# *Economic evaluation of different land*



SCHNELLER, KRISZTIÁN – KOHLHEB, NORBERT
SKUTAI, JULIANNA – PODMANICZKY, LÁSZLÓ

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## SUMMARY FINDINGS, CONCLUSIONS, RECOMMENDATIONS

**This study deals with five settlements (Karos, Karcsa, Pácin, Nagyrozvágy, Cigánd) of Bodrogköz. The main goal of the case-study is to provide a method for the assessment of the economic impacts of land-use planning. The paper shows the connection between economic and land-use models of specific areas. Although the input conditions of the evaluations (e.g. agri-environmental payments) have changed, the framework of the methodology is independent from the input variables, so it can be a useful example for similar assessments.**

**The first part of the study focuses on potential alternative land use options for the region. We suggested changes in land use on the basis of the so-called 'ecotype' model. In the second part we present the economic evaluation method of the land use changes. We analyzed the consequences of the suggested conversions based on an economic model. Data collection was done by using questionnaires.**

**The results indicated that in the studied area a range of significant modifications should be carried out, including especially the reduction of arable land area in favour of forests and grasslands.**

**The economic assessments indicated that adjusting land use to suit the potential of the land offers economic advantages; that is, when the suggested changes are implemented with the help of agro-environmental subsidies. Our study however, disregarded all other types of costs (investing into new machinery and special equipment), as well as the social (psychological) aspects of conversion. This latter issue should be taken seriously because significant changes often require farmers to engage in entirely new activities. As transition to a new, drainage-based management system influences a larger area, it also demands cooperation from the farmers and the inhabitants.**

**Researchers and experts consider our evaluation a suitable background for further studies. Our study provides farmers with local information so they can efficiently co-operate in regional land use activities. Similar studies and the continuation of this particular study are suggested in smaller regions within the floodland of River Tisza, where many attempts have already been made to introduce measures of floodland landscape management.**

**As the case-study area is an important site of floodplain landscape management, our findings may contribute significantly to the wealth of information on the new perspectives of this special farming method. Therefore another aim of the research was to develop a framework for complex assessments of the floodland landscape management methods.**

## INTRODUCTION

The *New Vásárhelyi Plan* (VTT in Hungarian abbreviation) aims at increasing flood safety and regional development in the watershed of River Tisza. While elaborating the outlines of VTT, a compound regional and area development program was created with a focus on improving the living conditions of inhabitants, increasing the population-preservation capacity of the region and meeting the basic demands of sustainable land and area use. Together with the technical planning of VTT development and settlement plans were also created with a focus on establishing a new type of environmental system that protects nature and landscape, sustains and promotes the well-being of local communities and increases flood safety, as well.

On behalf of VKKI (*Central Authority for Water Management and Environmental Protection*) and VÁTI Ltd., in co-operation with the *Institute of Environmental and Landscape Management of Szent István University* and *Bokartisz Public Company*, five settlements were analysed within the area of the Cigánd water reservoir, which was one of the model areas for landscape management of VTT in 2006. The aim of our study was to find the most sustainable type and method of land use. Economic consequences of potential changes of land use were also investigated.

## SUGGESTED MODIFICATIONS OF LAND USE

In a complex management system the elements of productions as well as the structure, size and composition of activities are adjusted to the characteristics of land, to the availability and re-production of natural resources, to the assimilation ability of landscape (*Csete – Láng, 2005*).

The concept of sustainable agriculture proved to be a milestone in the history of soil and landscape qualification. Multifunctional agriculture is based on the concept that the type and intensity of production methods should be adjusted to the abilities of land (*Ángyán – Menyhért, 2004*).

Many documents have outlined the basic principles of sustainable land use. The Food and Agriculture Organization (UN) has elaborated a framework of policies and a system of categories for sustainable land use and land evaluation (*FAO, 1976*).

The regional implications, production and protection functions of a sustainable and value-preserving agriculture were first detailed in Hungary by a 1997 study called 'Integrated land use zonation system of Hungary'. The study used the idea of land use pyramid where the intensity of production and protection and also their proportion were based on the special circumstances of the land (*Ángyán et al., 2003*).

The key element in creating a land use zonation system is a thorough, multi-aspect analysis and an evaluation of agricultural potential and environmental sensitivity. The final step is to create a balance of resources by setting agricultural potential against environmental sensitivity (*Ángyán – Menyhért, 2004*).

The more aspects are taken into consideration in the planning analyses, the more appropriately the suitability of the landscape is determined. One single element of the landscape might support more than one function. Sustainability is best achieved when potential land use alternatives are evaluated against the horizontal and vertical interconnection of the functions (*Ferencsik, 2000*).

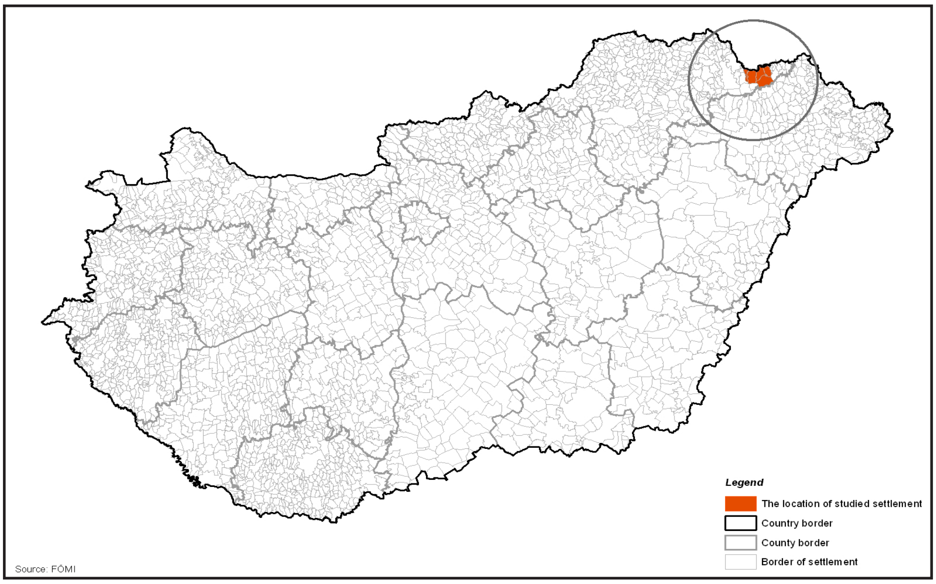
Potential land use alternatives can also be designated with another method called the *'ecotype landscaping'*. Each ecotype refers to an area with its own arable and forestry production potential and environmental (soil, water and the living environment) sensitivity. In addition to the aforementioned land use zonation system, ecotype landscaping investigates the suitability of areas for forestry production, as well.

Once arable potential, forestry potential and environmental sensitivity are measured and studied, the results serve as a basis to create the ten land use categories (ecotypes) for the whole country. This makes us possible to define a frameset of policies for land use (*Ángyán et al., 2007*).

Our study area of five settlements measures 17 000 hectares in the small region called Bodrogköz (Fig. 1). The ecotype model was proportioned to fit the size of the area. It means that we used larger scale maps for processing incoming data. When adopting the ecotype model, we had to consider that permanent drainage and the revival of floodland management are both considered potential elements of sustainable management of the area by VTT, so we had to calculate with the presence of actual and theoretical floodlands of various elevations as well. These conditions had a great influence on potential land use types and on suggested conversions.

Figure 1

**The location of studied settlements**




According to data obtained from water gauges and to the levels of the terrain of the Bodrogköz model area, four different floodland areas were set: low floodlands, shallow floodlands, high floodlands and flood-free areas (Table 1). We created a model depicting these four levels of floodland areas and compared it with the map of land use categories (already fitted to the size of the area). Our suggestion – regarding potential future land use – was reconsidered and a new, eleventh category called 'not suitable for arable due to the influence of water' was added (Table 2).

Table 1

**Ecotypes in the Bodrogköz model area, according to the four types of floodland areas**

| Ecotype | Original area | | Suggested area | |
|---|---|---|---|---|
| | (ha) | (%) | (ha) | (%) |
| Agricultural lands of exceptional/good quality | 340 | 1.9 | 188 | 1.1 |
| Agricultural lands of medium/poor quality | 104 | 0.6 | 84 | 0.5 |
| Environmentally sensitive agricultural areas | 0 | 0.0 | 127 | 0.7 |
| Suggested areas of afforestation | 4 268 | 24.2 | 4 016 | 22.8 |
| Suggested areas of protective forests | 10 | 0.1 | 292 | 1.7 |
| Environmentally sensitive areas suggested for afforestation | 0 | 0.0 | 0 | 0.0 |
| Agricultural lands of exceptional/good quality or areas suggested for afforestation | 2 737 | 15.5 | 2 707 | 15.4 |
| Agricultural lands of medium/poor quality or suggested areas of protective forests | 0 | 0.0 | 0 | 0.0 |
| Environmentally sensitive areas of good agricultural potential or for afforestation | 0 | 0.0 | 0 | 0.0 |
| Environmentally sensitive areas with poor arable and afforestation potential | 9 556 | 54.2 | 3 231 | 18.3 |
| Areas not suitable for arable farming due to the influence of water | - | - | 6 371 | 36.1 |
| Total | 17 631 | 100.0 | 17 631 | 100.0 |

*Highlighted in grey:* a new category we created while considering floodland types of different elevations.

Table 2

**Suggested conversions per modified land use types**

| Land use type | Suggested conversion |
|---|---|
| Agricultural lands of exceptional/good quality | intensive arable |
| Agricultural lands of medium/poor quality | extensive arable |
| Environmentally sensitive agricultural areas | extensive arable |
| Suggested areas of afforestation | industrial forestry |
| Suggested areas of protective forests | protective forests |
| Environmentally sensitive areas suggested for afforestation | protective forests |
| Agricultural lands of exceptional/good quality or areas suggested for afforestation | intensive arable |
| Agricultural lands of medium/poor quality or suggested areas of protective forests | extensive arable |
| Environmentally sensitive areas of good agricultural potential, or for afforestation | extensive arable |
| Environmentally sensitive areas with poor arable and afforestation potential | grassland management |
| Areas not suitable for arable due to the influence of water | wet habitat or protective forests |

## MODELLING ECONOMIC EFFECTS

Besides studying eco types and management methods, we also wanted to investigate the economic efficiency of land management in the Bodrogköz. Our analysis combined some acknowledged and widespread, static methods (e.g. gross margin and net income calculations) with dynamic ones, where the role of time is also included; eg. internal rate of return and net present value calculations. Our combined analyses aimed at modelling the economic importance of new land use strategies that was established on the grounds of sustainability.

The model contains the following system of interrelated, computer-based tables in excel format:

1. Regional proportion of conversions.
2. Usual crop structures of management types and their specific gross margin (GM).
3. Usual crop and livestock structures of management types and their gross margin calculations.
4. Estimated support for each management type.
5. Cash-flow, NPV and IRR values for each management type.

The model analysis was preceded by a comprehensive data-gathering covering about one hundred farms. We investigated management types and methods. The most frequent management types of the region were as follows:

1. Mostly self-sufficient farms (less then 5 hectares with a couple of animals).
2. Farms dominated by crop production with a weak market position (up to 10 hectares, the number of animals is of no importance with regard to the market).
3. Farms dominated by crop production with a significant market position (10-30 hectares, the number of animals is of no importance with regard to the market).
4. Farms dominated by crop production, with a dominant market position (30-100 hectares, the number of animals is of no importance with regard to the market).
5. Major farms (above 100 hectares or a major amount of livestock).

Once we studied their regional distribution, we were able to define the rate of converted land per management type. The Table 3 shows that except for conversion to grassland all types of management are quite similar. It can be seen that conversion to grasslands has the highest rate (Type 2).

Table 3

**Areas for conversion per each management type (%)**

| Farm type | Non arable | Intensive arable | Grassland | Forest for production | Forest for protection | Wetland | Total |
|---|---|---|---|---|---|---|---|
| Type1 | 0.4 | 23.6 | 0.2 | 49.2 | 1.0 | 25.7 | 100.0 |
| Type2 | 13.2 | 14.1 | 26.8 | 30.4 | 0.4 | 15.1 | 100.0 |
| Type3 | 15.5 | 31.3 | 5.5 | 27.7 | 1.8 | 18.2 | 100.0 |
| Type4 | 15.6 | 17.1 | 3.9 | 35.2 | 2.8 | 25.5 | 100.0 |
| Type5 | 16.2 | 14.1 | 12.3 | 46.6 | 1.2 | 9.6 | 100.0 |

## RESULTS: LAND USE ANALYSIS

As our suggestion can basically be interpreted for arable lands, we had to restrict the model area (and the results of our findings, as well) to arable lands as defined by Corine Land Cover program. The size of the reduced model area is 11 242 hectares, which is 66% of the original area. Out of the eleven different land use types (ecotypes), only five were found significant in the agricultural lands of the Bodrogköz region. Their size and the suggested conversions are shown in Table 4.

Table 4

**Area size for suggested conversions per land use type**

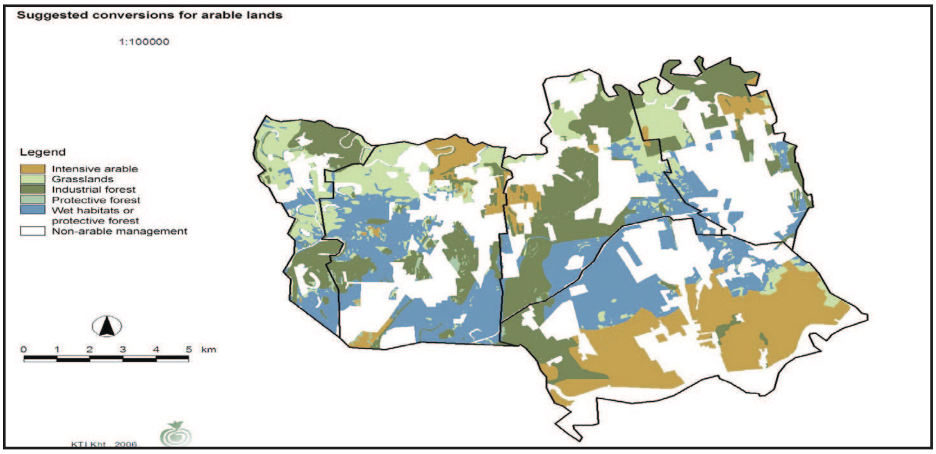
| Land use type | Size (ha) | Suggested conversion |
|---|---|---|
| Suggested areas of afforestation | 3337 | Industrial forest |
| Suggested areas of protective forests | 94 | Protective forest |
| Agricultural lands of exceptional/good quality or areas suggested for afforestation | 2513 | Intensive arable |
| Environmentally sensitive areas with poor arable and afforestation potential | 1814 | Grasslands |
| Areas not suitable for arable due to the influence of water | 3484 | Wet habitats |

According to the Table 4, the highest area of conversion means arable converted to wetlands. Such changes are only possible when VTT allows the implementation of a new, drainage-based management on flood-influenced lands (Fig. 2).

The second most significant conversion is turning arables into forests. There is a difference between afforestation for industrial and for protective purposes. Due to the characteristics of our study area establishment of industrial forests should exceed afforestation for protection. The amount of land with poor agicultural potential and those that are environmentally sensitive is quite significant. The Table 4 shows that four-fifth of the present arable should be modified according to our suggestions.

Figure 2

**Suggested conversions for arable lands**



Supposing that all suggested changes were actually carried out, the area of wetlands would be increased the most. The range of waters and waterlogged areas would be quadrupled. Forests and grasslands would occupy a higher ratio of the land. Arable lands on the other hand would be reduced to one fifth of their present range (Table 5).

Table 5

**Suggested conversions**

| Present land use | | | Suggested land use | | |
|---|---|---|---|---|---|
| | | | Effects of conversion | Optimal land use | |
| | ha | % | ha | ha | % |
| Arable | 11 242 | 66.1 | -8 729 | 2 513 | 14.8 |
| Grasslands | 2 919 | 17.2 | +1 814 | 4 733 | 27.8 |
| Mixed agricultural area | 261 | 1.5 | | 261 | 1.5 |
| Orchard | 385 | 2.3 | | 385 | 2.3 |
| Forest | 1 335 | 7.8 | +3 431 | 4 766 | 28.0 |
| Wet habitats | 865 | 5.1 | +3 484 | 4 349 | 25.0 |
| Total | *17 007* | *100.0* | | *17 007* | *100.0* |

## ECONOMIC EFFECTS

Economic analyses are based on a comparison of the per hectare gross margin values of present and future (suggested) land uses. For a full comprehension of both versions (pre- and post-conversion options) we defined a usual set of crops per each management type, as shown in Table 6.

Table 6

**Usual crop structure of management types (%)**

| Crops | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 |
|---|---|---|---|---|---|
| **Winter wheat** | 8 | 8 | 11 | 21 | 14 |
| **Summer wheat** | | | 3 | | |
| **Winter barly** | 10 | 5 | 4 | 7 | 0 |
| **Summer barly** | 6 | | | | |
| **Triticale** | 7 | 7 | 8 | | |
| **Rye** | | 10 | | 6 | 16 |
| **Oats** | 10 | 10 | 9 | 11 | 5 |
| **Maize** | 11 | 6 | 7 | 9 | 6 |
| **Maize silage** | | 6 | | | |
| **Potato** | 5 | | | | |
| **Sunflower** | 29 | 10 | 10 | 9 | 11 |
| **Rape** | | 20 | | | |
| **Alfalfa** | 15 | 16 | 49 | 5 | |
| **Red clover** | | | | 32 | |
| **Sand wetch** | | | | | 48 |
| **Mangels** | | 2 | | | |
| **Total** | 100 | 100 | 100 | 100 | 100 |

Gross margin of various management types and the economic effect of conversion per each management type are best evaluated when the per hectare values of gross margin, support and profit (composite gross margins and total support) are compared (Table 7).

Table 7

**Per hectare GM, support and profit values before and after conversion**

| Farm type | Gross Margin/ha | | Support | | Investing capacity | | Income | |
|---|---|---|---|---|---|---|---|---|
| | Before | After | Before | After | Before | After | Before | After |
| TypeI | 8 313 | 21 214 | 47 591 | 116 796 | 476 | 1 297 | 55 904 | 138 010 |
| Type2 | 16 578 | 44 943 | 47 680 | 103 437 | 547 | 1 385 | 64 258 | 148 380 |
| Type3 | 11 086 | 80 440 | 47 680 | 105 360 | 500 | 1 819 | 58 748 | 185 799 |
| Type4 | 16 645 | 60 419 | 47 680 | 114 883 | 548 | 1 585 | 64 325 | 175 302 |
| Type5 | 12 912 | 15 422 | 47 680 | 114 999 | 516 | 1 262 | 60 592 | 130 421 |

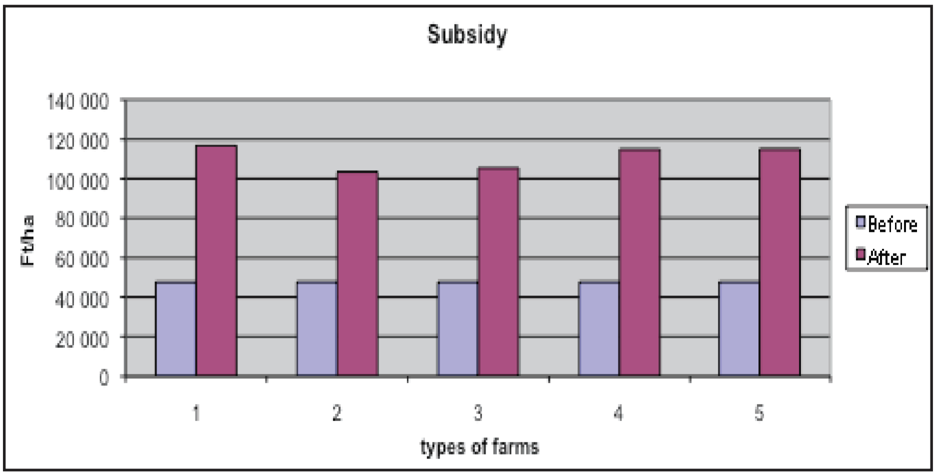
According to the changes in gross margin, conversion is the best option for areas under management type 3, since at present, their GM margin values rank second lowest, whereas it is the highest after conversion.

Conversion is the least desirable for farms belonging to management type 5, since according to our calculations their economic situation will only slightly improve.

If we compare the amount of financial support per hectare, all management types seem to prosper: any difference between the economic effect of conversion on different management types is explained by the different range and direction of conversions. Changes in support are depicted in Fig. 3.

Figure 3

**Support before and after conversion per management type**

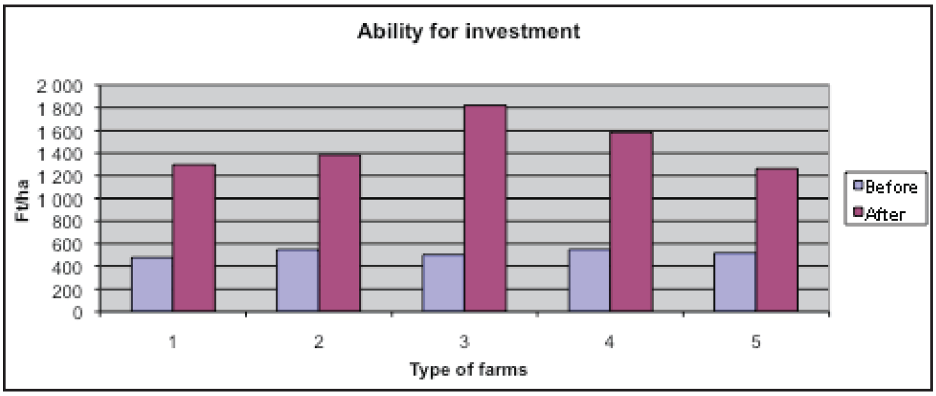


As shown in the Fig. 3, conversion at an average doubles the amount of support in almost every management type.

The effect of conversion on investing capacity is similar to that on gross margin. According to our findings, farms of type 3 benefit the most: investing capacity is almost quadrupled, whereas for other farms investing capacity is increased two or three times (see Fig. 4).

Figure 4

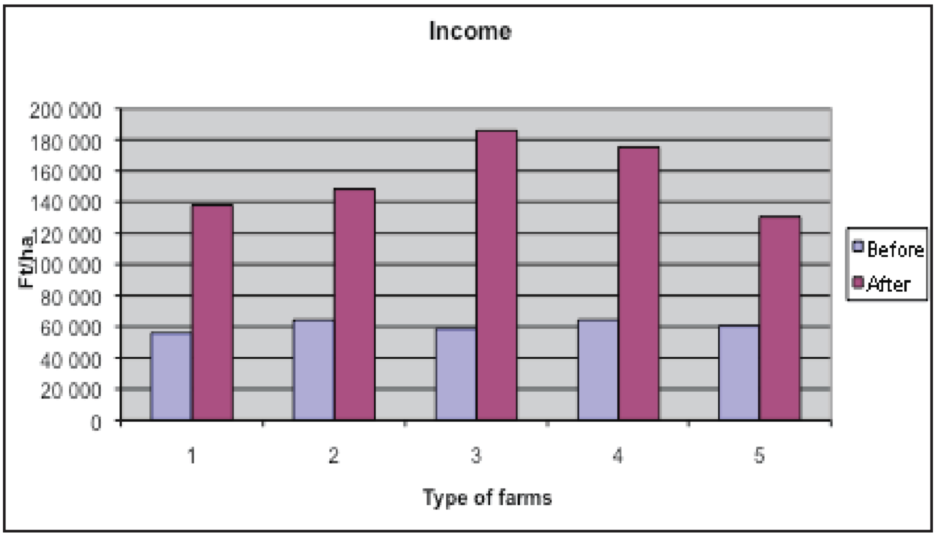
**Investing capacity per management type before and after conversion**




When support and gross margin values are combined, that is when profit is analysed, specific income is the best in the case of farms of type 3. The profit is the highest here: farmers might actually realize as much as HUF 186 000 per hectare (Fig. 5).

Figure 5

**Income per management type before and after conversion**




Without conversion these farms achieved the second lowest income (HUF 58 748) per hectare. The largest farms, however, are not able to gain as much extra profit as other farms: their profit is doubled.

## CONCLUSIONS AND SUGGESTIONS

Assuming frequent drainage, our study recommended potential land use alternatives for the model region and analysed the economic consequences of suggested conversions.

Our results stem from the Bodrogköz region and are suitable for further considerations for other floodland areas along river Tisza, where VTT allows future implementation of floodland management. Our study is considered informative for famers and is important for understanding floodland management. It may also help cooperation between land users.

May our study serve as a first step in drafting a zonal agro-environmental programme, where conditions of floodland landscape management are defined.

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ADDRESS:

**Schneller Krisztián,** területrendező tervező, PhD hallgató, VÁTI Kht. Térségi Tervezési és Területrendezési Iroda
spatial planner, PhD student, VÁTI Hungarian Nonprofit Ltd. for Regional Development and Urban Planning, Spatial Planning Department
1016 Budapest, Gellérthegy utca 30-32., Tel.: +36-1-224-31-00-4400, E-mail: kschneller@vati.hu

**Dr. Kohlheb Norbert,** egyetemi docens, Szent István Egyetem, Mezőgazdaság- és Környezettudományi Kar, Környezet- és Tájgazdálkodási Intézet, Környezetgazdaságtani Tanszék
associate professor, Szent István University, Faculty of Agricultural and Environmental Sciences, Institute of Environmental and Landscape Management, Department of Environmental Economics
2103 Gödöllő, Páter Károly u. 1., Tel.: +36-28-522-000-2266, E-mail: Kohlheb.Norbert@kti.szie.hu

**Dr. Skutai, Julianna,** egyetemi docens, Szent István Egyetem, Mezőgazdaság- és Környezettudományi Kar, Környezet- és Tájgazdálkodási Intézet, Területi Tervezési és Térinformatikai Tanszék
associate professor, Szent István University, Faculty of Agricultural and Environmental Sciences, Institute of Environmental and Landscape Management, Department of Regional Planning and Geographical Information Systems
2103 Gödöllő, Páter Károly u. 1., Tel.: +36-28-522-000-2270, E-mail: julianna.skutai@kti.szie.hu

**Dr. Podmaniczky László,** egyetemi docens, tanszékvezető, Szent István Egyetem, Mezőgazdaság- és Környezettudományi Kar, Környezet- és Tájgazdálkodási Intézet, Környezetgazdaságtani Tanszék
associate professor, head of department, Szent István University, Faculty of Agricultural and Environmental Sciences, Institute of Environmental and Landscape Management, Department of Environmental Economics
2103 Gödöllő, Páter Károly u. 1., Tel.: +36-28-522-000-1059, E-mail: Podmaniczky.Laszlo@kti.szie.hu