

# UTILISATION POSSIBILITIES OF ABANDONED LAND BY APPLYING MULTI-CRITERIA ANALYSIS

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## Abstract

The article analyses a significant 21<sup>st</sup> century issue of land abandonment. Land abandonment occurs due to a variety of reasons, including natural, social, economic, politic, geographic and holding structure factors. The article employs methods of scientific literature, statistical data, cartographical data, multi-criteria analysis, generalisation and logical reasoning in order to analyse the extent of land abandonment and possibilities of its utilisation in Lithuania. In order to determine rational possibilities of utilisation of abandoned land, the analysis of 36 particular abandoned land areas was carried out by taking into account 11 delineated criteria that are significant for finding alternatives for utilisation of abandoned land. It was determined that the majority of abandoned land areas, i.e., 10.58 ha, are expedient for afforestation (24 abandoned land areas), and the rest areas comprising 9.25 ha are expedient to revival of agricultural activities.

Key words: abandoned land, agricultural land, utilisation of abandoned land, multi-criteria analysis.

## Introduction

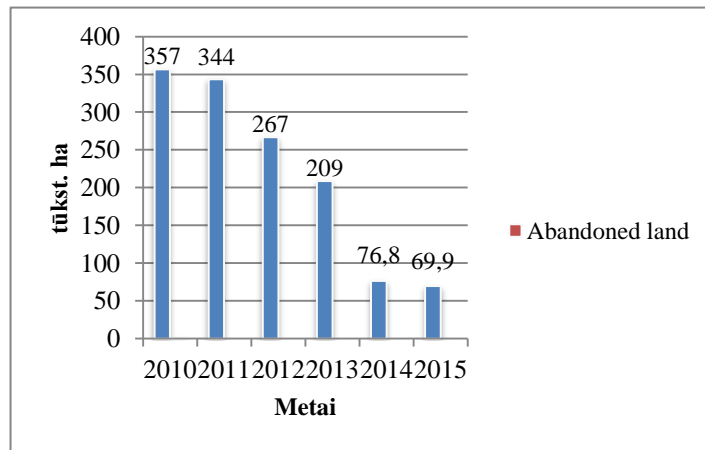
Abandoned land is a significant problem of the 21<sup>st</sup> century. Abandoned land might have been a result of a particular period unfavourable to agricultural activities where arable land was ceased to be cultivated. There might be numerous reasons of land abandonment, or combination of various circumstances that determined land abandonment in certain places (Ribokas, 2011). The analysis of the approaches of various authors suggests the following division of the factors leading to land abandonment (Rico et al., 2008; Benayas et al., 2007; Ambar, 2011a; Brouwer, Baldock, 1997):

- natural – slope of the land plot, complex terrain, poor soil;
- social – rural depopulation, lack of education and financial resources, unwillingness to take over farms from people who retreat from agricultural activities;
- economic – price fluctuations, increased prices of resources and relatively low yield potential, small payments, risk due to low demand for agricultural production;
- politic – land reform, lack of Government investment;
- geographic location – poor accessibility and transportation to land parcels;
- holding structure – small and uncompetitive holdings.

In Lithuania, abandoned land areas are located by State Enterprise “State Land Fund” by applying remote mapping methods, i.e. using spectral images from a satellite. Spatial data of agricultural land areas is stored in the special data set AŽ\_DRLT, which is available on Land Information System ([www.geoportal.lt](http://www.geoportal.lt)). This data set is updated annually with the latest digital orthophoto maps, georeferenced cadastral data and other information specified by National Land Service under the ministry of Agriculture of the Republic of Lithuania. The smallest area of spatial objects, the data of which is collected in AŽ\_DRLT, is 0.10 ha (Apleistos..., 2013).

Abandoned land for agricultural purposes can be restored through environmentally or economically alternative means, for instance, by afforestation. In Latvia, it is one of the most popular utilisation alternatives of abandoned land. Also, there is an option of restoration of abandoned lands so that they could be re-used for agricultural activities. Another option is to sell abandoned land plots or lease them to people who can utilise them properly and efficiently. According to P. Aleknavičius, abandoned private land plots would be of targeted use if they were located closer to prospective land holding as it would create a great opportunity for this land to be leased by farmers or agricultural businesses (Aleknavičius, 2012). It is important to note that the increase of agricultural production volumes by exploiting potentially fertile abandoned lands and inefficiently utilised agricultural land would not only contribute to reduction of the number of abandoned land areas, but would also create conditions for the development of competitive agricultural economy.

In recent years, the number of abandoned land areas in Lithuania has increased (Fig. 1).



**Fig. 1.** Changes in the number of abandoned land in 2010 – 2015

Sources: Mano..., 2012; Valstybės..., 2013; Nacionalinė..., 2015; Nacionalinė..., 2016a

The greatest number of abandoned land areas was observed in 2010. According to the data of July of the previous year, there was 69.9 thousand of land abandoned by the owners. Decreasing number of abandoned land areas in Lithuania shows that more and more people started to take care of their owned lands and look for alternative ways to utilise it. It is likely that the number of abandoned land decreased due to a higher land tax, which may vary in different municipalities from 0.01 to 4 percent of the land value

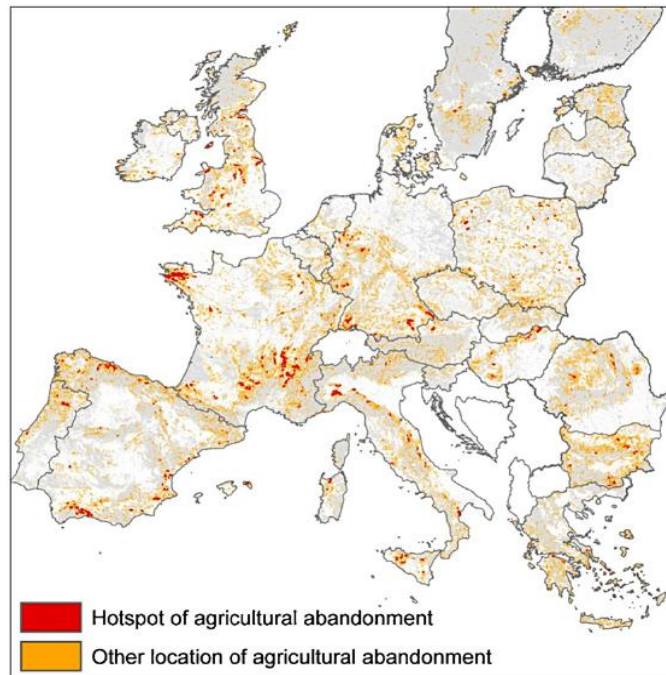
The highest number of abandoned lands is observed in the problematic Eastern Lithuania region due to unproductive soil and lower number of working-age rural residents.

The problem of abandoned lands exists almost everywhere in Europe. For example, in Latvia, especially since 1990, the emergence of abandoned lands and natural growth of forests have become an integral part of the Latvian rural landscape. This was determined by various factors, such as structural changes, features of the landscape and environment. Both in Latvia and Lithuania it is restitution of property which highly influenced the emergence of abandoned lands. Even though people reside in cities and are not interested in agricultural activities, they still were restituted their formerly owned land in villagers. What is more, abandoned lands are determined by economic, social and political factors. In Latvia, unproductive lands are mainly utilised by means of afforestation and fertile lands are reclaimed for cultivation (Ruskule et al., 2012).

In Estonia, reduction of land abandonment plays an important role in the activities of public authorities as well as other relevant institutions. One of the biggest counties in Estonia, namely, Tartu County, is analysed into greater detail. There is 26 351 ha of abandoned land in Tartu County, 20 741 ha of it being completely abandoned (covered with scrubs or even forests) and the rest being partly abandoned (covered with woody plants). Even though abandoned areas are distributed throughout the whole region, most of them are found near water bodies and forests. In Tartu County, there are observed separate abandoned areas ranging from 2.9 to 21 ha, however, very small abandoned land areas may also be found. There are intentions to use the abandoned land for afforestation, the possibility to use abandoned land areas in bioenergy field is also discussed (Kukk et al., 2010).

The issue of abandoned land is also relevant in Mediterranean European countries (Spain, Italy and Portugal). It was noticed already in 1950 that the land was ceased to be used for traditional agricultural purposes as meadows and arable land had transformed into naturally grown forests. This occurred mainly due to the fact that the areas are hilly and it is difficult to engage into agricultural activities. In these countries afforestation is one of the most acceptable means of utilisation of abandoned land (Tomaz et al., 2013).

Figure 2 provides a cartogram of all abandoned lands in Europe illustrating that abandoned land areas are found basically everywhere in Europe.



**Fig. 2.** Land abandonment in Europe: a) – the red colour indicates territories of great land abandonment; b) – the yellow colour indicates territories where the extent of land abandonment is not as severe (Renwick et al., 2013)

It can be observed that there is a great number of abandoned land areas in France, Great Britain, Germany, Poland and other countries. A bit lower number of abandoned lands is observed in Portugal, Denmark, and the Czech Republic. Therefore, determination of rational utilisation possibilities of abandoned land areas is a relevant issue for the entire European continent.

Hence, **the research aims** is to determine utilisation possibilities of abandoned land by applying multi-criteria analysis.

### Methodology of research and materials

Raseiniai district Sujainiai cadastral area was chosen for the analysis of utilisation possibilities of abandoned land by applying multi-criteria analysis. In Raseiniai district there prevails productive soil (average productivity index of agricultural land in the district is 42.2 as compared to the national average which is 39.7), hence, land abandonment should not be observed in this district. As it would be a difficult task to investigate the entire region, only one cadastral area was chosen, i.e. Sujainiai, since it is one of the rural cadastral areas in the district.

Currently, there is 841.72 ha of abandoned land in Raseiniai district, which constitutes 0.5 percent of the district area. In Sudainiai cadastral area, there are 36 abandoned land areas with a total area of 19.83 ha. The article analyses utilisation possibilities of all 36 abandoned land areas.

The research is based on the methods of scientific literature, statistical data, cartographical data, multi-criteria analysis, generalisation and logical reasoning

Key data for multi-criteria analysis was obtained from the data sets which are publicly available on the Land information System ([www. geoportal. lt](http://www.geoportal.lt)):

- *Mel\_DR10LT* – spatial data set of reclamation status and sodden soil of the territory of the Republic of Lithuania at scale 1:10000;
- *SZNS\_DR10LT* – spatial data set of special land use conditions of the territory of the Republic of Lithuania at scale 1:10000;
- *Dirv\_DR10LT* – spatial data set of soil of the territory of the Republic of Lithuania at scale 1:10000.

The aforementioned analysis is also based on the data from *maps.lt* and data set of natural frame

Utilisation possibilities of abandoned land are analysed by employing multi-criteria analysis software, namely DAM and HYPSE.

DAM (Decision Analysis Module) is a software product developed in 1999 and freely distributed by the International Atomic Energy Agency. DAM is designed for solving any tasks according to the MAUT (Multiattribute Utility Theory) method (Keeney, Raiffa, 1976). Linear and additive utility functions (U) are applied:

$$U=W_1X_1+W_2X_2+\dots+W_nX_n \quad (1)$$

here  $X_1, X_2, \dots, X_n$  – criteria values (indicating which target value, higher or lower, is the best);  
 $W_1, W_2, \dots, W_n$  – significance levels of criteria (weights).

Pareto dominated (similar) alternatives are selected in the compromise solutions space and then compared with the main criterion according to the dominance test. DAM enables analysis with undefined criteria by providing criteria in min-max range.

HYPSE software (Acronym of Hydro Power Systems Evaluations) is a package designed to perform a multi-criteria analysis even by entering their weights (European..., 2000). In order to carry out the analysis, ELECTRE method (Elimination Et Choix Traduisant la Realite – Elimination and Choice Expressing the Reality), which was developed in France in 1960s, is used. (Roy, 1968, 1996; Mayster et al., 1994). The advantage of this software is the possibility to use criteria of various dimensions, which is not possible in DAM. What is more, criteria may be given significance – individual effect significance level; criteria may also be grouped by indicating effect significance level of the whole group.

It is important to note that even though these two pieces of software reveal various cases of possible solutions, take risk factors into consideration, give a possibility to model their effects, describe the level of uncertainty of the solution, they, however, do not change the solution per se.

Data collection is one of the most important steps of multi-criteria analysis. The data collected are usually given in different units of measure, thus it is necessary to normalise (standardise) them so that they could be entered into the programmes. For this purpose data normalisation (standardisation) is performed. Possible types of standardisation are as follows: vector; linear scale, Min – Max procedure (Corner, Kirkwood, 1991). In this particular case Min – Max procedure is used, where values from 0 to 1 are normalised according the following formula:

$$r_{ij} = \frac{d_{ij} - \min d_{ij}}{\max d_{ij} - \min d_{ij}} \quad (2)$$

Here  $r_{ij}$  – normalised value;  $d_{ij}$  – matrix number;  $\min d_{ij}$  – the smallest number in matrix;  $\max d_{ij}$  – the highest number in matrix.

As opposed to DAM, HYPSE does not require normalisation of data.

The main aim of using these two pieces of software is to determine which of the 36 abandoned lands are expedient to restoration of agricultural activities and which ones are most suitable to afforestation. As it has already been mentioned, these options are considered to be the basic and most popular ones for rational utilisation of abandoned land areas. In order to solve the task, it is important to define criteria that will constitute the basis for decision-making. What is more, the accuracy of multi-criteria analysis depends on detailed selection of criteria. When selecting criteria it is important to evaluate and consider a variety of quantitative and qualitative factors that have impact on ration utilisation of abandoned land areas. This research defines 11 criteria (Table 1).

**Table 1**

Criteria used in multi-criteria analysis and the basis for criterion selection

No.	Criterion	The basis for criterion selection
1	2	3
1.	Productivity index	This criterion is very important for determining utilisation possibilities of abandoned land as it shows quality and value of the soil. According to the Regulations of Afforestation in Non-forest Land (2004), afforestation can be initiated in agricultural land with the productivity index not higher than 32. If the index is higher than 32, it is expedient to use abandoned land areas for agricultural purposes. This study determines productivity index determined according to soil productivity evaluation plans by calculating the average agricultural land productivity index.
2.	Distance from the settlement centre (km)	The distance of land plots from the settlement centre is of high importance to the farmers. If the land is quite far from the settlement, cultivation of such land is significantly more expensive. This study is based on the presumption that the further abandoned land is located from the settlement centre, the more suitable it is to afforestation.

1	2	3
3.	Configuration (regular – 1, irregular – 0)	Configuration of the abandoned land area is also important for the analysis of land utilisation possibilities. Farmers find it easier to cultivate regular-shaped (rectangular) land plots. This study is based on the presumption that the more irregular-shaped abandoned land area is, the more suitable it is to agricultural activities.
4.	Size of land plots (ha)	Land plots greater in size are more convenient and profitable to cultivate. Size of the land plot is a significant indicator in determining utilisation possibilities of abandoned land as the bigger land plot is, the more suitable it is to agricultural activities.
5.	Access by vehicles (yes – 1, no – 0)	All land plots should be accessible by vehicles. Thus, if the abandoned land area or the land plot where it is located cannot be accessed by car, this abandoned land should be used for afforestation.
6.	Reclamation status (not drained – 0, drained to a large extent – 1, drained – 2)	The soil of sodden, undrained land plots is difficult to cultivate. This study is based on the presumption that abandoned land located in undrained area is more suitable to afforestation.
7.	Special conditions of land and forest use (not applicable – 0, applicable – 1)	Special conditions of land and forest use impose certain limitations on farmers in terms of land cultivation. Hence, the study is based on the presumption if abandoned land area or land plot where it is located are applied special conditions of land or forest use, this land should be used for afforestation.
8.	Interposed between forests /adjacent to the forest (interposed/adjacent – 1, not interposed/not adjacent – 0)	According to the Regulations of Afforestation in Non-Forest Land (2004), it is advisable to carry out afforestation in agricultural land interposed between forests. Hence, the study is based on the presumption that if the abandoned land plot is interposed between forests or is adjacent to the forest, it should be used for afforestation.
9.	Is a part of natural framework yes – 1, no – 0)	According to the Regulations of Afforestation in Non-Forest Land (2004), afforestation is allowed in protection zones of natural framework and as a part of natural framework. Hence, the study is based on the presumption that if the abandoned land are is in the territory of natural framework, it should be used for afforestation.
10.	Terrain (flat – 0, hilly – 1)	Flat-surfaced land plots are easier to cultivate. If the abandoned land area is hilly and uneven, it is much more difficult to use it for agricultural activities. Hence, the study is based on the presumption that hilly abandoned land should be used for afforestation.
11.	Prevailing granulometric composition (sand, sandy loam – 0, loam, clay – 1)	Crop productivity depends on granulometric composition of the surface. Due to the soil type, sands are not suitable to intensive agricultural activities. The study is based on the presumption that if abandoned land area is in the sands, it should be used for afforestation.

Thus after the criteria necessary for finding the task solution had been selected and grounded, and various data sets had been used, the required data was fully collected. Criteria bounds are very important in finding solutions to the task, i.e. which abandoned land areas are expedient to restoration of agricultural activities and which ones are most suitable to afforestation. Criteria bounds differ depending on potential alternatives of abandoned land utilisation (afforestation or agriculture). The data matrix with criteria bounds for selection of different possible alternatives of abandoned land utilisation are provided in Tables 2 and Table 3.

**Table 2**

Data matrix for determination of which abandoned land areas are suitable to agricultural activities

Bounds	Criteria	Abandoned area number			min	max
		1	...	36		
max	Productivity index	24	28	36	14	47
min	Distance from the settlement centre, km	4.9	4.6	9.3	4.4	12.5
max	Configuration (regular –1; irregular – 0)	1	0	0	0	1
max	Size of the land plot, ha	0.1	0.99	3.79	0.1	3.79
min	Is a part of natural framework (yes –1/ no – 0)	1	0	0	0	1
max	Access by vehicles (yes – 1; no – 0)	1	0	1	0	1
min	Terrain (flat – 0, hilly – 1)	0	0	0	0	1
max	Reclamation status (not drained - 0; drained to a large extent – 1; drained – 2)	0	1	1	0	2
min	Special conditions of land and forest use (not applicable – 0 , applicable – 1)	0	0	1	0	1
max	Prevailing granulometric composition (sand, sandy loam – 0, loam, clay – 1)	0	0	0	0	1
min	Interposed between forests /adjacent to the forest (interposed/adjacent – 1, not interposed/not adjacent – 0)	1	1	1	0	1

**Table 3**

Data matrix for determination of which abandoned land areas are suitable to afforestation

Bounds	Criteria	Abandoned area number			min	max
		1	...	36		
min	Productivity index	24	28	36	14	47
max	Distance from the settlement centre, km	4.9	4.6	9.3	4.4	12.5
min	Configuration (regular -1; irregular - 0)	1	0	0	0	1
min	Size of the land plot, ha	0.1	0.99	3.79	0.1	3.79
max	Is a part of natural framework (yes -1/ no - 0)	1	0	0	0	1
min	Access by vehicles (yes - 1; no - 0)	1	0	1	0	1
max	Terrain (flat - 0, hilly - 1)	0	0	0	0	1
min	Reclamation status (not drained - 0; drained to a large extent - 1; drained -2)	0	1	1	0	2
max	Special conditions of land and forest use (not applicable - 0 , applicable - 1)	0	0	1	0	1
min	Prevailing granulometric composition (sand, sandy loam - 0, loam, clay - 1)	0	0	0	0	1
max	Interposed between forests /adjacent to the forest (interposed/adjacent – 1, not interposed/not adjacent – 0)	1	1	1	0	1

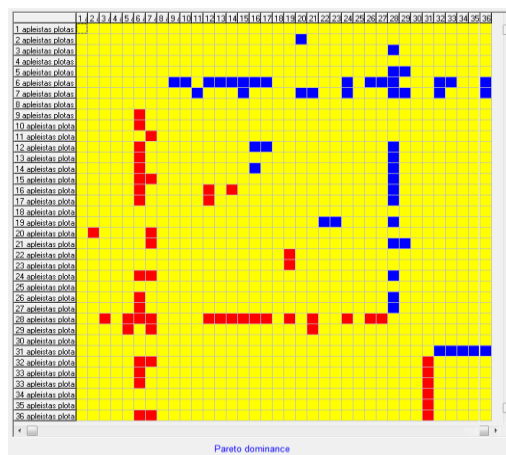
Hence, based on the created matrices and the aforementioned software, a multi-criteria analysis of abandoned land utilisation possibilities was performed. The obtained analysis results were summarised and corresponding conclusions and calls for discussion were presented.

## Discussions and results

Proper utilisation of abandoned land is an important factor for its analysis. In the majority of countries, utilisation alternatives include afforestation of this land or its use for agricultural activities by restoring land areas degraded with tree stands and scrubs. Afforestation of abandoned land has a positive impact on the climate change mitigation and development of forest area and ecological stability.

Currently, there is 69994.60 ha of abandoned land in Lithuania, which makes up 1.1 percent of the total area of the country. If all abandoned land areas were afforested, the forest coverage in Lithuania would increase to 2268466.98 ha, which makes up 37.7 percent. According to General Plan of Lithuania, if abandoned lands in Lithuania were afforested, the forest coverage in Lithuania could even increase to 37 – 38 percent. (Lietuvos..., 2002). Hence, the state has to promote afforestation of abandoned agricultural land in order to implement the provisions of General Plan of Lithuania (Mišku..., 2015; Nacionalinė..., 2016a). Restoration of agricultural activities in the abandoned land area is also important, especially if it estimated to have a high agricultural land productivity index. It paves the way not only for development of agriculture, but also for economic development.

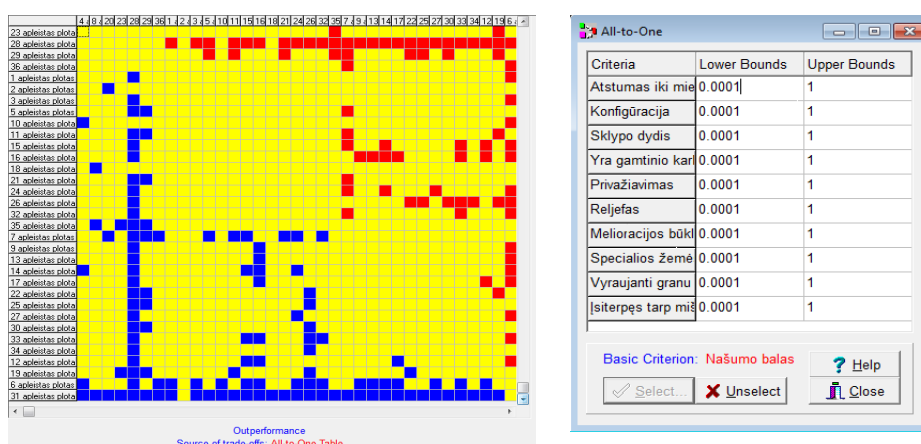
**Research results with DAM software.** According to Pareto dominance test results, abandoned land area No. 28 is the most suitable to agricultural purposes, and land area No. 6 (Fig. 3) is not suitable at all for agricultural activities.



**Fig. 3.** Pareto dominance test for the analysis of abandoned land areas suitable to agricultural activities

The rest abandoned land areas are distributed quite diversely. Abandoned lands areas No. 16, 17, 29 may be distinguished as being suitable to agricultural activities, however, and other land areas show one or several advantages, but a more detailed analysis is required in order to determine whether they are suitable to agricultural activities. The rest land areas are suitable to both afforestation and agricultural activities.

Further, an alternative dominance test is performed with only one main criterion being distinguished. In this case, productivity index is the main criterion. It is one of the basic criteria when performing analysis on abandoned land suitability to agricultural activities (Fig. 4).

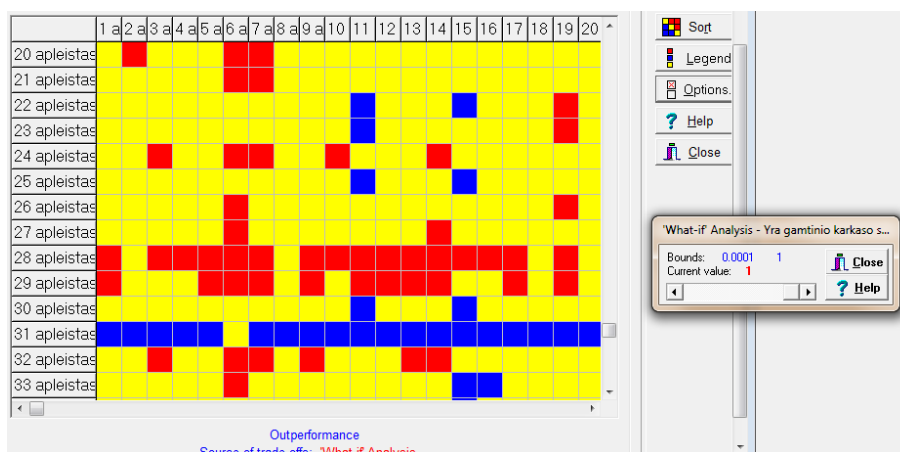


**Fig. 4.** Alternative dominance test with the main criterion selected (productivity index) for agricultural utilisation

It was determined that abandoned land area No. 28 remains the most suitable to agricultural utilisation in terms of productivity, however, in this case abandoned land area No. 31 is regarded as least suitable to agricultural activities, and land area No. 6 is also still regarded as less suitable to agricultural purposes. The rest land areas are distributed quite diversely.

Alternative dominance test was also performed with another criterion, i.e. granulometric composition which is prevailing in the abandoned land area. This criterion is important in terms of agricultural activities as crop yield depends on this criterion. According to the obtained results, abandoned land area No. 28 is still the most suitable to agricultural activities. Abandoned land areas No. 6 and No. 31 are still considered to be least suitable to agricultural activities.

In order to increase the accuracy of the analysis, the “What-if” analysis was performed by changing values of the following criteria: the land area is interposed between forests, it is a part of natural framework, there are special conditions of land and forest use. The results obtained remain the same, i.e., abandoned land area No. 28 is the best alternative for agricultural utilisation, land area No. 29 is also one of the best alternatives, and the worst alternative, as previously shown by Pareto and alternative dominance test, is abandoned land area No. 31 (Figure 5).



**Fig. 5.** “What-if” analysis with the criteria – abandoned land area is a part of natural framework

In order to determine abandoned land plots which are completely suitable to agricultural utilisation, the alternative dominance test was performed with all criteria. The results obtained are provided in Table 3.

**Table 3**

Optimal alternatives by all criteria

Criteria	Abandoned land areas optimal to agricultural activities
Productivity index	1;4;8;9;10;11;18;20;22;23;25; <b>28;29</b> ;32;34;35;36
Distance from the settlement centre, km	1;4;8;10;11;18;20;22;23;25; <b>28;29</b> ;32;34;35;36
Configuration	1;4;8;10;11; <b>28;29</b>
Size of the land plot, ha	4;8;10;18;20;23; <b>28;29</b> ;32;35;36
Is a part of natural	8;11;20; <b>28;29</b> ;32;36
Access by vehicles	1;8;11;22;23;25; <b>28;29</b> ;34;35;36
Terrain	1;4;8;10; <b>28;29</b> ;32;34;36
Reclamation status	8;20; <b>28;29</b> ;36
Special conditions of land and forest use	1;8;22;25; <b>28;29</b> ;32;34
Prevailing granulometric composition	2;4;8;10;18;20
Is Interposed between forests /adjacent to the forest	11;20;22;23; <b>28;29</b> ;34

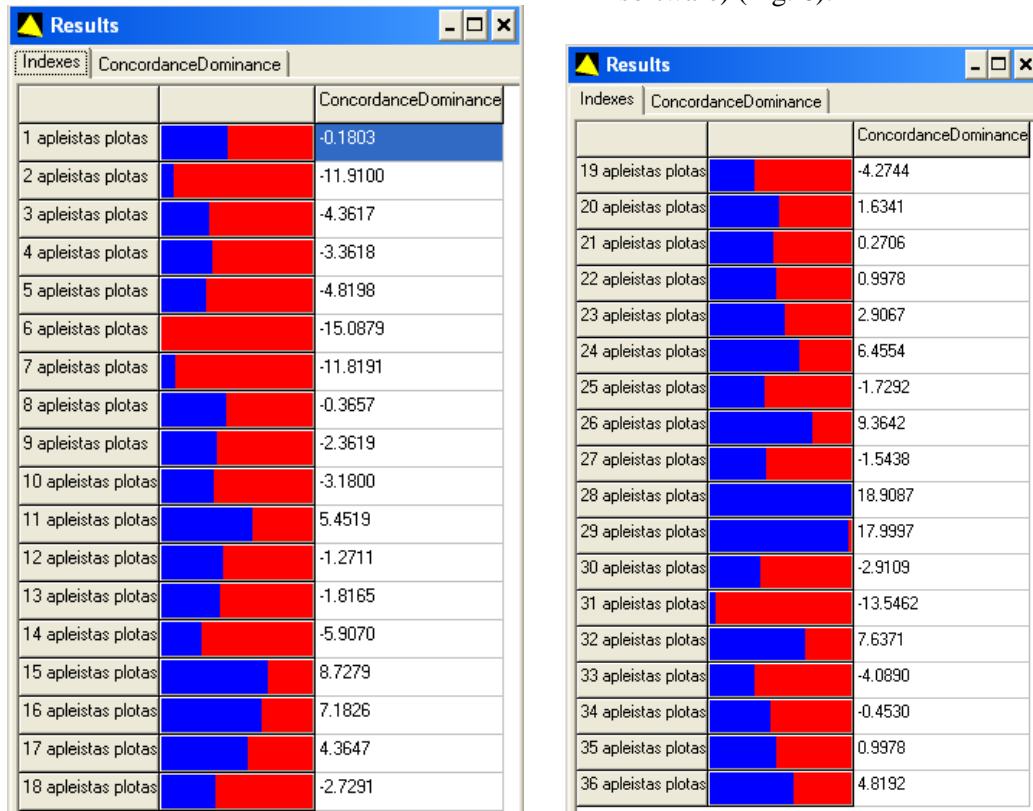
Optimality analysis with all criteria showed that abandoned land areas No. 28 and No. 29 are best suitable to agricultural utilisation by almost all criteria.

To sum up the results obtained, it might be claimed that abandoned land areas No. 31 and No. 6 are not suitable to agricultural utilisation as they are not optimal. Abandoned land areas No. 28 and No. 29 are most suitable to agricultural activities. Other abandoned land areas might also be potentially expedient to agricultural utilisation, but more detailed analysis is required to determine their suitability.

The analysis for determining utilisation possibilities of abandoned land for afforestation was carried out analogously as the analysis for determination of utilisation possibilities of abandoned land for agricultural purposes, i.e. Pareto dominance test and alternative dominance test were performed by setting out one main criterion and “What-if” analysis was carried out. It was determined that abandoned land area No. 6 is most suitable to afforestation as it is optimal in terms of its data. Abandoned land area No. 28 is unequivocally not suitable to afforestation, areas No. 29, No. 15 and No. 17 are not suitable either. The rest abandoned land areas are distributed quite diversely. Abandoned land areas No. 7 and No. 19 might be expedient to afforestation, other abandoned land areas have one or more advantages, however, their suitability for rational utilisation requires a more detailed analysis.

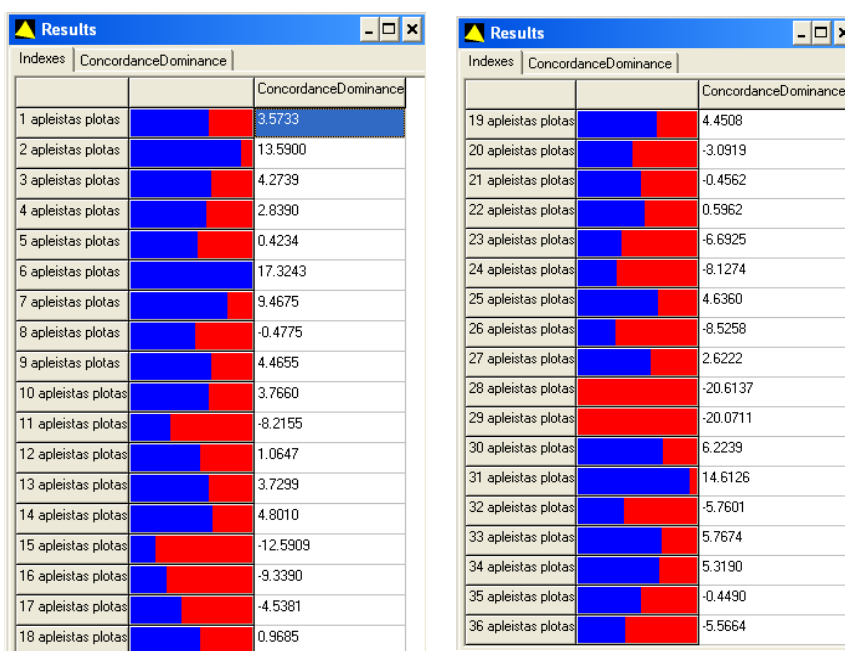
To conclude, multi-criteria analysis with DAM showed that abandoned land area that is most suitable to agricultural activities is area No.28, while areas No. 16, No. 17 and No. 29 being suitable to a lesser extent. Land area No. 6 is most suitable to afforestation, areas No. 7 and No. 19 being suitable to a lesser extent. Utilisation possibilities of the rest land areas are not clear as they have one or several advantages, but it is not enough to determine rational possibilities of their utilisation and more thorough analysis is necessary. HYPSE software is used for more accurate analysis as it does not only give a possibility to determine the best or worst alternative, the most suitable or less suitable activity with regard to a particular land area, but it also enables determination of rational utilisation of the land areas according to the results obtained.

**Research results with HYPSE software.** The analysis with HYPSE software was performed with the same criteria, whose weight is the same as it was in DAM, i.e., the weight of all criteria in terms of the result is 9.09 each. It was determined that abandoned land area No. 28 is most suitable to agricultural activities and area No 6. was determined to be least suitable to agricultural activities (the same as with DAM software) (Fig. 6).



**Fig. 6.** Results of the analysis of abandoned land areas suitable to agricultural activities

The analysis showed that abandoned land area No. 6 is most suitable to afforestation (the same result as with DAM) and that abandoned land area No. 28 is least suitable to afforestation (Fig. 6).



**Fig. 6.** Results of the analysis of abandoned land areas suitable to afforestation

The comparison of both utilisation alternatives of abandoned land areas by different pieces of software revealed that the majority of abandoned land areas (24) are suitable to afforestation and 12 abandoned land areas, which make up 9.25 ha, are suitable to restoration of agricultural activities (Table 2).

**Table 2**

Indicated rational utilisation possibilities of abandoned land areas

Analysed activities of abandoned land areas	Numbers of land areas suitable to a particular activity	Total (ha/number of abandoned land areas)
Forestry activities	1; 2; 3; 4; 5; 6; 7; 8; 9; 10; 12; 13; 14; 18; 19; 21; 22; 25; 27; 30; 31; 33; 34; 35	10.58/24
Agricultural activities		9.25/12

The greatest number of abandoned land areas which are suitable to afforestation are located near the already formed forests, and land areas suitable to agricultural activities are closer to cultivated fields, they are not interposed between forests or adjacent to them, can be accessed by vehicles and are not far away from settlements.

### Conclusions and proposals

1. The issue of abandoned land is relevant in all Europe. In most cases, the land is abandoned due to natural, social, economic and politic reasons, bad geographic position or holding structure.
2. In the majority of countries, utilisation alternatives include afforestation of this land or its use for agricultural activities by restoring land areas degraded with tree stands and scrubs.
3. Multi-criteria analysis of 36 abandoned land areas by 11 defined criteria showed that the majority (24) of abandoned land areas, which make up 10.58 ha, are suitable to afforestation, and the rest (12 land areas – 9.25 ha) are more suitable to restoration of agriculture.
4. Multi-criteria analysis is an objective tool which enables complex evaluation of the alternatives (in this case – utilisation possibilities of abandoned lands) and provides the best solutions in terms of the defined criteria. Therefore, the methodology provided for determination of best utilisation possibilities of abandoned land by 11 criteria can be efficiently used for the analysis of utilisation possibilities of abandoned land in other areas.

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