in order to meet the current needs along with ensuring the needs of future generations. The fulfilment of the task requires examination of scientific works on the issue of sustainable management of land resources and an ecological component of rural territory development.
Key words: degraded and unproductive arable land, rural development, land protection, sustainable land management.

Introduction

Important components of the state regional policy of Ukraine include development of rural territories and establishment of an efficient system of environmental protection. The two targets are substantially connected, because an area of agricultural lands occupies 70.8 % (among the total of agricultural lands, arable lands take 78.4 %) in the structure of land fund of Ukraine. It makes a considerable impact on ecological conditions of the environment within the rural territories, i.e. the territories outside the towns. Rural territories in addition to agricultural lands include water bodies, swamps, forests, shrubs, constituting together 90% of the land fund of the country (Rozvytok silskyh terytorii …, 2011).

National environmental policy of Ukraine is focused on stabilization and improvement of the environment by integration of that policy into social and economic development and introduction of an ecologically balanced system of land management (Pro Osnovni zasady …, 2010). On the way, the important stage is to make space planning of the territory development, which expects the measures focused on formation of stable communities by means of physical organization of space according to the general strategy of the region development with maximum consideration of natural potential of the territories (Parsova V., Stoiko N., Kryshenyk N., 2018).

For this reason it is needed to regulate the relations in the field of nature management through the Integrated neutral resource management (INRM) secured by the state, self-government and public institutions, which perform organizational and managerial, coordinative, advisory, controlling and other functions in the direction of efficient employment and protection of natural resources (Meine van Noordwijk, 2017; Lovell C., Mandondo A., Moriarty P., 2002). Such management is carried out both at the regional level and at the level of separate communities.

On the rural territory of Ukraine, land is the principal natural resource of economic and social value. Since 1992 it has become the object of property right. Consequently, denationalization of agricultural

lands and parcelling of collective farms has caused the situation when agricultural lands are divided into more than 10 million land parcels, transferred to private ownership. The state has introduced economic mechanisms of land relations regulation by payment for land, land assessment and economic responsibility during land use or for violation of land laws. Nowadays one can observe establishment of land market and circulation of agricultural lands (Natsionalna dopovid …, 2015).

However, such social and legal changes in Ukraine have still little influence on development of well-being, firstly, of rural population. Moreover, one sees a permanent tendency of deterioration of ecological conditions of land resources. According to the data of the Food and Agriculture Organization of the United Nations (FAO), degraded and unproductive arable lands take above 20 % of the total area on Ukraine. Depending on the degradation degree, 300-600 million tons of soil are lost annually due to soil erosion. It causes fall of yields of agricultural crops, but losses due to products deficiency account for 20 billion UAH (approximately 759 million USD) annually (FAO kicks off project…, 2018).

For Ukraine, it is important to stop land degradation, improve stability of ecosystems and reduce anthropogenic load on the environment in the regions. Thus, the strategic goals of the national environmental policy include reduction of the area of arable lands, consideration of environmental requirements in land use, introduction of the system of management of agro-landscapes by means of forest-melioration methods on the basis of sustainable development (Pro Osnovni zasady …, 2010).

Minimization of land degradation, reclamation of degraded land, support for sustainable employment of land resources can be secured by implementation of Sustainable Land Management (SLM). Sustainable Land Management is considered as "the use of land resources (including soils, water, animals and plants) for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions" (Sustainable Land Management…, 2017).

Such use of land meets the changing human needs (agriculture, forestry, conservation) and ensures long-term socioeconomic and ecological functions of the land (Dumanski, J., Gameda, S., Pieri C., 1998). It is a system of technologies and/or planning, which aims to integrate ecological principles with socio-economic and political ones in the management of land for agricultural and other purposes in order to achieve intra- and intergenerational equity' (Dumanski J., 1994).

The aim of the article is to demonstrate how the national environmental policy and land resources management can support sustainable development of land management in rural territories of Ukraine. To reach the goal, the following tasks were performed: the analysis of ecological conditions of arable lands and their protection on the example of Lviv region; the description of the main principles of land resources management on the basis of sustainable development. Consequently, a set of strategic targets is proposed for improvement of ecological stability of land management in rural territories.

Methodology of research and materials

The methodological basis of the research is the concept of sustainable development, integrating three components, particularly economic, social, ecological. The work considers one of the principles of the concept of sustainable development, i.e., to ensure a sustainable and long-term character of development to meet the needs of the present generation, while simultaneously securing the possibility of the future generation to satisfy their needs (Jonathan M. Harris, 2000; Sustainable use …, 2005). The stress is put on greening of land management by combination of the tasks of sustainable land resources management, environmental policy and development of rural territories.

The abstract and logical method, theories and hypotheses about sustainable development and greening of land use have been used to solve the issues of improvement of ecological stability of rural territories, to develop conclusions and give recommendations on their basis. The monographic method was applied for the analysis of negative ecological phenomena in agricultural land use. The method helped to analyze current conditions of arable land use and to specify potentially dangerous factors of land degradation, as well as to apply the obtained results while developing recommendations for improvement of ecological stability of land use in rural area. The graphic method was used for visual presentation of the data which constitute the studied statistical aggregate, and for depiction of their linear dependence.

Ecological aspects of land management on rural territories were investigated on the examples of Lviv region located in the west of Ukraine. It occupies 3.6 % of the territory (2183.2 thousand ha). In the structure of its lands the largest share is taken by agricultural lands, i.e., 58 % of the territory, forests – 32 %, built-up lands – 5 %. The index of the territory reservation accounts for 7.2 %. In spite of the fact that anthropogenic load on land resources is less in Lviv region than generally in Ukraine (ploughing of land in the region constitutes 32 %, while in Ukraine the average figure is 54 %), the processes of land degradation still occur in the region. The common kinds of degradation of arable lands include erosion (24.3 % of the total area) and blowout (18.1 % of the total area). In the territory of the region there are also 12,040.61 ha of deteriorated lands, 8,273.68 ha of low-productive lands, 736.5 ha of industrially polluted lands, 2,236.30 ha ravines[1].

Anthropogenic load on landscapes causes a reduction of biodiversity and deterioration of ecological balance (Matson P.A. et al., 1997). Arable lands are the most ecologically sensitive among all agricultural lands. For optimization of land management it is reasonable to determine the index of ecological nonconformity of current use of arable land (I_{in}) and excess of permissible ploughing (E) (Kanash O., 2013). The authors of the article performed calculations on the example of Lviv region (Table 1) according to the following formulas:

$$I_{in} = T_a / A \quad (1)$$

$$E = (I_{in} - 1) \cdot 100 \quad (2)$$

Where T_a – is the total (recorded) area of arable lands, ha; A – is the area of lands, available for arable farming, ha, calculated by the formula:

$$A = T_a - (D + S_d) \quad (3)$$

Where D – is the area of degraded and low-productive arable lands, ha; S_d – is the area of soil, which can be easily subjected to degradation under intensive employment, ha (arable land parcels with medium-washed soils on > 3° slopes).

On an average in Ukraine, the index of ecological nonconformity of current use of arable lands constitutes 1.17 (Dobriak D.., Kuzin N., 2016). Comparison of the indicator with Lviv region proves that excess of permissible ploughing in the region is by 36% more than the average in Ukraine. The higher the index of ecological nonconformity of current use of arable land (I_{in}) is, the more the excess of permissible ploughing (E) is. In Peremyshliany district the indicators are the highest and constitute 3.2 and 221.2, while in Stryi district, they are the lowest, i.e., 1.1 and 9.4 respectively.

Excess of permissible ploughing in Lviv region is described by a linear dependence $y = 1.3219x + 47.124$ (Fig. 1). The study of the dependence of excess of permissible ploughing (E) on the index of ecological nonconformity of current use of arable lands (I_{in}) confirms that the structure of arable lands includes a considerable area of degraded lands, which have lost their model properties due to excessive anthropogenic load (eroded, secondary salted and alkali, waterlogged or dried), or low-productive lands, which have been employed in agricultural production under conditions of extensive arable farming, regardless their poor fertility (too light or heavy soils by their granular content, skeleton, salted and alkali, waterlogged and overwatered).

Thus, in Lviv region, excess of land ploughing constitutes 53.5 %. It grounds the need to introduce the measures concerning protection of arable lands. The authors of the article consider that in that case it is important to perform the measures of land conservation as well as phyto- and forest- melioration. However, the analysis of implementation of the regional program of use and protection of lands in Lviv region argues that since 2012 measures of land conservation have not been performed[2]. It is a

[1] According to data of the Main Department of State Office of Ukraine on the issue of geodesy, cartography and cadastre in Lviv region as of 01/01/2017

[2] According to data of the Main Department of State Office of Ukraine on the issue of geodesy, cartography and cadastre in Lviv region as of 01/01/2012

negative practice because conservation is an important measure of environmental protection (Spencer R. Meyera et al., 2014).

Discussions and results

In 2014 Ukraine initiated the process of power decentralization and establishment of amalgamated territorial communities. Thus, the issue of land protection is of an urgent importance because efficient development of the territories is possible under conditions of comprehensive employment of land resources. The authors of the article consider that interruption of soil degradation and performance of the measures concerning land protection require improvement of the system of land resources management on the basis of sustainable development and integration of the system into social and economic development of the communities. Inter alia, land resources management should be based on the following principles:

- integration (to combine social and economic tasks with ecological problems of the territories at the state, regional and local levels);
- subsidiarity (land resources management should be "bottom-up" organized, i. e., all problems, which can be efficiently solved at the local level, should stay within the competence of municipal authorities);
- inter-sector character (to consider the needs of all sectors of activity, e.g., agriculture, recreation, environmental activity, etc.);
- generation approach (to employ land resources by the present generation, considering the needs of future generations); inter-generation approach (to consider the needs for land resources by different social groups);
- publicity (to secure a free access to the information about land resources conditions).

Table 1

Calculation of the index of ecological nonconformity of current use of arable lands within the boundaries of Lviv region [3]

Administrative district	**Total area of arable lands, ha (T_a)**	**Area of degraded and low-productive arable lands, ha (D)**	**Area of the soils, which can be easily subjects to degradation under intensive employment, ha (S_d)**	**Area of lands, available for arable farming, ha (A)**	**Index of ecological nonconformity of current use of arable lands (Iin)**	**Excess of permissible ploughing of lands, % (E)**
Brody	42,381.2	5,563	10,525	26,293.2	1.61	61.2
Busk	36,008.5	2,381	4,477	29,150.5	1.24	23.5
Horodok	36,871.1	242	11,511	25,118.1	1.47	46.8
Drohobych	3,722.6	291	12,054	24,876,6	1.50	49.6
Zhydachiv	44,187.1	1,281	11,854	31,052.1	1.42	42.3
Zhovkva	56,490.4	1,740	17,531	37,219.4	1.52	51.8
Zolochiv	46,170.4	2,296	10,156	33,718.4	1.37	36.9
Kamianka-Buzka	40,090.1	971	4,864	34,255.1	1.17	17.0
Mykolaiiv	22,518.5	2,187	3,936	16,395.5	1.37	37.3
Mostyska	45,038.6	3,169	19,571	22,298.6	2.02	102.0

[3] According to data of the Main Department of State Office of Ukraine on the issue of geodesy, cartography and cadaster in Lviv region as of 01/01/2012

Administrative district	Total area of arable lands, ha (T_a)	Area of degraded and low-productive arable lands, ha (D)	Area of the soils, which can be easily subjects to degradation under intensive employment, ha (S_d)	Area of lands, available for arable farming, ha (A)	Index of ecological nonconformity of current use of arable lands (Iin)	Excess of permissible ploughing of lands, % (E)
Peremyshliany	37,865.1	1,354	24,723	11,788.1	3.21	221.2
Pustomyty	47,705.7	724	14,813	32,168.7	1.48	48.3
Radekhiv	49,464.8	11,555	8,513	29,396.8	1.68	68.3
Sambir	44,593.5	14	12,619	31,960.5	1.40	39.5
Skole	12,891.8	86	4,341	8,464.8	1.52	52.3
Sokal	63,668.7	6,004	20,916	36,748.7	1.73	73.3
Staryi Sambir	38,338.1	2,445	16,684	19,209.1	2.00	99.6
Stryi	31,761.5		2,717	29,044.5	1.09	9.4
Turka	21,635.8	334	10,346	10,955.8	1.97	97.5
Yavoriv	35,790.8	469	10,172	25,149.8	1.42	42.3
Total in the region	**790,693.3**	**43,106**	**232,323**	**515,264.3**	**1.53**	**53.5**

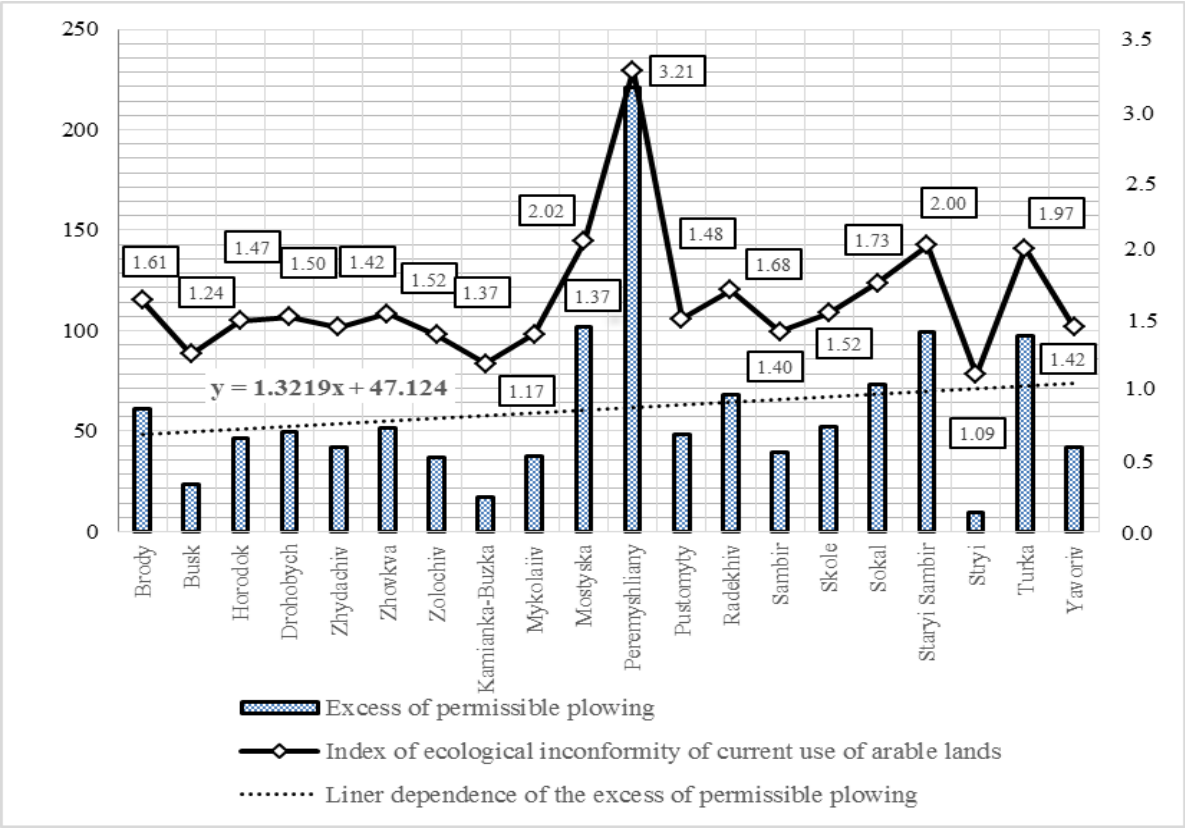

Fig. 1. Liner dependence of the excess of permissible ploughing on the index of ecological nonconformity of current use of arable lands (developed by the authors).

The system of land resources management should secure the decisions which would be beneficial for: land-owners and land-holders (profit from land use); local self-government (a land tax); the state generally (food and ecological safety). In its turn, all subjects of land relations should focus their efforts to support sustainable land management. However, an important position is occupied by a combination of managerial functions in the field of land relations with the tasks of development of territorial communities and national environmental policy (Fig. 2).

It is proposed to make planning of land use outside settled areas on landscape and ecological basis, i.e., landscape and ecological zoning of lands, to improve ecological stability of rural territories in Ukraine. Such zoning will help to define types of land use according to ecological and economic suitability for different kinds of land use. Each type of land use is characterized by territorial restrictions in land use according to the standards and norms in the field of land protection, as well as technological parameters of soil-protective arable farming. Such a step will determine the land areas, which require land protection measures, particularly phyto- and forest-melioration, including withdrawal for permanent conservation.

A considerable share of degraded lands is in private property in the forms of land parcels (shares). It makes the process of extraction of such lands more complicated and requires introduction of an efficient mechanism of performance of land protection measures.

Concerning the fact that in Ukraine a considerable share of land fund is employed in agricultural use, demonstrating incorrect land management that is the principal reason of land degradation, particularly soil erosion, it is important to motivate land-owners and land-holders to make conservation of the agricultural lands using the principles of good will and stimulation. Referring to the foreign experience (Stoiko N., 2014), conservation easement, i.e., agro-protective agreement between landowners and the state or local authorities, is an efficient instrument in the direction. Conservation easement expects restriction of some kinds of land use or suspension of any activity on the land for an indefinite period (mainly a long-term one) or forever only on the basis of a good will. Land can be transferred for protection free of charge, as well as can be sold by a landowner with a determined compensation. Such easements help owners to keep the right of private property, to live on their own land, to carry environmentally safe use of their own land and get tax privileges.

For Ukraine it is important to introduce the methods of indirect economic stimulations for business entities concerning implementation of the measures of land protection as well as their conservation. Such methods can include granting of payment for the land parcels, which are at the stage of revival or intended for phyto- or forest belts, granting of payment for the land parcels, which are under temporary conservation; tax privileges for the land parcels under permanent or long-term conservation, tax privileges by means of accelerated depreciation. Those methods do not need considerable funds from the state or local budgets.

Local authorities should initiate land inventory for obtaining of reliable information about quantity and quality conditions of lands, as well as for control of land use and protection. The land inventory will make a basis for the register of unproductive lands and development of the measures concerning their perspective employment (growing of energy crops, re-naturalization of lands, etc.). It is also necessary to develop an economic mechanism in order to stimulate performance of land protection measures, for example, the tax breaks for farmers, who keep to the requirements concerning land protection, who run organic arable farming or develop animal breeding. A substantial attention should be paid both by local authorities and by the state to development and support for alternative kinds of activity on rural territory (rural tourism, ecological tourism, fishing, hunting and others).

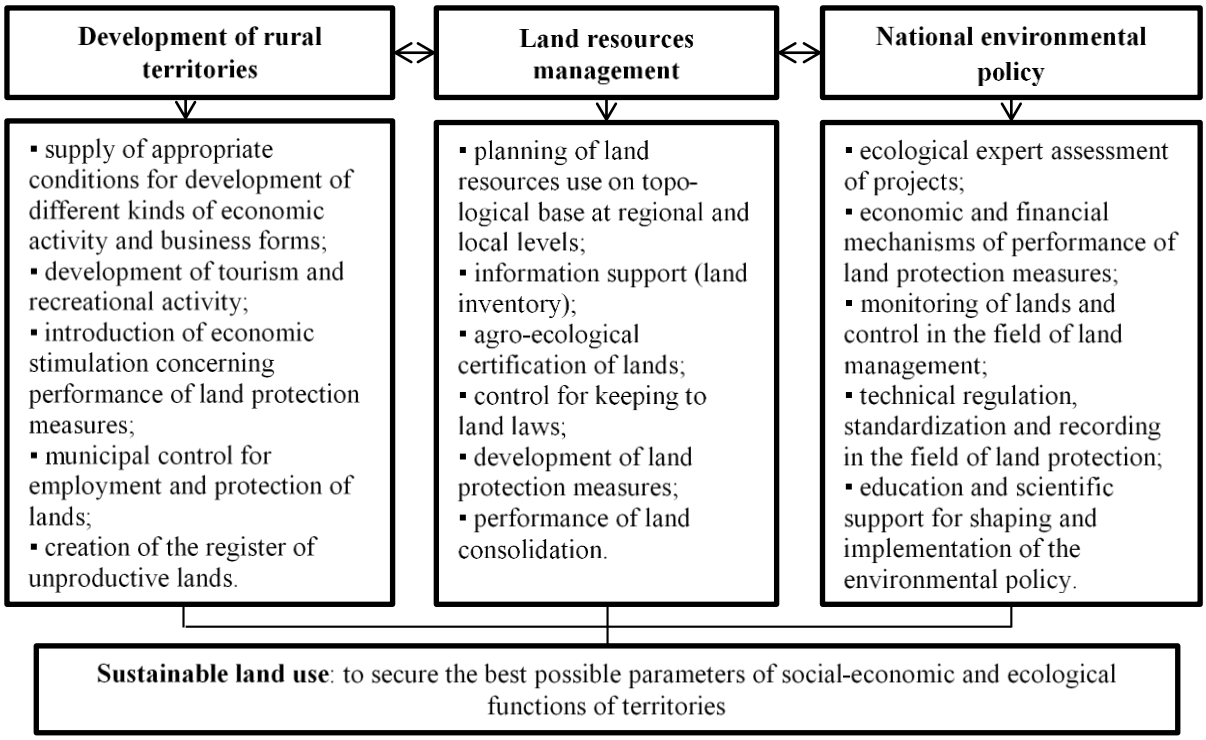

Fig. 2. Strategic goals concerning improvement of ecological stability of land use on rural territories (developed by the authors).

The national environmental policy should be focused on organization, regulation and control of activity of the society and the state for an efficient combination of the functions of land use and protection to secure appropriate living environment for the current and future generations. The main targets of environmental policy in the field of land use should include: control for keeping to the standards and rules of rational use and protection of lands (while a law-breaker pays a fine and compensates the harm committed to land resources and environment); introduction of an efficient mechanism to encourage and support performance of land protection measures by development of state and regional programs of land protection with a rigid control for the intended use of the funds appropriated for such measures; improvement of ecological responsibility of population and ecological respect to nature management by separate landowners, land-users and communities.

It is proposed to develop programs concerning protection and reclamation of land resources by means of land conservation. The programs should be coordinated by the Ministry of Ecology and Natural Resources of Ukraine. They can be various, but the principal goal is to reproduce the valuable vegetation layer in order to prevent soil erosion, to improve the quality of water, to reduce losses of living environment for wild animals and birds, to support appropriate conditions of forests and water-swamp lands.

Conclusions and proposals

1. In Ukraine degradation of agricultural lands, mostly arable ones, is a serious challenge for sustainable development of rural territories. It is caused by a high level of economic use of the territory. On average in Ukraine, the index of ecological inconsistency of the current use of arable land constitutes 1.17. In the studied region, i.e., Lviv region, the indicator is by 36 % higher and constitutes 1.53.
2. Sustainable development of land use in rural territories of Ukraine requires introduction of the tools of sustainable management of land resources, which would integrate the targets of environmental policy into social and economic development of territorial communities. The authors of the article consider that planning of land use outside the settlements on the topographic and ecological basis is an important instrument, which expects specification of ecologically sensitive land parcels and setting of territorial restrictions concerning their employment.

3. It is stressed that land conservation, including degraded and low-productive arable lands, is an essential measure for improvement of ecological stability of rural territories. It is recommended to apply the methods of indirect economic stimulation (tax privileges and granting of payment for land) to motivate business entities to introduce the measures of land protection and conservation.
4. The state environmental policy should plan development and introduction of the target environmental programs of agro-ecological focus, which would be coordinated by the Ministry of Ecology and Natural Resources of Ukraine.

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Information about the authors

Nataliia Stoiko, Ph.D, Associate Professor of Department of Land Organization of Lviv National Agrarian University. Address: Lviv-Dublyany, Ukraine, 80381, phone: +38 067 132 76 16, e-mail: n_stoiko@ukr.net Fields of interest: land management, land use planning, environmental economics, environment protection.

Nadiia Kryshenyk, Ph.D, Lecturer of Department of Land Organization of Lviv National Agrarian University. Address: Lviv-Dublyany, Ukraine, 80381, phone: +38 097 183 93 17, e-mail: nadya_kryshenyk@ukr.net Fields of interest: environmental economics, land management, land protection, land use planning.

Olha Soltys, Ph.D, Associate Professor of Department of Land Organization of Lviv National Agrarian University. Address: Lviv-Dublyany, Ukraine, 80381, phone: +38 096 301 47 77, e-mail: soltysog@gmail.com Fields of interest: environmental economics, economic-mathematical modeling, optimization of land use.
Oksana Cherechon, Ph.D, Associate Professor of Department of Land Organization of Lviv National Agrarian University. Address: Lviv-Dublyany, Ukraine, 80381, phone: +38 097 530 09 33, e-mail: okcherechon@gmail.com Fields of interest: environmental economics, organization of the territory, land protection.