

UNIVERSITY OF WEST HUNGARY  
FACULTY OF FORESTRY

Doctor of Philosophy (PhD) dissertation

**COMPARISON OF THE ECOLOGICAL BASIS OF THE FORESTRY AND  
AGRICULTURAL LAND EVALUATION SYSTEMS, POSSIBLE WAYS OF  
HARMONISATION**

Written by:  
Zoltán Patocskai

Sopron  
2012

Doctoral School School: Roth Gyula Doctoral School for Forestry and Wildlife Management

Chief: Prof. Dr. Professor Alexander Farago

Program: The Biological Foundations of Forestry (E2)

Program leader: Professor Dr. József Kolozsár

Supervisor: Associate Professor Dr. habil Gábor Kovács

## **1. RELEVANCE OF THE SUBJECT**

Land use dates back for thousands of years in the Carpathian Basin. Independently of the way of land use, people were always interested in estimation of the yield. To be able to plan the management, we have to know our resources, its usability and last but not least its value, in detail. The evaluation of soil - as a natural resource of distinct importance – has been in the focus of interest since the last century.

The need for replacement of the multiply obsolete land evaluation system currently in use, has been long expressed. Many researchers and farmers in practice have already called attention, that the incremental Gold Crown land evaluation system needs to be replaced in the Hungarian real estate cadastre.

The National Research and Development Program (NKFP 2001-2004) funded the development of the so-called D-e-Meter system, a modern information system for rating the environmental aspects of land evaluation. With the support of the Economic Development Grants of the National Development Plan for Development of Applied Research employees (GVOP 2005-2008), the possibility was opened to apply the system in a model area. The developed system provided the basis for the implementation of an integrated land evaluation system, which is able to express not only economic elements of agricultural use, but of other land use forms too (4F NKFP project 2005-2007).

In the project an information system was developed by the research and development consortia, which includes on-line GIS tools for map visualization of the land-value, crop modeling based on land quality and other criteria, as well as the planning of land-use based on computer-maps.

The information system is based on the land-evaluation system. The agricultural land classification ratios are developed, and the question is whether there are there ways for the classification of forested areas on an objective basis - based on measured data, in numerical form. The completion of the evaluation methods of different land use systems with economic calculus procedures, we can get to a new land evaluation system, which makes it possible to replace the gold crown value by expressing the actual value of any possible landform. Based on these we can then decide over the most profitable management mode. For drafting the possible alternatives, evaluation of different agricultural land use forms have to be comparable.

The high importance of this topic is supported by the fact that our country, despite the fact that forest cover grew in the last hundred years from 12% to nearly 21%, is still one of the least

forested countries in Europe. According to current plans of the National Forest Programme, the forest cover should grow up to 25% till 2020.

## **2. OBJECTIVES**

The basic aim of the author of this thesis is to review the existing domestic and international site-evaluation systems, as in the different economic sectors, habitat evaluation methods differ significantly from country to country and even within our own country.

The only proper, objective grading system in our country, which can satisfy the present-day needs, is the D-e-Meter system, which is supplemented with IT-systems, and works based on thematic digital maps, measured and quantified data.

The research was designed to join the NKFP-2004-4/015. project titled "Land quality, land value and sustainable land use in the European Union that are between", to harmonize the data of the 1:10000 scale digitized genetic soil maps used in the D-e-Meter system for the forest land evaluation, and to develop the forest site-scores, thus establishing the objective basis for a forest site evaluation system.

To ensure that in the future the land evaluation for each of the three land use systems can be performed without problems, the author had been setting the target to unify the site description methods of agricultural, forest and grassland habitat management. As the grasslands habitat rating criteria and indicators can completely be found in the agricultural soil and site descriptions, only the agricultural and forest soils and site evaluation had to be standardized.

## **3. RESEARCH METHODOLOGY**

The thesis is basically using data of the agricultural and forest soil / site description systems currently in use.

In order to enable the site classification for all the agriculture, forestry and grassland management at the same time, the author standardized or developed those categories, indicators. The methodology of the agricultural soil and site description, the writing of soil protocol can be found in the Agroinform publications with the title "Guide for the large-scale national soil mapping implementation (Annex '88)" Agroinform publication. The methodology of the forest site description is included in the publications of the National Forest Service, titled "Guide to the preparation of forest resources management plans".

Description of the agricultural soils consists of on-site inspection reports and laboratory test results. In the forest practice, the site description is composed of the T-sheets (sheet describing the site) and the lab test results table.

The author analyzes which national databases should be considered for the investigation. Henceforth the author analyses the data of the National Forestry Database. He examines how the individual forest stands and site information could be applied to help reaching the objectives of the research. He determines the test methods required for data analysis. Shows up which data may be included in the study. He gives a detailed description over the importance of separation of the particular tree species-groups based on origin, mixture ratio, age and site description methods in order to quantify the yield of them.

He analyzes the site data for the tree species-groups, and quantifies the timber yield for the particular site category variants. He determines the national average values of timber yield capability, which he uses for counting the factor-numbers for the D-e-Meter system. He develops a 100 point - land evaluation system for forest sites.

#### **4. RESULTS**

The author provides an overview of the international and domestic situation and problems of land evaluation systems. He states that the EU has no uniform system of land evaluation, developing them is a national responsibility. He analyzes the status of the agricultural and forestry land evaluation. The author presents in his work the most important categories - parameters and systems that are currently used in some countries in the world. He states that the existing domestic land evaluations for agricultural and forestry purposes are only subjective assessments of estimations.

The thesis compares the domestic agricultural and forest soils and site description systems. Compares the different site category ratings of the different land use systems, and establishes their particular unified categories.

He states that requirement imposed today, even more in the future, on the land evaluation is to build up the system on measured data, as well as on the a statistical processing of measured data, which provides information on margins of error and accuracy of numbers describing soil quality.

He quantifies the national average timber yields for the particular tree species-groups. The dissertation determines for 4160 cases of 20 tree species-groups the site category yield rates. He compares the yields of site categories for each trees species with the national average timber yield values. This creates the objective basis for forest site evaluation. It notes that data could be used in 467 cases from the 4160 cases – for land evaluation –, and gives quantitative information about the margin of error of values and accuracy of timber yield potential. He determines land evaluation ratings in 467 site type categories for the *D-e-Meter* system.

## 5. THESES

1. In the thesis the author systematized the international and national land classification systems, their main aspects and characteristics. He states that requirement imposed today, even more in the future, on the land evaluation is to build up the system on measured data, as well as on the a statistical processing of measured data, which provides information on margins of error and accuracy of numbers describing soil quality.

2. The researcher conducted for forestry land evaluation purposes the fitting of the 1:10000 scale genetic soil map data, currently used by *De-Meter* system for land evaluation in case of agricultural use currently under classification used for and mapping of forest land for rating.

3. The author determines the national average values of potential timber yield ( $\text{m}^3/\text{ha}/\text{év}$ ) with statistical methods for 20 tree species, depending on their origin, and the timber yield rates for the particular site categories in numerical form. He creates factors from the resulting data, which demonstrate the yield capacity of the particular site categories on national level. He calculates the factors in 467 cases for tree-species groups and site categories, and incorporates the results into the forestry module of the *D-e-Meter* system.

4. The national arithmetic mean of yield potential of the seed originated pedunculate oak tree species group was  $9.02 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 2.020. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 39 different site types.

The national arithmetic mean of yield potential of the shoot originated pedunculate oak tree species group was  $7.54 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 1.815. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 79 different site types.

5. The national arithmetic mean of yield potential of the seed originated sessile oak tree species group was 10.41 m<sup>3</sup>/ha/év, with a standard deviation of 2.261. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 18 different site types.

The national arithmetic mean of yield potential of the shoot originated sessile oak tree species group was 8.38 m<sup>3</sup>/ha/év, with a standard deviation of 2.044. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 25 different site types.

6. The national arithmetic mean of yield potential of the seed originated Turkey oak tree species group was 7.98 m<sup>3</sup>/ha/év, with a standard deviation of 1.647. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 30 different site types.

The national arithmetic mean of yield potential of the shoot originated pedunculate oak tree species group was 6.12 m<sup>3</sup>/ha/év, with a standard deviation of 1.610. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 79 different site types.

7. The national arithmetic mean of yield potential of the seed originated beech tree species group was 9.14 m<sup>3</sup>/ha/év, with a standard deviation of 1.769. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 19 different site types.

The national arithmetic mean of yield potential of the shoot originated pedunculate oak tree species group was 7.94 m<sup>3</sup>/ha/év, with a standard deviation of 1.803.

8. The national arithmetic mean of yield potential of the seed originated hornbeam tree species group was 4.31 m<sup>3</sup>/ha/év, with a standard deviation of 1.770. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 15 different site types.

The national arithmetic mean of yield potential of the shoot originated pedunculate oak tree species group was 4.60 m<sup>3</sup>/ha/év, with a standard deviation of 1.815. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 10 different site types.

9. The national arithmetic mean of yield potential of the seed originated Black Locust tree species group was 9.81 m<sup>3</sup>/ha/év, with a standard deviation of 3.828. The analysis shows that for the

purpose of a forestry land evaluation, useful numerical data can be determined for 38 different site types.

The national arithmetic mean of yield potential of the shoot originated Black Locust tree species group was  $10.05 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.676. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 85 different site types.

10. The national arithmetic mean of yield potential of the seed originated maple tree species group was  $8.65 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.025. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 38 different site types.

The national arithmetic mean of yield potential of the shoot originated maple tree species group was  $8.43 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 2.994. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 1 site type.

11. The national arithmetic mean of yield potential of the seed originated elm tree species group was  $8.75 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 4.025. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 38 different site types.

The national arithmetic mean of yield potential of the shoot originated pedunculate oak tree species group was  $8.73 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.906. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 1 site type.

12. The national arithmetic mean of yield potential of the seed originated ash tree species group was  $11.65 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.457. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 4 different site types.

The national arithmetic mean of yield potential of the shoot originated ash tree species group was  $8.21 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 5.214. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 1 site type.

13. The national arithmetic mean of yield potential of the seed originated wild fruits tree species group was  $10.53 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 2.557.

The national arithmetic mean of yield potential of the shoot originated wild fruits tree species group was  $6,70 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 1.418.



The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 1 site type.

14. The national arithmetic mean of yield potential of the seed originated “other hardwood deciduous trees” tree species group was  $7.58 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.759. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 1 site type.

The national arithmetic mean of yield potential of the shoot originated “other hardwood deciduous trees” tree species group was  $6.00 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 2.769. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 1 site type.

15. The national arithmetic mean of yield potential of the seed originated native poplars tree species group was  $10.07 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.927. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 2 different site types.

The national arithmetic mean of yield potential of the shoot originated native poplars tree species group was  $10.07 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 4.558. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 4 different site types.

16. The national arithmetic mean of yield potential of the seed originated willow tree species group was  $13.67 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 4.16. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 2 different site types.

The national arithmetic mean of yield potential of the shoot originated willow tree species group was  $12.20 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.362. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 2 different site types.

17. The national arithmetic mean of yield potential of the seed originated alder tree species group was  $8.66 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 2.416. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 44 different site types.

The national arithmetic mean of yield potential of the shoot originated alder tree species group was  $9.01 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 2.095. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 10 different site types.

18. The national arithmetic mean of yield potential of the seed originated linden tree species group was  $11.61 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 2.725.

The national arithmetic mean of yield potential of the shoot originated linden tree species group was  $9.38 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.400.

19. The national arithmetic mean of yield potential of the seed originated “other softwood deciduous trees” tree species group was  $11.34 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.786.

20. The national arithmetic mean of yield potential of the seed originated Scots pine tree species group was  $8.78 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 1.473. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 67 different site types.

21. The national arithmetic mean of yield potential of the seed originated European Black pine tree species group was  $6.48 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 1.358. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 18 different site types.

22. The national arithmetic mean of yield potential of the seed originated Norway spruce tree species group was  $12.92 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 2.311. The analysis shows that for the purpose of a forestry land evaluation, useful numerical data can be determined for 8 different site types.

23. The national arithmetic mean of yield potential of the seed originated European larch tree species group was  $16.92 \text{ m}^3/\text{ha}/\text{év}$ , with a standard deviation of 3.422.

24. For a more detailed description of sites and for enhancement and deepening of its method accuracy, aspects of description must be maintained as far as possible. The unified system shall contain all the information that are part of the individual systems separately. It is not necessary to create new categories for the uniformization, but the bedrock categories shall be reduced and the category of artificial soil formations extended – which have already been added to the forestry site classification system.

## 6. AUTHOR'S PUBLICATIONS IN THE FIELD OF THIS RESEARCH

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