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Abstract

The problems of management of abandoned agricultural land as well as their effective use are relevant for any country to a greater or lesser extent. The endeavours to tackle the problems of effective utilization of abandoned agricultural land and in various ways are made in Lithuania as well as elsewhere. While analyzing the issues related to abandoned agricultural land, a clear definition of an abandoned area is important to perceive as well as potential methods for the identification of such areas are needed to analyse. Also, in order to suggest an effecticve utilisation of abandoned agricultural land for sustainable land use in the country, the analysis and statistics of such land is important to undertake.

The paper discusses the analysis of abandoned agricultural land in Lithuania, providing the dynamics of changes of abandoned agricultural land and the the percentage distribution of such land across Lithuania. Also, the factors, which caused the abonded agricultural land appearance in Lithuania identified and described. The Remote Sensing method identified and analysed as the most effective methodology for abandoned agricultural land identification. A collection of spatial data on abandoned agricultural land was formed on the base of spectral images of the terrene obtained from an artificial Earth satellite and a map of abandoned agricultural areas was created upon applying remote cartographic methods.

Keywords: development; abandoned agricultural land, sustainability, land use, spatial data, Remote Sensing

1. Introduction

Proper utilization of land, as a limited resource, is a very important condition for survival and evolution of a human and the society, a basis for welfare of a nation. If a farmland is not used for agricultural activities for a long period, it gradually turns into an abandoned area. In such an abandoned area, the number of various pests harmful for cultivated agricultural plants grows several dozen times. The state should ensure a rational utilization of land, its protection and sparing. In addition, uncultivated land plots may impact negatively the landscape of the locality and in such a way, both the public interest and the interest of owners or users of neighbouring plots of land or other property is violated. The neighbouring farms may suffer losses.

The range of problems. In Lituania, there are abundant abandoned land, their total area decreases very slowly, so the opportunities to create the added value of agriculture and forests are not exploited. The legal norms do not regulate the management of accounting the abandoned areas to a sufficient extent, the level of eligibility of abandoned areas for cattle breeding is unknown, the knowledge of changes that take place in an abandoned area, such as changes of its biovariety or agrochemical properties of the soil, is not available.

In this paper, the abandoned agricultural land existing in Lithuania are analyzed, the trends of

their changes are disclosed and the causes of appearance of such areas are described. For the discussion, Vilnius District Municipality where the abandoned areas are the largest had been chosen. As exemplified by the said Municipality, it was tried to analyze what causes predetermined the greatest abandonment of area close to the capital of the country.

For solving the problems of management of abandoned agricultural land as well as their effective use it is very important to exactly identify and often to update the data concerning abandoned agricultural land. Remote Sensing methodology is useful where tests or information gathering performed by a human are too costly or require considerable time input. The process of segmentation was accomplished for inspection and the identification of abandoned agricultural land within the territory of Lithuania. The collection of spatial data on abandoned agricultural land of Lithuania was compared with the obtained result of segmentation.

In Lithuania, a collection of spatial data on abandoned areas was formed on the base of spectral images of the terrene obtained from an artificial Earth satellite (www.geoportal.lt, 2018). All the information on the abandoned areas – the statistical land accounting data is freely available on the website of the National Land Service under the Ministry of Agriculture (www.nzt.lt) and is public, so we can see how such abandoned areas are distributed. In addition, the factors affecting the changes of abandoned areas (their appearance and decay) in Lithuania are analyzed herein. The recommendations and proposals how to reduce abandoned areas by their appropriate use are the most important. An appropriate use of each abandoned plot of land is a quite complicated task, because the social, natural and economic factors should be taken into account. In course of preparation of this paper, it was found that definitions of abandoned areas are abundant in literature and the causes of their abandonment are broadly analyzed; however, less attention is paid to an appropriate use of an abandoned area. Reduction of abandoned territories would provide economic, social and environmental benefits, so it is no wonder that the issues related to such a reduction are being dealt both in Lithuania and other countries.

2. Literature review

Land is a very important and limited resource of any country, so its use should always be expedient and economically feasible. The Aticle 21 of the Land Law (Land Law, 1994) provides that land owners and other users shall use their land in accordance with the principal intended purpose and the way of use. An inadequate use of land or avoiding its use according to the intended purpose causes various negative phenomena and impedes a harmonious development of the whole country.

The change of political system in central and eastern European countries from 1990 onward triggered the process of land privatization with the dismantling of collective farms. This may have led to land abandonment as:

- property rights were not always well established;
- many cases of co-ownership or unknown owner, leading to non-functioning land market.

All these resulted often in high fragmentation and small size of agricultural plots and holdings, not allowing profitable and commercial farming to develop (Report by JRC, 2013). There are many definition and interpretation of the terms “land abandonment” or “abandoned land”. The theory used to explain land abandonment is based on economic models of human behaviour (Gellrich et. al., 2007). Whilst land abandonment is often viewed negatively, it is not always clear that land abandonment is detrimental (Report by JRC, 2013). But in some locations, abandonment could be highly beneficial, particularly in highly fragmented landscapes and where it could provide the opportunity for significant large-scale restoration of non-agricultural habitats (Keenleyside et. al., 2010).

From the broad spectrum of the provided concepts, several most important ones, such as a definition of an abandoned area according to (Pointereau et al., 2008; Kuliešis et al., 2010, 2011; or Moravec et al., 2007), may be singled out:

• a transition from a certain land use model (frequently intensive traditional farming) to less intensive land use because of restricted human activities; after such land use, the land becomes covered with shrubs and finally with a forest;

• a transition from a traditional land use to less intensive use, i.e. the land abandonment, is not limited by a termination of farming, but is also related a change of land use in the farm;

• an area that is not used anymore and is covered by a vegetation layer all the year round;

• an area that is used neither as an implement of production nor as an environmental resource.

According to Lithuanian Rural Development Programme (RDP) a abandoned area is interpreted as a land of agricultural purpose that is not used for agricultural activities and is not declared for at least 3 years in turn. The sphere of application of this concept was limited by RDP measures; abandoned areas were not accounted and monitored according to the said definition (Kuliešis et al., 2010). In

2002, the Minister of Agriculture issued the Order (Order of the Minister...., 2002), where an official definition of abandoned agricultural land was approved and it was planned to collect data on a thematic spatial data collection (AŽ_DB10LT). It was decided to include agricultural areas covered with woody plants (except of plantations) identified by remote sensing methods in the category of abandoned agricultural areas. These agricultural areas are being identified by the state-owned enterprise The National Land Fund (a subdividion of the National Land Service); the National Land Service under the Ministry of Agriculture is responsible for spatial data and the state-owned enterprise „GIS Centras“ is a manager of spatial data portal www.geoportal.lt where data on abandoned areas are provided.

The redevelopment abandoned agricultural land in Lithuania started only on 2002 year when in the Europe as early the 1970s and being in the progress now. In our paper, Remote Sensing methodology for identification of abandoned agricultural land is presented.

3. The analysis of accounting abandoned agricultural land in Lithuania

In Lithuania, as in other countries, a unique definition of an abandoned area is searched for and it is tried to tackle a problem of an abandoned area by analyzing the causes of its appearance.

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3.1. Spatial data analysis of abandoned agricultural land in Lithuania

In the collection of data on abanonned areas, the information on abandoned, neglected or unfit for use according to their principal purpose (agricultural activities) agricultural areas in Lithuania is stored (Order of the Director..., 2011). All territories of neglected agricultural areas are identified by remote cartographic methods. A fragment of the collection of spatial data on abandoned agricultural land is provided in Fig. 7.

The state-owned enterprise “The Center of Registers” /„Registrų centras“/ processes the data of the collection of spatial data on abandoned areas that are updated annually, where the area of a smallest spatial object is 0.10 ha (Order of the Minister..., 2013). The Land Tax and a fine for ignored agricultural areas are calculated according to the spatial data on the borders of land plots provided on the Real Estate cadastral map and the data from the Real Estate Register (Order of the Minister...,2013).

3.2. The dynamics of changes of abandoned agricultural areas

According to information on agricultural land provided in reports of the National Land Fund, it is evident the dynamics of changes of abandoned agricultural land plots in 2014–2017 (Fig. 1).

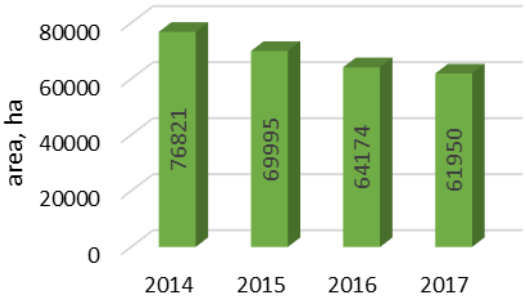

Fig. 1. The dynamics of changes of abandoned agricultural areas in Lithuania (ha) in 2014–2017 (Source: authors)

It may be seen from Fig. 1 that the areas of abandoned agricultural land are step by step decreasing and now form about 1.8% of the total agricultural land of the country. The said percentage is low enough; however, it should be taken into account that agricultural lands in Lithuania are recognized abandoned areas when they are covered by woody plants – this means that they are evidently neglected and are not used according to their intended purpose for a long time. Agricultural areas that are not used according to

their intended purpose but are not covered by woody plants, i.e. are approaching to the limit of neglection, are not included in the layer of neglected areas.

The territory of Lithuania is divided into 10 counties, all named after their capitals. The counties are divided into 60 municipalities: 9 city municipalities, 43 district municipalities and 8 municipalities. An analysis of statistical data on counties shows the distribution of abandoned agricultural land evaluating the total area of each county – see Fig. 2.

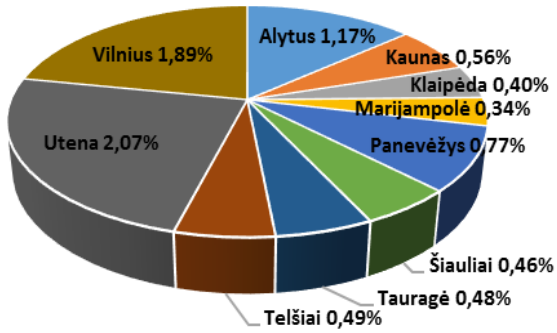

Fig. 2. The distribution of abandoned agricultural land in counties evaluating the total area of each county (the data before 01 January 2018) (source: authors)

The largest areas of abandoned agricultural land sites exist in Utena County (2,07%) and Vilnus County (1,89%), so the situation of territories of the said counties and the causes predetermining poor statistical data were analyzed in details.

A detailed analysis of the statistical data on Utena (Fig. 3) and Vilnius (Fig. 4) counties shows that a majority of abandoned agricultural land evaluating the total area of each Municipality are situated in Vilnius District Municipality (3,2%).

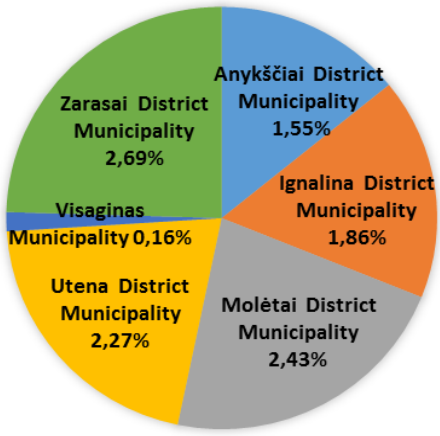

Fig. 3. The percentage distribution of abandoned agricultural land in Utena County evaluating the total area of each Municipality (the data before 01 January 2017) (source: authors)

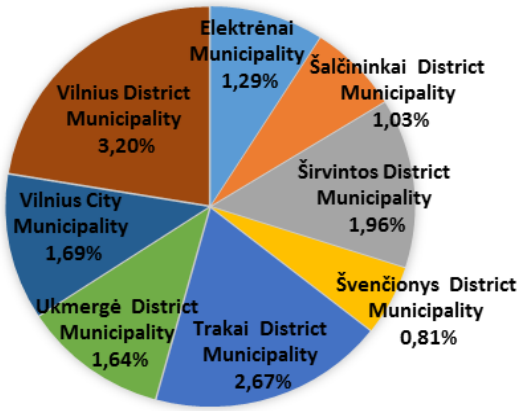

Fig. 4. The percentage distribution of abandoned agricultural land in Vilnius County evaluating the total area of each Municipality (the data before 01 January 2017) (source: authors)

Vilnius District Municipality is distinctive: there are abundant unproductive lands around Vilnius and they are abandoned for this reason. In Vilnius District Municipality, there is no clear specialization of agriculture; in addition, the average size of a farm is smaller, as compared to the whole country. Because of poorer lands, the level of fecundity in Vilnius District Municipality is lower, as compared to the average indicators of the country. In Vilnius District Municipality, the performance of agricultural lands is 36 scores, whereas the performance of the most fertile lands of Lithuania is 60 scores. 4 rural elderships of the Municipality are classified as localities where natural obstacles take place. They include Buivydžiai, Dūkštos, Medininkai and Sužionys elderships. In Vilnius District Municipality, stockbreeding predominates; however, in recent years, the number of stock-breeders and the number of livestock decrease in Vilnius District Municipality more rapidly, as compared to the whole Lithuania. For the said circumstances, the Municipality faces problems, because farms are small, lands are infertile, the small farms are not able to produce abundant agricultural production, it is sold for a low price, so the situation of the farmers is very complicated – thus, the consequence is almost the largest areas of abandoned agricultural land in the County (Vilnius district.., 2016).

On summing up the above-described, it may be stated that changes of abandoned agricultural land (appearance and decay) in Lithuania are impacted by the following factors:

1. The demographic factor. Residents more rapidly emigrate from locations where abundant poor quality lands predominate and farming activities are non-viable. In course of time, such locations become attractive neither for residing nor farming.

2. **The social and economic factors.** In Lithuania, small farms predominate and they do not provide high income. The large expenses and low profits do not stimulate agricultural activities of the population.
3. **The political factor.** The national land policy in Lithuania considerably impacts a reduction of abandoned agricultural land. Since 01 January 2013, when the new wording of the Law of Republic of Lithuania on Land Tax came into force and the rate of the Land Tax for abandoned agricultural land was increased, a considerable reduction of them is being observed.
4. **The historical factor**. In the agricultural sector, as in a majority of other sectors of activities, changes take place constantly: less livestock is bred, so less forage and hayfields are required; in course of improvement of agricultural equipment, less and less manpower is needed. All the above-described predetermine a lower demand farmland and this circumstance influences an appearance of abandoned agricultural land sites. In addition, after the restitution, many new land owners that are not ready for farming activities and are not prone to be involved in them appeared - this fact contributed to an appearance of abandoned agricultural land as well.
5. **The geographic factor.** Lands turn into abandoned agricultural land, if they are situated in geographically disadvantageous territory and are poorly accessible, situated far away from towns, or are inconvenient for farming activities.
6. **The agroecological factor.** Low quality infertile lands require considerable investments and do not provide good results, so a risk of turning into abandoned agricultural land arises for them (Kuliešis et al., 2011).

Existence of abandoned territories ensures poor social and economic conditions for persons living around them; in addition, they damage the general country's landscape, so reduction of such territories is of very high importance for improvement of the country's image.

4. Methods: the Remote Sensing methodology for abandoned agricultural land identification

Remote Sensing is a methodology applicable for obtaining information on a remote object or phenomenon by using record technologies or real-time sensor equipment that does not enter a physical contact/a direct link with the examined object. Remote Sensing methodology enables collecting information from dangerous or inaccessible places of the planet; in addition, this methodology is useful where tests or information gathering performed by a human are too costly or require considerable time input. Examples of application of Remote Sensing methodology workdwidely are various: they include monitoring the deforestation in the Amazon watershed, monitoring the impact of climatic changes on the glaciers of the Arctic and Antarctic, depth measuring in the ocean and coastwise. Spatial data collection methods may be divided to: overground measurement in the location upon applying classical geodesic devices; and remote measurement according to the materials of photographic images.

The data for remote measurement systems are obtained from plains, unmanned aerial vehicles and drones, complicates satellite systems (RADAR - Radio Detection and Ranging; LiDar – Light Detection and Ranging), overground photographic or laser scanning equipment not contacting with an object of cartography. The quality of the image is predetermined by the properties of the system's sensor/platform (Prasad et al., 2016).

The electromagnetic energy registration data for satellite systems are digital images stored in elements of images of a net of squares (rectangles) - pixels. Each pixel has its digital value (DN-Digital Number). The data of the images are defined by (Prasad et al., 2016):

- the size of the image: the number of lines and columns;
- the pixel size in the locality (the smallest read-out object of the locality) – it is a spatial resolution, such as 20 m, 30 m, etc.;
- the number of bands (wavelength ranges). For example, 1 band is black-and-white photo, 4 bands - SPOT multispectral images, over 10 bands – multispectral images;
- the spectral resolution (that depends on the share of registered electromagnetic spectrum) and radiometric resolution (energy difference). For example, 1 bit (8 bytes) shows the values of pixels in the range from 0 to 255;
- the time interval between obtaining two adjacent images.

The scale and the resolution of photographic materials as well as geometrical, spectral and other properties of photos differ depending on the height of photographing and the sensor installed in the system's platform.

4.1. Remote Sensing Technology for abandoned agricultural land indentification

In territories, abandoned agricultural land are identified by interpreting spectral images of the terrene obtained from an artificial Earth satellite (Order of Minister of Agriculture, 3D-212, 2013). In Lithuania, SENTINEL-2 optical and RapidEye

satellite systems are used for abandoned agricultural land identification. The multispectral high-resolution double satellite system of SENTINEL-2 (multispectral (MSS) provides digital data of SPOT and LandSat type (Prasad et al., 2016) (Fig. 4).

Fig.4. SENTINEL-2 sattelite (E ESA, 2017)

Two identical SENTINEL-2 satellites operate simultaneously; they are remoted from each other by 180 degrees and fly along a synchronous orbit on the average height of 786 km. The position of each SENTINEL-2 satellite is measured by a double frequency Global Navigation System (GNSS) receiver. SENTINEL-2 system is curated and supervised by the consortium formed of 60 enterprises managed by "Astrium GmbH" (Germany). "Astrium SAS" (France) is responsible for the multispectral production in the equipment ("MultiSpectral Instrument" (MSI)). MSI: includes a linear matrix scanner „Pushbroom“ with an optical system of filters. The scanner is based on an energy accumulating equipment CCD. The CCD array (matrix) is a linear photo-sensitive detector. Each line is registered individually. In the route, registration is uninterrupted. The advantage (as compared to “whiskbroom” – a scanner with a rotating mirror): each line of pixels is provided with an individual detector.

CCD array conforms to the spectral band and all detectors of the array are sensible to a specific wavelength range. The sensitivity of modern CCD-matrices is up to the wavelength of 2.5 μm. The imperfection of CCD is that producing a matrix with the same (or similar) sensitivity of all its elements is a very complicated task. Inequality of sensitivities impacts the images: vertical band-shaped lines appear.

The geometrical properties: the central projection is the same, as of an aerial photography. When the locality is not relief and the height difference is limited, the scale in a single CCD line is the same. So, there is a possibility to turn the scanner to one or another direction (rightwards or leftwards from the line of the orbit) and to obtain stereoimages in such a way (as in a case of a leaning photo). In such a case, a variety of scales is obtained.

MSI fixes 13 bands of the spectrum (443 nm–2190 nm), including 4 bands of the visible spectrum (VIS) and infrared spectrum (NIR), with a resolution of 10 m, 6 bands – of short infrared spectrum (SWIR) with a resolution of 20 m and 3 bands with atmospheric corrections and the resolution of 60 m (E ESA, 2017). Each spectral separation of a band to individual wavelengths is performed by band-pass optical filters equipped over the detectors. The numbers, titles and wavelengths of the bands are provided in internet (Earth, 2017). All the data fixed by MSI from SENTINEL-2 satellite are provided on a certain level of processing from 0 to 1C. Data of the zero level present information fixed in real time and stored in files together with annotations and metadata. They are unprocessed digital images that may be processed upon applying special programmes. The first level data include three stages of processing: they are generated into data levels 1A, 1B and 1C starting from the consolidated data level 0. The said three levels conform to the data titles S2MSI1A, S2MSI1B and S2MSI1C, respectively. For control of the territory of FOS (Fibre Optic Sensors) data users, sometimes the results of the level 0 are sufficient (Sandeepan, 2017). The optical and radar data from SENTINEL satellites are updated once in 5-10 days. This information is public and accessible for any user. The data are sent via „Copernicus Open Access Hub“ site: https://scihub.copernicus.eu/.

For indentification of abandoned agricultural land upon applying algorithm MeanShift, the process of segmentation has been accomplished. The Mean-Shift segmentation algorithm to render regions with contrasted colors (homogeneous coloring density) and the labeled output passed to the “ColorMapping” application, which is based on Kernel density estimation. The Kernel density estimator with kernel *K(x)* and a symmetric positive definite $d \times d$ bandwitdth matrix *H*, computed in the point *x* is given by (Comaniciu et al., 2002)

$$f(x) = \frac{1}{n} \sum_{i=1}^{n} K_H (x - x_i),$$

where

$$K_H (x) = |H|^{-1/2} K(H^{-1/2} x)$$

and *n* – data points x_i, $i = 1,\ldots n$ in the d-dimensional space.

Kernel *K(x)* is a bounded function with compact support satisfying

The main suggested stages of segmentation using MeanShift algorithm are as follows (Grizonnet et al, 2017):

- Find features (color, gradients, texture, etc.);
- Initialize windows at individual pixel locations;
- Perform mean shift for each window until convergence;
- Merge windows that end up near the same “peak” or mode.

The following parameters have been used in the analysis:

- Spatial radius of the neighborhood. In the test default value: "5";
- Range radius defining the radius (expressed in radiometry unit) in the multispectral space. In the test default value: "15";
- Algorithm iterative scheme will stop if mean-shift vector is below this threshold or if iteration number reached maximum number of iterations. In the test default value: "0.1";
- Algorithm iterative scheme will stop if convergence hasn't been reached after the maximum number of iterations. In the test default Value: "100";
- Minimum size of a region (in pixel unit) in segmentation. Smaller clusters will be merged to the neighboring cluster with the closest radiometry. If set to 0 no pruning is done. In the test default value: "100".

Test results are providing below (4.2 chapter).

4.2. Testing of technology

For inspection and identification of abandoned agricultural land within the terrritory of Lithuania, the materials of the level 2Ap with resolution of 10 m dated 29 September 2017 were sent. A data fragment is provided in Fig. 5 below.

Fig. 5. SENTINEL-2 data fragment (source: authors)

The white spots in the photo are clouds; in addition, black shadows of the clouds are visible as well. The advantage of radar satellite systems, as compared to optical systems, is that electromagnetic waves spread through clouds and the atmospheric conditions do not impact the quality of the material. Since the year 2017, the materials processed by Sentinel-2 are provided on Lihuanian website of spatial information www.geoportal.lt as well.

The said algorithms are fit for processing large data collections; the data may be provided both in vectorial and bitmap form; in addition, carrying out an analysis of images of objects is possible.

The result of segmentation of the object of investigation upon applying algorithms MeanShift is provided in Fig. 6 below.

Fig. 6. The obtained result of segmentation (source: authors)

In Fig. 7, the collection of spatial data on abandoned agricultural land of Lithuania is presented and it is compared with the obtained result of segmentation (Fig. 8).

Fig. 7. The collection of spatial data on abandoned agricultural land of Lithuania (www.geoportal.lt, 2018)

1) 2)

Fig. 8. The comparizon of the obtained result of segmentation with the collection of spatial data on abandoned agricultural land of Lithuania 1) the image www.geoportal.lt; 2) the obtained result of segmentation (source: authors)

While comparing the obtained results, it may be noticed that the obtained result of segmentation slightly differs from the image of the abandoned area in the collection of data. The causes may be various: different resolutions of images, different algorithms used for segmentation, the date of the satellite image (the situation changed because of it). The first spatial data on abandoned agricultural land in Lithuania were prepared in 2002-2005 and the materials of the year 2017 were used for the investigation. The materials on different periods are useful for monitoring the changes of territorial development.

5. The importance of reduction of abandoned agricultural land areas in Lithuania and the development of sustainabale land use

Before tackling the abandoned agricultural land development there is important to analyse whether the land was completely or partially abandoned; the dislocation and size of plots, soil fertility of such land. The application of abandoned land for other purporse or restoration of their agrarian condition require different solutions and financial resources.

The main benefits of sustainbale abandoned agricultural land highlighted by Hillaker A., 2014 and Dixon, T., 2006 fit for Lithuania case as well. The main benefits of sustainable redevelopment of abondanded agricultural land in Lithuania would be as follows:

Economic:

- Using abandoned land for renewable energy or other purposes could promote the emergence of additional jobs in Lithuanian regions.

Social:

- Sustainable use of abandoned lands would help to attract investment and improve living conditions in the regions of Lithuania. The low living standards in the regions of Lithuania cause a decreasing population.

Environmental:

- Improved landscape;
- Restoration of environmental quality.

On the base of the literature review (Rural..., 2007; Kuliešis, 2011; Renwick, A. et al., 2013) and undertaken analysis in Lithuania, the proposed stretegies how abandoned agricultural land development can be tackled are listed below:

1. Land taxes for abandoned land are applied in Lithuania, they are gradually being increased, but this does eliminate the problem of abandoned agricultural land.
2. Abandoned agricultural land can be restored by planting forest on them: in addition to improvement of the ecological and environmental conditions of the country, this strategy would ensure economically reasonable use of unbroken and low-value soils. This method is applicable in Lithuania, but areas of abandoned agricultural land usually are small (up to 1 ha) and therefore not suitable for planting forests.
3. Cultivation of energetic plants on abandoned agricultural land is a promising strategy of their use. Plant biomass is one of the most important resources of renewable energy. In addition to mitigation of the consequences of the global climate warming, the plants cultivated on abandoned agricultural land enable to use better the land resources. The cultivation of energetic plants is a viable way, however it is not very popular in Lithuania due to the high prices of equipment and complex technological processes.
4. In cases when the land is not hopelessly abandoned, it can be restored by using natural resources, recreation or promotion of economic development in rural regions.
5. Construction of wind power plants is one of possible ways for use of abandoned agricultural land. Also, the use of renewable energy sources is greatly encouraged. This way distinguishes itself for a number of imperfections: wind energy is not stable and depends on the direction and the speed of wind; people residing close to wind power plants are usually negatively impact as the noise caused by them and shading of their wings. In addition, construction of such plants and their connestion to electric network is an expensive process that requires considerable investments. The effective location to build wind power plants in Lithuania is the Baltic sea coast of Lithuania, however there is lowest level of abandoned agricultural land.
6. In some cases, use of light and solar energy by equipping the relevant systems on abandoned agricultural land may be a possible way for use of such land. However, this way is not free of imperfections: weather directions in Lithuania are very changeable and sunny days are not abundant; in addition, this technology is expensive and the expenses related to power accumulation and transportation equipment are high.

Conclusions

1. Precisely to define an abandoned agricultural land is a complex task; it is also attested by the experience of foreign states where various definitions of an abandoned agricultural land exist.
2. The detailed analysis of the statistical data on abandoned agricultural land shows that the biggest

area of Lithuanian abandoned agricultural land exist in Vilnius District Municipality, which is very close to Lithuanian capital city Vilnius. The Vilnius District Municipality has well -developed infrastructure and the lowest level of unemployment in Lithuania. The analysis showed that that the land with poor soil, small and unprofitable farms, even in strategically convenient places, eventually become useless and land abandoned.

3. In Lithuania, a collection of spatial data on abandoned agricultural land was formed on the base of spectral images of the terrene obtained from an artificial Earth satellite and a map of abandoned agricultural areas was created upon applying remote cartographic methods. They are modern contemporary methods that enable to obtain and update the recent data without high costs.

4. The modern GIS means applied for identification of abandoned agricultural land enabled to ensure a free access to data on abandoned agricultural land for all users.

5. Different periods Earth Satellites Spatial data from „Copernicus Open Access Hub“ site provide valuable materials for observing changes of abandoned territories.

6. There are many different ways to reduce abandoned land, however it is important to find the most efficient strategy for each abandoned land plot to be turned into economically viable real estate

7. Sustainable abandoned agricultural land redevelopment provides economic, social and environmental benefits, so it is evident that problems of redevelopment of such territories should be solved and the results of their solutions are of a great importance both for an individual land owner and for improvement of the landscape of the whole country.

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