

Land Consolidation Based on GIS

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Abstract— Land consolidation is still needed in Hungary 25 years after the change of the political system. The land structure has been fragmented, the landownership and the land use have been separated and the undivided joint ownership also makes problems. The absence of legal, economical and technical conditions makes the fulfillment of land consolidation difficult. On the other hand, it would be crucial to have an informatical application that could be widely used. While consolidating land, land quality and other essential influential aspects should be taken into account. Geoinformatics is the most efficient solution. DigiTerra being a Hungarian development has got the modul of Land Consolidation which deals with the tasks on the basis of cluster analysis. The improved version of the software would be suited to support a complex land consolidation.

I. INTRODUCTION

The aim of this paper is to present how it is possible to carry out land consolidation with the help of geoinformatics. GIS can support decision making processes and it is the goal of the present paper to introduce a method that can contribute to it.

Let us first take a look at land consolidation in Europe. European countries think of the use of land consolidation in different ways. While in Western European countries land consolidation is the means of development of rural areas, Central and Eastern European countries use it to reform land. As for the former, a rural area should be developed to increase agricultural productivity, environmental sustainability and even the status of rural households. Regarding the Central and Eastern European countries, land reform has two aims. On the one hand, it needs to make up the consequences of collectivization. On the other hand, it deals with social equity concerns [1].

Land fragmentation reduces the productivity of land. In the paper, Reference [2] collects the reasons for this problem. First of all, there are space-consuming borders between the parcels. Secondly, it makes the contiguous parcels less productive. Along with these negative impacts, Reference [2] introduces the advantages of fragmentation such as employment or low costs, too. Since fragmentation has both positive and negative sides, the most essential thing is to find the middle that might be good for everyone. To be able to make the right decision on land fragmentation, the government needs to have reliable measurement indices. But the current indices cannot fulfil this task since some crucial factors are ignored [3]. It seems that land fragmentation is still a problem in European countries. To solve it, Reference [3] suggests a solution in the paper. The solution is LandFragmentS (Land Fragmentation System) which joins GIS with a multi-attribute decision making method (MADM) to make a “global land fragmentation index”.

One reason of the necessities of land consolidation in Hungary is that the land structure has been fragmented. Another reason is the disunion of land ownership and land use. In other words, sometimes the owner and the user is not the same. What is more, the undivided joint ownership is a problem, too. Statistics have shown that the rate of agricultural land is the highest in Hungary after Denmark in the European Union. Although the government has recently started to set it, the land structure is being even more fragmented.

II. LAND TENURE LOOK-AROUND

A. The Hungarian Land structure

In Central and Eastern Europe after 1989 there were land reform approaches. In Hungary land reform meant compensation, distribution of physical parcels and privatization through sale. In the course of compensation people were compensated with land because of former prejudices. The parceling was carried out in a short time therefore it did not really fulfill its goals since there was not any restrictions and legal person could also buy a land.

Bipolar land structure can be found in Hungary: there are either small land holdings or large land holdings; there are no medium sized agricultural holdings (See Table I). In the last few years it has become better and better and more and more farms over 50 hectare have been born.

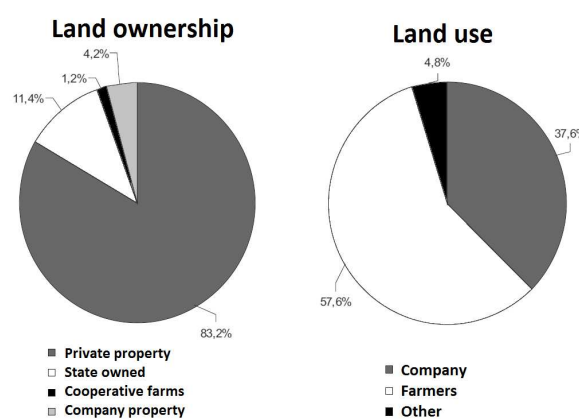
The rate of large land holdings belongs to the lowest in the European Union. With its 3,9 % Hungary is behind the average of 11 %. Nowadays there are about 3,3 million land owners who have 2 hectare agricultural field and 1 million acquire incomings from land renting.

TABLE I.
THE DISTRIBUTION OF THE FARMS

	Gazdaságok száma (ezer db)	Megosztás (%)	Terület (ezer ha)	Megosztás (%)	Átlagos terület (ha)
10 ha alatt	279,3	78,5	758,9	11,7	2,7
10-30 ha	47,1	13,2	797,9	12,3	16,9
30-100 ha	20,4	5,7	1064,4	16,4	52,2
100-300 ha	6,8	1,9	1153	17,8	169,6
300 ha felett	2,4	0,7	2719,3	41,8	1133
Összesen	356	100	6493,5	100	18,2

Ministry of Agriculture (2011)

Because of the determining role of private property (83%) the land use of economic organisations is based on land tenancy. The formed land sizes are not suitable for the maintenance of viable farms. The structure of land tenancy can slightly help this situation but it does not provide real solution. The reason for this is that it pulls out the capital from the production. In Hungary land tenancy is not the sign of the expansion of competitive farms but the sign of the clear consequence of compensation and privatization (See Fig. 1). The goal is the formation of an appropriate land structure and a competitive size.



1. Figure. Difference between land ownership and land use

B. New land market regulation in Hungary

A new land distribution law was brought in on 1st May 2014 in Hungary, because the moratorium of land purchase finished. The law supports individual and family farmers who are residents. So only the private person can acquire agricultural land who is a farmer and who has got the license of the authority and the Land Use Committee. The maximum size of the land can be 300 hectares. According to the government, the winner of the regulation can be the circle of small and medium sized land holders consisting of individual or family farmers. Therefore a decision has been made to create a 20 and 80 % rate of small and large land holdings, in favour of smallholders. The government has modified the support system so that farmers with over 1200 hectare lands cannot get any support. The European Union has not accepted the law yet; debates can be expected in the European Parliament.

C. The antecedents of land management

Hungarian land consolidation is preceded and after the regime change the following provisions can be found [4]:

- 1994: land law making voluntary land exchange facilitate
- 1994-2005: pilot projects
- 2001: Elaboration of Bill on land consolidation
- 2002: Acceptance of land policy by the Parliament
- 2002: foundation of National Land Agency
- 2004: formation of National Land Consolidation Strategy

More pilot projects were going on with foreign partners after the change of the political system, for example: TAMA I-II. with German partner or PRIDE, TALC with Dutch partner.

Unfortunately, the above-mentioned projects reached only partial results. The reason for this is that the foreign models could not be adapted totally because of legal, administrative and social differences. More informatical ideas such as linear optimization, combinatorial modeling were created for the solution of the problem, but their application did not spread.

D. Conditions of land consolidation

According to the paper about land consolidation strategy [5], there are three possible ways of land consolidation: spontaneous, institutionalized and intensive. Land consolidation based on voluntary land exchange has not been able to prove its effectiveness and the intensive land consolidation would need a lot of resources. Therefore, both national economically and socially the institutionalized land consolidation seems to be feasible.

Beside the present institutions, the bureau and the land registry could carry out land consolidation. The reason for this is that the system of land registry has been developed in the last few years (electronical cadastral register, development of database), and it has representation in all administrative areas. Since it is a complex task, in addition to land owners and land users, the different advocacy organisations, the municipality and the representatives of the competent authorities should be involved into procedures.

III. POSSIBLE INFORMATICS SOLUTION OF LAND CONSOLIDATION

A. General geoinformatical support

In the course of land consolidation, the several sources should be handled together supported by procedures of geoinformatics. The use of geoinformatics contributes to the appearance of synergy that provides new opportunities. Its introduction enjoys advantages in terms of fast and divided data access, the reduction of redundant activities, and –with the help of appropriate maintenance – reliable and up-to-date information. Geoinformatics supports land consolidation on different informational levels. On the level of management it helps the ministries with special information. On the level of decision it provides answers for questions such as how it is possible to guarantee the advocacy of farmers; how it is possible to introduce the advantages of land consolidation; or how it is possible to make the municipalities, farmers and authorities interested. On the level of operation it contributes to the technological planning and the formation of land structure [6].

GIS can be applied in almost all parts of the processes of land structure strategy:

In the phase of preparation the impoundment of the area can be carried out in the data base of cadastral registry. This procedure can immediately be visualised in maps. The owners of the areas, the land users and their demands can be handled in the attribute table of the data base.

On the previous land consolidation plan the tracks of linear constructions (roads, water furrows) can be marked

that can localize the further divided blocks. On the basis of demands different land consolidation variants can be made.

In the course of land consolidation the occurrent calculational demands such as the weighting of factors that modify the value or the release of contradictions can also be treated.

Publicity can contribute to the success of land consolidation. It is supported by visualization and publication of plan variants.

The results can be easily converted from the database into cadastral registry. The web and visual applications make the acceptance more simple.

Such a GIS can contribute to the choice of the most appropriate land consolidation plan.

B. DigiTerra - land consolidation functioning

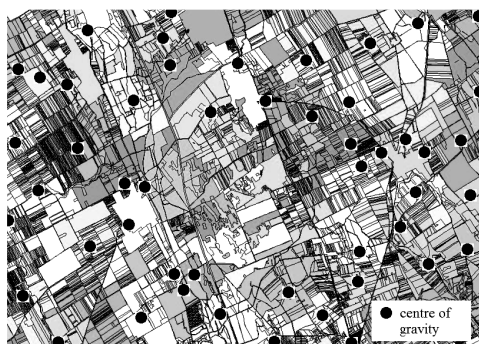
There is a Hungarian geoinformatical development called DigiTerra which provides informatical supports for forestry and agriculture. One of the softwares is DigiTerra MAP that can help land consolidation.

The functioning of the above software is based on Cluster analysis. Although the original land structure remains, the software reallocates the ownership rights so that the parcels get to another farmer.

The very first step of the method is to define the centre of gravity of the area belonging to the owner (See Fig. 2). Then all parcels get numerical values relevantly for all owners. These values are based on 3 parameters [7]:

- the previous owner,
- the nearest centre of gravity of distance,
- the rate of the distance of the nearest and the furthest centre of gravity.

The owner receiving the highest value will get the parcel.



2. Figure. The centre of gravity of the area belonging to the owner

As every coin has two sides, DigiTerra has both advantages and disadvantages. As for advantages, DigiTerra is based on voluntary land exchanges. What is more, it makes the reallocation on the basis of objective viewpoints. As for disadvantages, on the one hand, DigiTerra does not reduce the number of parcels. On the other hand, it works well primarily with numerous and small sized parcels. Besides, it ignores important factors that can modify the value of the property.

C. Ways of development

There are three main ways of development. Factors such as size, shape, distance or soil quality should be

taken into account. What is more, the owner’s site should also be added. Besides, the formation and unification of same size areas would contribute to the change of land structure, as well.

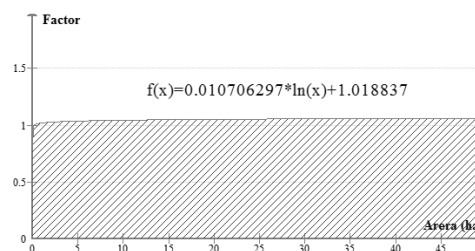
Land consolidation should be based on such an evaluation system that can both guarantee the value of the property and save the interests of owners. In Hungary golden crown has been in effect since – in snatches – the middle of the 19. century. Since land registries use this, it is practical to start here the evaluation. In the course of property real estate not only soil quality but also other crucial factors are taken into account. For instance: shape, area, size; geographical location; accessibility, road conditions; relief and slope condition; water management, melioration, irrigation conditions, things that can block cultivation, demographical conditions, farming culture, inclination for frostbite/ hail damage/wild animal damage; fencing; aesthetic impression; environmental status and pollution; economic situation; infrastructure and utilities; natural protection; culture status. To determine the collateral value of land, correction needs to be taken into consideration according to Decree No. 54/1997. (VIII.1.) FM.

Although it is essential to use the main factors in the course of development, too many aspects can also cause problems when convincing the partners. Table II contains a reduced list with correction interval.

TABLE II.
CORRECTION INTERVAL OF FACTORS

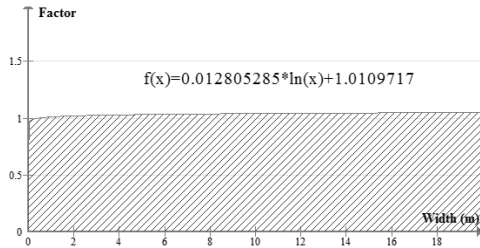
	Max factor	
	low	high
Area	-10	10
Shape	-10	10
Distance from clear	-20	15
Distance from paved road	-30	25
Slope	-20	0
Clime	-20	10
Natural protection	-20	0

The size of the area means that to a certain degree the specific value grows because there is higher demand for larger parcels. Fig. 3 presents data with logarithmic model.



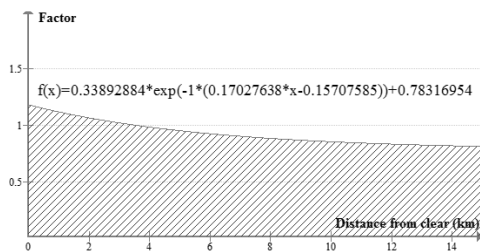
3. Figure. Factor depending on area

The shape signifies that narrow parcels are more valueless than the broader. Fig. 4 shows data with logarithmic model.



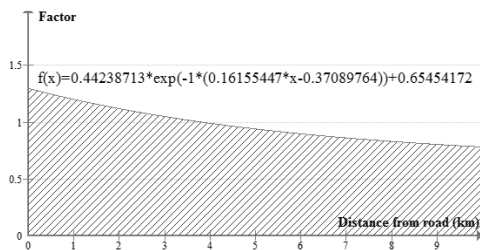
4. Figure. Factor depending on average width

The distance from the clear denotes that the lower the distance from the clear is the more valuable the parcel is. Data can be illustrated by negative exponential model (See Fig. 5).



5. Figure. Factor depending on distance from clear

As for the distance from the road, if the farmer can approach his parcel under all weather conditions, the value of the parcel will be higher. Correction factor can be presented by negative exponential model on Fig. 6.



6. Figure. Factor depending on distance from paved road

All in all, regarding the steps of the method, it is essential to determine the value of the land and to form unit areas inside the parcels. Moreover, the site of the farmer is needed and the new owners should be assigned to the parcels, too.

The consolidation can be carried out regarding the owner and the user. The owners can give their sites since it is not sure whether the site is close to the calculated centre of gravity.

IV. CONCLUSIONS

Irrespective of land policy, land consolidation can be explained in many ways. In Hungary land concentration would contribute to competitive farming to a great extent. To accomplish it, several conditions should be fulfilled such as a pliantly applicable informatical solution. Geoinformatics can support the planning in the course of land consolidation and it can contribute to its success, as well. The method should be formed in a way that it would serve farmers' interests. It is provided by the appropriate property evaluation and the opportunity for adding the site. The application itself cannot solve land consolidation but it can contribute to its realization.

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