

# : Results of the Evaluation of the Supported Forest Effects for the Recreational and Educational Function of Forests in Suburban Forests

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## ■ ABSTRACT

The paper presents the results of the author's doctoral thesis entitled 'Quantification, Evaluation and Enumeration of Supported Forest Effects for Recreational and Educational Function of Forests in Special Purpose Forests - Suburban Forests'. By developing the objectives in a step-by-step manner, the values of the supported effects of forests for recreational and educational functions were quantified in a case study of the Chrudim - Podhůra Recreational Forests using three methods. The first method used was from the Czech Republic, the second method was selected from methods developed in the European Union. The third method used was developed in this paper to value the supported effects by quantifying the actual amount of increased costs. Finally, a comparative analysis of the results of the methods used to evaluate the forest's supported effects was carried out. The results of the work can be used for the valuation of other ecosystem services.

## ■ KEYWORDS

**Societal functions of forests, subsidies, ecosystem services, forest categories, methods, compensation for increased costs, payments**

## ■ 1 INTRODUCTION

An increasing number of people are becoming aware of the irreplaceable role of forests in their lives, especially for their recreation, sport and relaxation. As the urban population grows and the number of people in the countryside decreases, the importance of suburban forests increases. Thus, the vast majority of suburban forests mainly perform recreational and educational effects and functions, cultural (recreational and educational) ecosystem services (ES). However, the provision of cultural ES imposes increased costs on owners and operators. Costs are paid for by the operator of cultural ES mainly from the income from forest management or other activities and with the help of contributions from owners or subsidies.

Due to climate change, forestry is currently undergoing major changes in management. In most cases, these changes have a negative impact on the economic situation of

individual forest owners, which means that owners will have fewer resources to provide some ES.

The main objective of this paper is to present a comparative analysis of the results of the applied evaluation procedures of the social socio-economic significance of the functions of special purpose forests (suburban forests) in the Czech Republic and Italy. The comparative analysis includes testing the hypothesis and developing an interpretation of the results obtained from the application of each method. The quantification of inputs for supporting and maintaining the recreational function of the forest is carried out in a case study on the territory of the Chrudim - Podhůra Recreational Forest due to the author's familiarity with the area.

The hypothesis is tested on whether the amount of compensation for the provision of ES of the forest of non-market environmental health and hygiene (recreational) and cultural and educational (educational) in the special purpose forests - suburban forests determined by this work is sufficient (H+), or whether it is insufficient (H-) and due to the current economic situation in the forestry sector there is a risk that the owners will stop providing these ES or reduce them.

## ■ 2 METHODOLOGY

### 2.1 Definition of terms

According to Section 2 of Act No. 289/1995 Coll., the Forest Act, as amended, forest functions are the benefits conditioned by the existence of the forest, which are divided into production and non-production. The functions of the forest can be understood as the realised production of the effects of the forest, which result from its nature and from ecosystem processes (Vyskot et al., 2003).

Forest ES can be divided into market (productive, production, internalities) and non-market environmental services (non-productive, non-production, externalities) and can be defined according to the socio-economic area in which they satisfy social needs. The differentiation of forest functions is similar to the differentiation ES (Šišák et al., 2017).

According to Section 6 of Act No. 289/1995 Coll., Forest Act, as amended, forests are divided into three categories according to their predominant functions: protective forests, special purpose forests and economic forests.

### 2.2 Literature review

The area of Chrudim - Podhůra Recreational Forests is located almost in the centre of the Czech Republic. The area is part of a larger forest complex called Podhůra Recreational Forests. The owner of the forests in the complex is the town of Chrudim (the forests owned by the town of Chrudim are called the Chrudim - Podhůra Recreational Forests), the town of Slatiňany and the Forests of the Czech Republic, state enterprise.

Podhůra Recreational Forest is in the Iron Mountains Protected Landscape Area (Faltysová and Bárta, 2002) and is also part of the Slatiňansko - Slavicko Conservation Area (Národní památkový ústav, <https://www.pamatkovykatolog.cz/slatinansko-slavicko-7663986>).

The recreational forests of Chrudim - Podhůra have an area of 122.87 ha, the forests are managed by the company Městské lesy Chrudim, s.r.o. based on a lease agreement with the town of Chrudim, the forests are classified as special purpose forests - suburban forests and as other forests with increased recreational function. The sole owner of the company is the town of Chrudim. The forests are in the Forest Management Unit of Městské lesy Chrudim. The currently valid forest management plan is drawn up for a period of 10 years, valid from 1 January 2020 to 31 December 2029.

In order to carry out a proper quantification, evaluation and enumeration of the supported forest effects for the recreational and educational function of the forests, all supported forest effects and increased costs of cultural ES of the selected area were first studied and described in detail. For the sake of clarity, the quantification and description of the implemented supported effects is carried out in the paper in ascending order according to the year of implementation of the projects from 2004 to 2022, all prices are given in thousands. The implemented projects were divided into three categories according to the financial volume of investment (Odvárka and Meňházová, 2022).

### **2.3 Analysis of the management of company and the company's recreational forest section for the period 2010 to 2022**

The analysis and results of the company Městské lesy Chrudim, s.r.o. is divided into two parts, the results of the management of the company as a whole and the results of the management of the recreational forest section. All data is presented in thousands of Czech crowns (CZK) without VAT.

In order to determine the results of the management, the company's accounting and production documents were analysed, especially budgets and projects, approved annual accounts, accounting audits, etc. On the basis of the analyses, a database of the company's overall management results and a database of revenues, costs, overall management results of the recreational forest section were created. The total economic results, the average results of management in total and per 1 ha of land of the company as well as its recreational forest section, the owner's contributions and the average amount of contributions in total and per 1 ha were quantified.

### **2.4 Quantifying the value of supported forest effects using two existing methods**

Using two selected evaluation methods (the first method was chosen from methods used in the Czech Republic, the second from methods used in the European Union), the value of supported effects (the amount of compensation for the provision of supported recreational and educational ES) on the territory of the Chrudim-Podhůra Recreational Forest will be quantified.

### **2.5 Developing a new method and using this method to quantify the value of the supported forest effects**

The dissertation will develop a new method of valuation of supported effects using the actual amount of increased costs called "Method of quantification, evaluation and quantification of supported forest effects for recreational and educational function

of forests in special purpose forests - in suburban forests". This method quantifies, evaluates and quantifies the supported effects of the forest for recreational and educational functions in the selected area using the actual amount of increased costs, which is determined by analysing the area, the ES (effects) supported and accounting data by quantifying the actual annual revenues, costs and economic results of the supported effects of the forest of the selected area.

This new method will be used to quantify the value of supported forest effects (the amount of compensation for the provision of supported recreational and educational ES) in the Chrudim-Podhůra Recreational Forest.

## 2.6 Comparative analysis of the results of the applied evaluation procedures

The first step of the comparative analysis of the results of the applied evaluation methods will be the preparation of the Experimental Results Sheet I., which will summarize the results of the three applied methods of quantifying the value of the supported forest effects for recreational and educational function (the amount of compensation for the provision of supported recreational and educational ES) and will compare the individual results of the applied methods of evaluation of supported forest effects, i.e. the amount of annual compensation for services in CZK/ha/year according to the individual evaluation methods.

The next part of the comparative analysis will be the creation of the Experimental Result Sheet II, which will contain the amount of annual compensation for the provision of increased supported ES, determined by the work according to the individual assessment methods, the amount of compensation for services according to the actual results of management, determined for the testing of the hypothesis on the territory of the Recreational Forests Chrudim - Podhůra in thousand CZK without VAT/territory/year and the result of hypothesis testing.

## ■ 3 RESULTS

### 3.1 Value of supported forest effects quantified using two existing methods

The total amount of the value of supported effects (the amount of compensation for the provision of supported recreational and educational ES) according to the first selected (in the Czech Republic used) method called "Methodology for assessing the social socio-economic significance of forest ecosystem services" (Šišák et al., 2017) is set at an annual amount of 7 715 CZK/ha.

The total amount of compensation for the provision of supported recreational and educational ES according to the second selected (used in Italy) method called "Assessment, valuation and mapping of ecosystem services in Alpine forests" (Häyhä et al., 2015) is set at an annual amount of 1 857 CZK/ha.

### **3.2 The new evaluation method and the value of the supported effects quantified by the new method**

A new evaluation method called “Method for quantification, evaluation and quantification of supported forest effects for the recreational and educational function of forests in special purpose forests - suburban forests” was developed by the dissertation.

The total value of the supported effects (the amount of compensation for the provision of supported recreational and educational ES) is set at CZK 9 953/ha per year under this (third overall) new method.

### **3.3 Comparative analysis of the results**

#### **3.3.1 Experimental result sheet I**

In Experimental Results Sheet I, the results of the applied evaluation procedures for the supported effects of the forest are collected, according to these results the evaluation and comparison of the supported effects of the forest is carried out, i.e. the comparison of the amount of annual compensation of services in CZK/ha/year according to the different evaluation methods.

The arithmetic mean of the annual service compensation amount CZK/ha/year according to the individual evaluation methods is calculated at 6 508 CZK/ha/year, the median is calculated at 7 715 CZK/ha/year.

#### **3.3.2 Experimental result sheet II and hypothesis testing**

In the experimental result sheet II, the amount of compensation for the provision of supported ecosystem services of the forest according to the actual economic results of management (excluding forestry profits and owner’s contributions to the activity) in the Recreational Forests Chrudim - Podhůra (determined for testing the hypothesis) is quantified at CZK 1 223 thousand CZK/territory/year.

The amount of compensation calculated according to the first method of assessment called “Methodology for assessing the social socio-economic significance of forest ecosystem services in the Czech Republic” (Šišák et al., 2017) in the amount of CZK 948 thousand CZK/territory/year and according to the second evaluation method entitled “Assessment, valuation and mapping of ecosystem services in Alpine forests” (Häyhä et al., 2015) in the amount of 228 thousand CZK/territory/year is insufficient, the test result is H-, the hypothesis is refuted.

The amount of compensation calculated according to the third evaluation method entitled “Methods for quantifying, evaluating and quantifying the supported effects of forests for the recreational and educational function of forests in special-purpose suburban forests” in the amount of CZK 1 223 thousand CZK/territory/year is sufficient, the testing result is H+, the hypothesis is confirmed.

## 4 DISCUSSION

The results of the work on identified values of compensation for increased costs are mainly influenced by the choice of the specific methods used for the evaluation.

To compare the values of increased costs according to each method, we should value (price) these supported ES at their normal value (normal price). According to Act No 151/1997 Coll., the Act on valuation of property, as amended, normal value means the price or value that would be achieved if the same or similar supported forest ES were provided. However, as is evident from the nature of the variability in the provision of forest ES, each forest asset that provides a supported ES is different. There are differences in the size of the estates, the location of the estates, the species and spatial composition of the forests, the different activities supported, the number of activities etc.

It is therefore very difficult to compare the results of the management of the area according to the observed values of the increased costs and the individual results of the procedures used to assess the supported forest effects per ha of area, because the ES supported by the area are not the same or similar.

Another problem in comparing the total value of the supported benefits and ES of the area is the individual choice of the extent of provision of the supported ES by the forest owner.

## 5 CONCLUSION

By successive elaboration of the sub-objectives, the values of the supported forest effects for the recreational and educational function of forests were quantified on the case study area in the Chrudim - Podhůra Recreational Forests using three methods of evaluation, a comparative analysis of the results of the used evaluation methods was carried out and the hypothesis was tested.

The application of the work should be in several areas. The results of the work should not only serve the owners of suburban recreational forests who perform the supported ES of the forest, but could also be used by the state administration, ministries, regions, municipalities, etc. to determine contributions and compensation for forest management constraints due to the performance of social (recreational) functions of forests and in determining the amount of compensation for increased costs and payments for the provision of cultural ES of forests.

The method developed by the dissertation can be easily modified and then used to evaluate the supported other effects of forest and forest ES.

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