

**Nyugat-magyarországi Egyetem**

**PhD dissertation theses**

**THE LAND EQUIVALENT RATIO  
AS AN ELEMENT OF LAND CONSOLIDATION**

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## Research topic relevance

Hungary's agricultural land is one of its national treasures, and is an irreplaceable, continuously and conditionally renewable natural resource. Protecting it, and promoting the best uses of its features, are primary tasks. Before agrarian and rural development may proceed, it is necessary to be able to classify and provide a true evaluation of the land's agricultural characteristics, in other words, its soil attributes and the production types and locations.

The unambiguous definition of the *exchange-value* used in land consolidation procedures is also an important question. Current prices occurring in the land market are not entirely suitable for defining the real value, but we are forced to calculate using these for the immediately foreseeable future. The *aranykorona* (AK)(traditional Hungarian unit of evaluation, dating back 150 years) does not give a perfect value either, because this unit is an index which expresses the quality of the land, and today should be seen as an approximate value, especially in view of the differing branches of cultivation.

Because the land market is still highly limited and undeveloped, there are numerous open and unanswered questions when it comes to evaluating agricultural land. Foreign experience shows that estimating the value of agricultural land is still a requirement, even if the land market is fully operating, and the system of buying and selling, as well as renting land, is well developed. The reason for this is that for a whole range of macroeconomic decisions, the current expected value (not the price) of land needs to be known.

## Research aims

The main aim is to achieve rational management of land resources, which naturally entails employing *modern methods* of land use, land protection and land evaluation. The structure of ownership that has developed, as a result both of the land compensation process and of the consolidation of lands under shared-ownership, has been recorded both on land survey maps and in the land register. The so-called *land equivalent ratio* could appear as a supplementary item in the land register. The elaboration, modelling and application of this ratio are the main aims of my research. Introducing this ratio would assist the future planning of land consolidation, with emphasis on the fact that the model under development has to be equally suitable for local and land market conditions (taking into consideration the well-developed small-area land uses of plant cultivation and animal husbandry, and the removal of restrictions on land ownership).

A further aim of the research involves the practical application of the expected future land consolidation law. A land equivalent ratio will make it easier to find solutions for land consolidation, and will thereby help strengthen economically viable branches of the economy, and encourage the establishment of new ones. It could play an important role in compulsory land purchase procedures, in land exchange transactions and in the development of the land market generally.

## Materials and methods of investigation

The territory of the model is in a mixed-use belt of land in the County of Fejér, in Transdanubia. The surface of the surrounding area is variable (Bakony, Vértes and Velencei hill ranges). The south and south-east of the county is made up of the fertile loess soils of Mezőföld, the natural boundary to the east is the River Danube, and the largest lake is Lake

Velence. Two thirds of the territory is cultivated agriculturally, 7% is covered by forest, and 12% has been taken out of cultivation. Fejér County has the lowest ratio of forested land in the whole of Transdanubia, which is partly due to the high quality of the agricultural land, and partly due to the fact that the productive areas are extremely weak for forestry.

The investigation focused on the areas in the territory of the model which are cultivated as fields, grasslands (pastures) and forest. The data used for calculations and analysis are the following:

- land registry map: cut-off points of land section boundaries, cut-off points of subdivision boundaries, plot numbers,
- land registration certificate data: plot numbers, the area of the land sections, the area of the subdivisions, branches of cultivation, quality category, AK (*aranykorona*, see above) value, site productivity value (TÉ).

The quality category, AK and TÉ data provided by the Fejér County Land Registry Office were collected from the original registers for "site productivity determination" in the settlement of Pátka, compiled in 1983. The quoted quality categories are representative of the soil characteristics of the land sections in the territory of the model. A certain regularity may be discerned in the ratios, based on the calculation of the TÉ/AK ratios.

The investigations and calculations were carried out for 37 land sections. The results thus gained made up the observation data, which were included in the analysis. Essentially, the specific forint/hectare rate was calculated using the equation for calculating the price offered by the National Land Fund, and the results thus gained were used in the regressive calculations. The site productivity (TÉ) values were included in the analysis as follows: The AK values related to the subdivisions that appear in the land register are given in proportion to the area. The available TÉ values, however, were recorded per hectare. As the boundary of the subdivision to which the TÉ refers is, in some cases, the same as the quality category subdivision boundary, their area may be derived from the registry data. For other land sections, the productivity value was apportioned based on the area value, and the ensuing data was included in the calculations.

Using two types of data (ecological and economic) and a linear regression equation, a new index, or ratio was arrived at: the *land equivalent ratio*.

## Statistical analysis

The most important part of the analytical work is investigating the stochastic relationships between the quantitative criteria. On investigation it can be established that the qualitative data of agricultural land can be quantified using the site productivity value (TÉ). This enables pricing to be carried out by conducting a statistical examination, which simplifies the practice of land evaluation, and facilitates deeper economic analysis.

One of the variables in the bivariable correlation (in the example,  $x$ ) is the site productivity value (TÉ). Its dependent variable (in the example,  $y$ ) is the value expressed in forints. The basis of the primary analysis was linear regression. To measure how close the stochastic relationship is, a linear correlative coefficient was used.

The result of the calculation:  $r_{xy} = 0.97$ , which shows a close relationship between the TÉ and the forint per hectare value. Our calculations, therefore, support the thesis that the site productivity value (TÉ) of land has a strong effect on pricing.

The resultant linear regression equation:

$$y = 7631x + 14899$$

can be rounded up to make calculation easier, as follows:

$$y = 7600x + 15000$$

In place of  $x$ , the average site productivity value should be given. The  $y$  value gives the land equivalent value, in other words the specific value for the agricultural land, in forints, for the specific given land section. Using this formula simplifies the process of defining, in forints, the value of land sections. A further advantage is that the site productivity value plays a role, which better expresses the ecological value of the agricultural land. The reason for this is that land quality is defined over smaller areas (10-12 hectares) and involves more detailed soil examinations. Among the factors taken into consideration are exposure, inclination and meteorological factors.

The results and values achieved using the research methods are realistic, and representative of the areas under investigation. Proof is demonstrated by calculating the margin of error. The values achieved using the equation based on the yield calculations for calculating price offers were compared with the actual purchase prices, as provided by the National Land Fund.

During evaluation of the task, the margin of error for the regression-line fit was calculated. It was established that the calculated values differed from the offered values (based on yield calculations) by an average of 2,842 forints. The relative error is 0.7%, so the points representing the offered values fit the regression line well. The correlation of 0.97 also demonstrates the close relationship between the TÉ and the offered values.

Our analysis supports the proposition that employing mathematical tools can make it easier and faster to define the economic value of land, and provides a stronger basis for this.

A thematic map was prepared of the land sections selected from the territory of the model. This is the value map, showing soil quality categories, to which we have added the specific values and the land equivalent values (in forints per hectare). The map was created using ArcGIS software. By reading the data on the map, it is very quick and simple to define the value in forints of specific land sections.

## **Summary and theses of the scientific results**

1. I have analysed and explored the current conditions of the ownership and property structures in agricultural land, as well as the related expected land consolidation requirements. I have established from the land register that the ownership structure is extremely fragmented, but that the natural state - because of use by tenants and undivided shared ownership - diverges significantly from this. Precise knowledge of the relationships between ownership and use is a basic condition for the objective planning of land consolidation. I have shown, in the territory of the model, the necessity of using data from several sources (land register, soil maps, orthophotography, land cover maps, contour maps, topographical maps, site surveys, etc.), and their synthesis in evaluation tasks which occur in land consolidation.
2. I have carried out the analysis of the indices used in Hungary for agricultural land quality taking into account the expectations of the 21<sup>st</sup> century, focusing especially on their application in land consolidation, which is expected to be more frequent in the future. It can be seen that the currently registered land values are unsuitable for defining the required exchange-values. For this reason, I have elaborated an index

which can be used relatively simply and quickly, and with an acceptable degree of approximation, to define land values which may occur in connection with agricultural land consolidation.

3. The methodological result of my research work, based on existing and widespread indices (*aranykorona*, site productivity value): the land equivalent value can be used as a basis for conducting land-related processes (land exchange, land consolidation, compulsory land purchase and expropriation). The applicability of the method is proved by the calculations carried out in the territory of the model.
4. The statistical calculations and the tightness of the stochastic connection justified the theory that the effect of site productivity value (TE) on pricing is important and determinative.
5. The average of the agricultural land values of the different land sections, which is necessary for calculating the land equivalent ratio, offers a realistic opportunity for its inclusion in the property register, and its practical application. The observation and application of the market economic value of the land equivalent could play an important role in various land-related fields (land use, planning, land consolidation, consolidation of lands under shared-ownership, compulsory land purchase).

### Using the results

The significance of the exchange value in *land consolidation*. The land equivalent ratio has a role in the technical solutions of land consolidation, namely in the division of land areas. The tried and tested interactive map editing software (ITR) can be used to divide land according to its value. The value that has been used until now in such calculations is the AK value for the specific land section. This would be replaced by the *land equivalent value*, which is perfectly appropriate for the requirements, as it is a *forint* value for the land which is being divided. Since this is also a measure of value, as the AK value is, it can be substituted in forint units of calculation. In western countries, land values have been divided using a land price since before the Second World War.

The role of the land equivalent ratio in *compensation for compulsory purchase procedures*. The use of the land equivalent ratio is especially relevant where values need to be defined quickly, in the interest of accelerating the various procedures. Such tasks mainly occur in compulsory purchase and expropriation, in establishing the value of exchangeable land, and when land is taken out of production.

*For pricing land*. Appraisers use calculations based on the yield indices offered by the National Land Fund for defining the prices of agricultural land. Using the land equivalent ratio in these instances would also make calculations easier and faster. The ratio is a figure which can be put to good use by the National Land Fund. Using the land equivalent ratio as the basis for negotiations with owners could speed up the process of defining price offers for agricultural land.

Because the land market is poorly developed, there is not enough data to enable values to be defined on the basis of market data analysis or direct price comparisons. This is a further reason for using the land equivalent ratio.

*Defining replacement values for changes in branch of cultivation*. Defining replacement values means evaluating land on the basis of the replacement principle, which assumes that the productivity of land taken out of cultivation can be replaced with investment of additional capital in the remaining agricultural areas. The capitalised value of the excess investment is assumed to be equal to the price of the land which has been taken out of production.

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