ENVIRONMENTAL IMPACT OF LAND CONSOLIDATION

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Abstract
Land consolidation – an important stage of agricultural and rural development. This is a significant land use planning process, when private, municipal and state land parcels located in rural areas are redistributed in a complex way, their boundaries and location are changed by the prepared land consolidation project of a certain area. Recently, there has been a lot of talk about the benefits of land consolidation to farm structure and productivity, restructuring of rural areas and development, but there is not enough emphasis on the benefits of our environment, landscape and biodiversity. Experience of European countries shows that the land consolidation projects can be useful not only for farmers but also for our environment and its individual components. The article gives an overview of not only the positive aspects of environmental preservation. The fact that the land consolidation projects can bring negative results (i.e. that they are implemented without regard to the sustainable transformation of the territory) is noted as well.
Key words: land consolidation, environmental protection, land parcel, sustainable development

Introduction

Land consolidation is carried out in many countries of the world. In each country, it is different and unique, depending on many factors, in particular on the specific needs of the country, its traditions, specificity, culture, legal framework, and the country's economic, social and environmental considerations. However, despite different interests of the countries and the factors of land consolidation issues, the main goals remain the same: to improve the compactness of the scattered parcels of land and as well as to expand land holdings; to create the necessary rural infrastructure and implement other agricultural and rural development and environment protection policy objectives.
Most authors in their articles analyze the land consolidation benefits of economic aspects, forgetting that these projects can significantly contribute to the improvement of the environment. One can agree with the fact that at present in various scientific articles there are references to the land consolidation benefits to the environment and its components, but it is not an essential part of the discussion in the terms of the above-mentioned project analysis and execution.
The aim of this paper is to analyze how land consolidation and its measures affect the surrounding environment, landscape and biodiversity.

Methodology of research and materials

At present, the preservation of the environment is crucial for the world and therefore the autors pay the maximum attention to the implementation of environmental protection measures when preparing land consolidation projects. Foreign experience of land consolidation was analyzed using a variety of Lithuanian and foreign literature, scientific articles. Specific land consolidation projects performed in Poland, Slovakia, Cyprus and other countries were used in the paper. Literature and statistical data analysis, data abstraction and assessment methods were used in the paper.

Discussions and results

Land consolidation is being carried out to form farms' rational land holdings and to improve living conditions in rural areas. Many European countries have this practice: France for over than 200 years, Denmark, Holland, Belgium, Switzerland, Germany – almost for 100 years. This process is also widely implemented in other countries – the Czech Republic, Luxembourg, Slovenia, Poland, Spain, Portugal, Austria, Luxembourg. At present, the land consolidation projects are implemented and in the Scandinavian countries – Finland, Norway and Sweden. It is important to note the fact that these projects are carried out not only in Europe but also in China, India and Africa (Bennett et al., 2016; Wang et al., 2015; Oldenburg et al., 1990).
According to Derlich (2002), land consolidation projects addressed not only rearrangement of land parcels, but also the implementation of different rural development measures. This fact is confirmed by other authors as well, which claim that land consolidation projects promote local initiatives to develop the land consolidation mechanism as an essential tool for integrated rural development (Kavaliauskienė et al., 2011). According to Hartvigsen (2014), currently land consolidation is a multifunctional tool for the purpose of implementation of the tasks related to the protection of the environment. Dapkus (2008) states that land consolidation is not only for the forming of rational land

parcels but is an important factor in the balanced development of rural areas, increasing the competitiveness of both farms and the region, as well as improving social and economic infrastructure itself for the needs of local community. Meanwhile, Pašakarnis (2016) described how land consolidation could be useful in the transport sector.

It is important to note the fact that at the same time during the land consolidation it is possible to provide compensation to those people who have lost their once managed land due to the implementation of the public interest (in this case, due to the performance of corresponding land consolidation objectives).

The analysis of the literature showed that the land consolidation could be called not only a tool for improving the structure of landholdings, but also a tool to create a harmonious and sustainable rural development.

The detailed analysis of land consolidation measures (that are related to environmental conservation) was carried out. Denmark has many years of experience in this field. Environment protection and its policy are the matter of priority as land consolidation planning tool in this country (Hartvigsen 2014; Kovandova, 2006). However, in other countries the environmental protection is an important factor as well in the preparation of land consolidation projects (Table 1).

Table 1

The main objectives of land consolidation in Finland, Germany, the Netherlands, Spain and Sweden (Vitikainen, 2004; Bergen..., 2014)

Objectives	Finland	Germany	The Netherlands	Sweden	Spain	Norway
Rearrangement of land parcels	XXX	XXX	XXX	(X)	XXX	XXX
Rearrangement of forest land parcels	XX	(X)	(X)	XXX	XXX	XXX
Property division improvement in villages	X	XXX	XXX	0	0	X
Changes in the field of lease	X	XXX	XXX	X	X	X
Farm size increase	XX	XXX	XXX	XX	XX	0
Municipal or State land acquisition	0	XX	XX	0	0	0
Rearrangement of homesteads	X	XX	XX	0	0	0
Road network improvement in consolidated territory	XX	XXX	XXX	X	XXX	XXX
Renovation of land reclamation systems	XXX	XXX	XXX	X	XX	XX
Implementation of environmental and conservation measures	X	XXX	XXX	X	X	0
Promotion of regional development projects	X	XXX	XXX	X	0	0

Note: XXX – the primary objective XX – the secondary objective
X – an objective of minor importance 0 – not mentioned in the objectives

It was found that one of the most important tasks almost in all of the countries concerned is the reorganization and increasing of land holdings as well as drainage and road network, however, the environment and nature conservation measures are also a priority factor, especially in Germany and the Netherlands.

As for the Lithuania's neighboring countries, Poland is worth mentioning, because in this country land consolidation projects and their environmental aspects are widely considered now (Leń et al., 2016; Leń et al., 2016; Przegon et al., 2016). Latvia and Estonia held only preparatory works in the field of land consolidation, specific projects are not carried out yet. These countries have only taken the first steps in the implementation of these projects. According to Platonova and Jankava (2013), in Latvia land consolidation is a new concept, but it is becoming more and more popular. According to the survey conducted, it was found out that both farmers and professionals from various institutions (34 and 45 percent, respectively) are interested and would like to participate in the implementation of land consolidation. This shows that the third of the farmers, and almost a half of the surveyed specialists

are ready for new challenges, so it makes sense to evaluate the need of land consolidation and to find the most appropriate and effective method for the implementation of these projects in Latvia.
The situation in Estonia is similar. Jürgenson (2016) argues that in this country land consolidation projects were implemented after the independence of 1919 and 1990. Unfortunately, these projects have not been further developed. Estonian politicians, the authorities, land owners also would like to see that land consolidation is one of the tools that enable the development of a comprehensive and sustainable management of territories.
As for the land consolidation impact on the environment, most of the analyzed authors agree with the fact that the analyzed projects can make a significant contribution to improving the environment. Hiironen and Niukkanen (2012) found that the implementation of the main land consolidation task – transforming the scattered land parcels, enables air pollution and greenhouse effect reduction, because the environment gets less carbon dioxide emissions. This is due to the fact that farmers no longer have to go to every managed land parcel scattered across the farming area (in this case, they are designed into larger land parcels, close to the farmstead), which results in reducing the cost of fuel used, and which leads to negative consequences for the environment.
Land consolidation can contribute to increasing the biomass. These studies were carried out in one of the Chinese provinces – Hubei. The survey analyzed by the authors showed that the implementation of certain measures of land consolidation increases biomass levels (Table 2).

Table 2

Biomass calculation before and after land consolidation project (Yu et al., 2014)

	Total area hm^2		**Average biomass t/hm^2**		**Total biomass t**		**(%)**		**Biomass**
Type of plant	Before LD	After LD	Before LD	After LD	Before LD	After LD	Before LD	After LD	**change t**
Open forest	3.140	3.14	19.870	19.870	62.392	62.392	6.79	4.16	0
Aspen forest	0.000	2.41	0.000	52.042	0.000	125.421	0	8.37	125.421
Waste grassplot	13.559	0.00	1.352	0.000	18.332	0.000	2	0	-18.332
Rice	70.170	124.78	6.010	7.210	421.722	899.664	45.92	60.04	477.942
Dry-land crop	130.035	104.07	3.200	3.950	416.112	411.077	45.30	27.43	-5.035
Total biomass					918.558	1498.554	100	100	579.996

The positive trend is that the biomass in the analyzed territory has increased by almost 580 tons. Mostly, the biomass of rice increased, the least – aspen forest, and there were such groups of plants which biomass unchanged or even decreased. Biomass increase can reduce soil erosion, greenhouse gas (carbon dioxide), and its changes contribute to the landscape structure change.
Measures of land consolidation, related to environmental protection and improvement of the environment in Europe, are already quite common. Measures taken during the land consolidation in Poland, for example, were as follows: arranged most of reclamation systems; afforested unproductive lands; submitted proposals to farmers on starting organic farming. These measures have already been implemented in one of villages located in Poland – Hucisko (Fig. 1).

a b

Fig. 1. Implementation of environmental measures during the land consolidation in Hucisko surroundings (Poland): a) – renovated reclamation system and designed culverts; d) the afforestation of unproductive lands (Leń et al., 2016)

The analyzed land consolidation project in Hucisko settlement lasted for three years (2011 - 2013). Not only reclamation systems were renovated and a certain area was afforested, but other important works related to the improvement of life and transformation of land parcels were carried out as well. The total result of the land consolidation – the number of land parcels decreased from 2,355 to 1,568. An example, where environmental protection measures are to be implemented through land consolidation projects, refers to Slovakia (Hudecová, 2015). One of the consolidation projects was selected in Prešovský settlement. In this project, one of the tasks focused on the reduction of soil erosion (Fig. 2).

a b

Fig. 2. The implemented land consolidation project in Slovakia, Prešovský territory: a) the situation before the land consolidation; b), the situation after the land consolidation (Muchová, 2016)

After the planting of an alley of trees along the road, fewer pollutants will fall into cultivated fields, at the same time it will prevent the wind erosion on nearby cultivated land.
In terms of a landscape, land consolidation projects can contribute to the improvement of its structure. In one of the settlements in Cyprus Vyzakia, Nikitari, effective results were achieved not only in the environmental field, but it was a complex transformation taking into account the economic and social aspects (Fig. 3).

Fig. 3. Complex redevelopment of the terrritory in one of the settlements in Cyprus (Land..., 2012)

The presented figure shows that it is possible to design and implement coherent and integrated rural development decisions during the preparation of land consolidation projects. In this case, surroundings were afforested with tree plantations, also local and farmers' roads were designed. This once again proves that the land consolidation can be an effective tool for implementing most of the problems existing in rural areas and connected with the environment and welfare.
Another relevant measure is the preservation of biodiversity, which may contribute to the consolidation of projects. Currently, biodiversity is constantly declining, which has an extremely negative impact on the environment. In order to preserve and enrich it, it is important to design such land parcels during the preparation of land consolidation projects that their size and shape should be more favorable to biodiversity.
The favorable landscaping issue is widely discussed by quite a lot of authors, one of them is Forman Richard T. T. (1995), who has precisely identified favorable and unfavorable landscaping cases. According to the above-mentioned author, specific biodiversity-friendly landscape mosaic development alternatives were designed (Fig. 4).

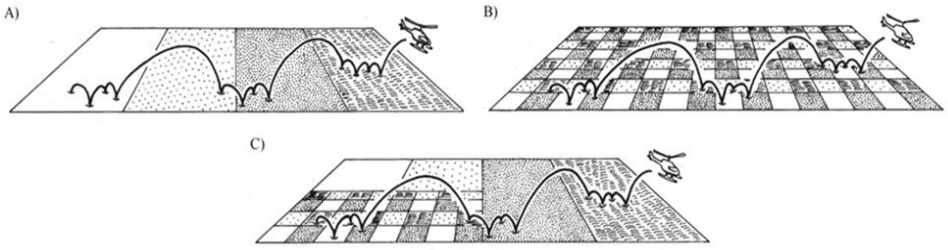

Fig. 4. Biodiversity favorable landscape structure development alternatives (by R. Forman (1995)). A) a large variety of landscape level, but small variety of area level (a very suitable habitat for internal types, specialized types, a wide range of environmental conditions); B) very suitable for peripheral species, for species, which are in need of habitat diversity, these are the most common species; C) landscape architecture suitable for most types

The analysis of the three options showed that alternative C is the most favorable for biodiversity, because it contains all the components of biodiversity conservation and restocking. Alternative C includes suitable habitat for both internal as well as peripheral species.
After the critical analysis of a wide range of scientific literature, it can be said that it is possible to achieve good results in the preservation of the environment in the area during the preparation of land consolidation projects by doing the following:

- reducing soil erosion;
- arranging reclamation facilities;
- preserving biodiversity;
- reducing air pollution;
- properly shaping the land;
- renovation of the landscape.

As for the negative impact of land consolidation on the environment, it is important to properly and competently implement these projects, so that they would bring the expected benefits. If only the improvement of economic conditions will be taken into account during the preparatory phase, also negative damage could be done to the environment. This is confirmed by several authors (Jun et al., 2015), who found that if only the arable land will be increased at the expense of natural meadows, wetlands and other useful natural areas, then the ecological stability of the territory will be reduced. In terms of biodiversity conservation, according to Osawa et al., 2016, if there is a consolidation of a large area and with endangered species in it, these projects are likely to reduce their emissions, and it will result in significant harm to the environment. Therefore, it is important that during the preparation and implementation of land consolidation projects environmental specialists should be involved, who would single out areas sensitive to human economic activities and provide appropriate environmental measures for the solving of these problems (Kupidura, 2010; Gilvickienė, 2009).
In summary it can be said that the land consolidation is a unique tool for the implementation of the tasks related to sustainable rural development. We are glad that in most countries environmental protection and improvement are taken into account in land consolidation. Six fields were identified, in which good results can be achieved in the field of environmental conservation during the preparation of analyzed projects. It is important to note the fact that the land consolidation process may bring negative consequences to the environment if it is focused only on the economic conditions, and without any regard to environmental aspects.

Conclusions and proposals

1. It was found that the land consolidation projects are an excellent means to ensure sustainable development of the territory. It is possible to create cost-effective and socially significant environmental areas during the development of these projects.
2. The analysis carried out in selected European countries found that land consolidation could contribute significantly to environmental protection, so other countries could benefit from this experience during the preparation of these projects.
3. The most important tasks during the consolidation of land parcels that could improve the environment include: reduction of soil erosion; arrangement of draining facilities; biodiversity conservation; reduction of air pollution; suitable land parcels formation and landscape renovation.

4. It is very important to assess the potential impact on the environment during the land consolidation through the development of these projects and provide for such reorganization measures without having negative consequences for the environment and its components. Therefore, it is proposed to consult with environmental specialists and other stakeholders on nature conservation issues.

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