SZENT ISTVÁN UNIVERSITY

# DEVELOPMENT OF LAND USE SYSTEM APPLYING ENVIRONMENTALLY BENEFICIAL FARMING METHODS IN THE PERIPHERY OF BONYHÁD

## Theses of doctoral dissertation

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## 1. ANTECEDENTS AND OBJECTIVES OF WORK

In Hungary, structural changes and conversion processes have been initiated, by minor steps though, in agriculture. These processes are characterised by sustainability, environmentally beneficial production systems and nature protection approach in farming. According to the environmental management aspect of farming, long-term use, methodical development and effective protection of natural and human formed environment by sustaining the ecological balance of nature and satisfying the needs of society are of high importance (MADAS 1985).

Accordingly, multifunctional farming has several fundamental tasks: on the one hand it has to produce high-quality food originated from a healthy environment and exempt from chemical residues and, on the other hand, preserve and restore the diversity (including not only production function but also aesthetic appearance and cultural history values) of rural areas; preserve and maintain biodiversity and natural balance of the landscape.

The accomplishment of these manifold tasks can generate extensional conflicts, requiring reasonable, deliberate and well-judged decisions. To comply with the objectives, the land use system has to be modified. One of the most important basic element of value sustaining farming is the establishment of functions, activities, cultivation systems and intensity level conforming to the landscape and environment, i.e. the introduction of a land use system accruing from and conforming to the environment itself, its potentials and limits (ÁNGYÁN 1997).

With regard to agri-environmental issues and production development, three types of land use are proposed to be established considering our environmental and natural characteristics (ÁNGYÁN 1998):

- Protective land use (protecting water quality, soil, nature and landscape),
- Extensive farming (in areas unfavourable for agricultural production), and
- Intensive farming (observing the aspects of favourable agri-ecological potential and landscape management).

The objective of this land use strategy is to integrate land use and nature protection, determine the intensity of protection and use and their relation in accordance with the features of the landscape. This approach tries to create a harmony between the two targets respecting the potentials of the landscape but without going to extremities.

All these views are highly supported by EEC Regulation No. 2078/92 developed in the frame of CAP reform in 1992, obligating the establishment of subsidizing systems which promote the integration of environment, nature and landscape protection into agricultural activities. In consequence, a considerable part of subsidies awarded for production up to now will be allocated to develop rural areas and support the non-productive (environmental, ecological, social, employing, cultural, etc.) functions of agriculture. This agri-rural policy proceeding in the EU and already initiated in Hungary prescribes the survey of target fields for various measures and the establishment of a zone system at several (national, regional, local) levels conforming to the farming and non-farming potentials of the areas as far as possible, categorizing the individual areas in accordance with these co-ordinates and applying different priorities within the development of agriculture and rural areas in each zone.

The three-category land use zone system based on these principles and policies represents an important starting-point for the target programmes of National Agri-environmental Programme (NAKP), which encourages participating farmers to establish a land use structure and environmentally beneficial cultivation forms which conform most to the landscape features. As a rough review, the land use zone system surveying the whole country supports the establishment of agricultural development strategies in various zones in accordance with its scale. The integration of regional data provides a more refined review involving thematic data expansion as well which enabled the preparation of the zonal map of the region, the county. In this procedure, one of the most important tasks was to further refine the information databases (mainly by the expansion of the database on natural resources).

Local planning level creating frames for sustainable field use and cultivation methods at farm level generates further questions. The features, potentials, values and traditions of an area can be best explored on the basis of local information and data gathered and corrected on the site. Therefore, development of an expanded database is required during the establishment of a sustainable field use system preserving the biodiversity, features and historical traditions of the landscape. Beside the definition of agri-ecological potentials and environmental sensitivity, further important objectives include the exploration of landscape history and features, traditional farming elements implemented even nowadays, as well as the preservation and integration of landscape values and characters.

On the basis of this, the objectives of research can be grouped into two main categories:

1. On the one hand, to explore the landscape traditions, features, developmental stages of the area by field information analyses of historical maps (landscape dynamics, changes and stability in cultivation systems, constant analysis). The results of these analyses were integrated into the database of habitat evaluation and mapping, and that of the zone system.

2. On the other hand, to explore the agricultural eligibility and environmental sensitivity of the area considering as many up-to-date information on the features of the area as possible. On this basis, the agricultural eligibility – environmental sensitivity scale was prepared, scenarios were created and zones were specified.

## 2. MATERIALS AND METHODS

It is advisable to divide this chapter into two parts in accordance with the division of the objectives. The first section of the chapter describes the analysis of historical maps, the review of documents about the former landscape structure of the area examined, the traditions (landscape character), and the methods and sources used for their investigation, while the second section introduces the creation of the database applied for the determination of agricultural eligibility and environmental sensitivity, as well as the course of examination.

### 2.1. Analysis and evaluation of historical maps

Primarily, maps of military surveys and historical maps showing the boundaries of estates dated between 1745 and 2001 were available in the case of the target field called István grange periphery located at the exterior area of Bonyhád. Only the more accurate military maps (dated 1782, 1858, 1950, 1989) and the digital cadastre map of the Land Registration Office of Bonyhád (dated 2001) were used for computer processing (**Table No. 1**), all the other maps were regarded as additional information.

**Table No. 1:** Maps used

| Designation of map | Year of preparation | Scale | Type | Number of sections | Origin |
|---|---|---|---|---|---|
| **First military survey** | 1782 | 1 : 28 800 | military | - | Map collection of war history (Budapest) |
| **Second military survey** | 1858 | 1 : 28 800 | military | - | Map collection of war history (Budapest) |
| **Military survey** | 1950 | 1 : 25 000 | military | L-34-62-A-a | Map collection of war history (Budapest) |
| **Military survey** | 1989 | 1 : 25 000 | military | L-34-62-A-a | Institute of Geodesy Cartography and Remote Sensing (FÖMI, Budapest) |
| **Digital cadastre map** | 2001 | 1 : 10 000 | cadastral | - | Land Registration Office (Bonyhád) |

Information supplied by the maps was well-complemented by several other written documents such as:

- works of Mátyás Bél titled „Notitia Hungariae novae historica geographica" written in 1735 and 1742,
- entries from the diary of botanist Pál Kitaibel in 1799 and 1808,
- data collected by Antal Egyed in 1823,
- land register of the cadastre map dated 1860,
- pasture utilization plan dated 1880.

Field information tools were used to obtain as much information from the historical maps as possible. First, the maps were geocoded and digitized to make them suitable for different field information comparisons and other operations. The digital maps enabled the following **analyses** to be executed:

- ***Preparing the Land use changes diagram*** by the statistical evaluation of the maps of each time section.
- ***Preparing the Land use stability map*** by the field information totalization of raster (grid) maps.

The map provides information on how frequently the cultivation branches, i.e. land use categories were provably changed in the last 219 years in each field unit (cells with the size of 5x5 meters).

It is advisable to convert the vectorial (polygon) database into a raster (grid) map for the preparation of the land use stability map to make field analyses easier. In the course of this procedure, the vectorial coverage was converted into a grid with the cell size of 5x5 meters, and land use categories were kept as thematic data. Then the grids were coded by replacing the relevant cultivation branches with the values specified in the table below (**Table No. 2**).

**Table No. 2:** Codes of land use categories in the cells

| ***Cultivation branch*** | ***code*** |
|---|---|
| Lake, creek | 1 |
| Marsh, swamp, vegetation along watercourse | 2 |
| Forest | 3 |
| Reed plot | 4 |
| Shrubbery – reed plot | 5 |
| Shrubbery | 6 |
| Bush plantation | 7 |
| Tree and bush plantation | 8 |
| Grassland | 9 |
| Vineyard, orchard | 10 |
| Plough-land | 11 |
| Garden | 12 |
| Interior area of a settlement, road | 13 |

To analyse changes extensionally and thematically at the same time, the grids of sequent periods were deducted from each other, generating the grids that relate to the place and extent of changes. This operation gives a result of zero, if the cultivation branch, i.e. the land use category was not modified in the given area. If the result of the operation differs from zero, the cultivation branch was converted in the course of time. Change frequency maps (land use stability map) were prepared on the basis of land use changes maps. Grids were recoded by giving the code 0 to the areas where cultivation branch was not changed (already having code 0), and giving the value 1 to the areas where cultivation branches were modified (having a code different from 0). This map is a binary map demonstrating whether there has been a change in cultivation in the given cell between the two dates. After preparing all four binary maps, the change frequency map relating to the period between 1782 and 2001 was calculated by the adding of the binary maps between the two dates, resulting in the creation of the cumulated land use stability map.

- The determination of ***areas with constant field use systems*** was carried out on the basis of digital polygon maps.

The land use stability map does not reveal which fields are cultivated with extensive methods and are likely to have higher ecological value out of all the constant areas, nor the fields that have been cultivated more intensively for centuries and are likely to have damages (erosion, deflation). Thus, the objective was to separate and visualize the constant areas belonging to different land use categories. Therefore, the maps of the five time sections were integrated by the submenu Geoprocessing of the menu Extensions in the program Arc View version 3.1, enabling the determination of constant utilization forms by sorting the information provided by historical maps stored in one coverage.

- ***The examination of extensive-intensive conversions in cultivation branches*** was carried out by coding raster (grid) maps, and deducting them from each other by time intervals.

In the course of data processing, land use categories were sorted into two groups. The first group (code 1) contains the land use categories characterised as extensive farming, while cultivation branches characterised as intensive farming were assigned to the second group (code 2). To specify the two groups, the effect the cultivation branches take on the soil and their natural potential as a possible habitat were considered (**Table No. 3**). The land use categories belonging to the two groups were coded accordingly by using the grid maps of historical maps.

**Table No. 3:** Codes of land use intensity in the cells.

| ***Cultivation branch*** | ***Code*** |
|---|---|
| Lake, creek | 1 |
| Marsh, swamp, vegetation along watercourse | 1 |
| Forest | 1 |
| Reed plot | 1 |
| Shrubbery – reed plot | 1 |
| Shrubbery | 1 |
| Bush plantation | 1 |
| Tree and bush plantation | 1 |
| Grassland | 1 |
| Vineyard, orchard | 2 |
| Plough-land | 2 |
| Garden | 2 |
| Interior area of a settlement, road | 2 |

Using Map Calculator, the database of this latter map was deducted from the database of the former grid map, making the differences and the direction of modifications visible and ready for statistical evaluation.

Field information and other computer **software**s used for **analysing historical maps** were as follows:

- Arc View 3.1 field information software,
- Arc Info 8.0 field information software,
- ERDAS 8.4 field information software,
- Excel spreadsheet software.

## 2.2. Database for land use zone analyses and the course of examination

As the first step of the investigation of the present state of the area examined, maps and documents available were collected and evaluated in relation to the features and parameters of agricultural eligibility (soil, climate) and environmental sensitivity (soil, water, flora, fauna).

Incomplete information not covering relevant areas was not suitable for field information applications nor for the modelling of agricultural eligibility and environmental sensitivity, therefore, a new database had to be created for the parameters of both agricultural eligibility and environmental sensitivity with regard to the aspects of soil, water, flora and fauna. This database was prepared on the basis of a three-year period of on-site measurements and observations. The results of the measurements were presented as digital databases prepared with field information tools. These databases can be extended and updated continuously in accordance with the requirements.

### *2.2.1. Preparation of database containing parameters of agricultural eligibility and environmental sensitivity of István grange periphery*

- **Preparation of slope category map**

  The slope category map was prepared on the basis of the digital topography database. The elevation model was created with the topogrid module of the software ARC/Info, the contour-lines were provided by EOV (Unified National Projection system) map section (scale = 1 : 10000, FÖMI, Budapest). The elevation model was used to calculate the angle of slope, which was executed by the Surface / Derive slope menu of Arcview.

- **Definition of new soil parameters by on-site measurements**

  The soil parameters were defined collectively with the colleagues of the Institute of Environment and Landscape Management of the Faculty of Agricultural and Environmental Sciences of Szent István Univerity. EOV maps (scale = 1 : 10000) containing the cultivation branches and contour-lines related to the areas were used as draft maps. Further information was obtained from aerial photographs and cartograms mentioned before. The point system of data collection was planned by the comparison of aerial photographs, examination of maps, and site visits, enabling the preparation of soil type map, the update of physical type and pH maps and the preparation of soil thickness maps.

  The point system was created on the basis of the former soil map taking the vegetation and the relief features into consideration. This point system is not squared but erratic, therefore, the points of data collection can be arbitrarily concentrated in more diverse areas, providing a more representative image on soil features (BARCZI, 1995, 1997, 2000). The point system of data collection was specified in accordance with the experience of site visits. Soil mapping and data collection was executed with borer stick technique by Pürkhauer. Soil types were determined on the basis of the works of STEFANOVITS (1992) and SZODFRIDT (1993).

  The water management of soils were examined in accordance with the methods described by FINNERN (ed.) (1994), GORTNER and HARRACH (1994) by evaluating the utilizable water resources and ranking the soil types into categories. Later, further samples were taken to check the homogeneity of soils and get as many data about the soils as possible. The most important information required to draw the soil type map was provided by the points of data collection, the elevation model (on the basis of the contour-lines of the draft map with scale 1:10000), and the vegetation. The map was prepared by mechanical and field information methods as well.

The maps demonstrating the physical type, pH and soil thickness were created by field information tools exclusively. To prepare the physical type map, the information provided by the points of data collection and the database of former cartograms were used. The Spatial Analyst feature of the field information program Arc View enables the conversion of points into polygons in such a way that a Thiessen related to a point surrounds the area where the points are located closer to the given point than to any other point. Soil thickness and pH maps were prepared by mechanical methods and GIS (Geographical Information System) application (interpolation) considering the points of data collection, the elevation model and the surface.

The evaluation of soil erosion was carried out on the basis of the equation evaluating general soil loss, which defines the estimated value in tonnes/ha of annual soil destruction (A) for an agricultural field or an area having the size of an agricultural field:

**A= RKLSCP,**

where:
- R refers to the energy of rainfall,
- K refers to the erodibility of soil,
- LS refer to the slope features,
- CP refer to the farming system.

In the case of István grange periphery located in the exterior area of Bonyhád the factors of multiplication were as follows (CENTERI, 2002):
- **R**=1030,
- **K**= (*clayey brown forest soil*: 0.0098; *earthy barren*: 0.042; *rendzina*: 0.038; *slope sediment*: 0.0001; *alluvial meadow*: 0.0001; *Ramann brown forest soil*: 0.0097; *low moor*: 0.0001),
- **C**= (*plough-land*: 0.5 →*maize, row crops*: 0.25 → *cereals*; *forest*: 0.006 →*under oak forest:* 0.11→ *acacia, mixed forest insufficient cover*; *grassland*: 0.11; *vine*: 0.55),
- **P**=1,
- **LS**= the multiplication of the length and steepness of slope can be executed with a field information operation using the elevation model.

The program uses the Digital Elevation Model and the slope feature derived from the model to define the length of slope and the LS factor (PATAKI, 2000).

The equation can be solved with GIS tools by storing the factors of the multiplication in different coverages. Then each non-raster map and coverage are converted from polygon to grid, and the different coverages are multiplied using Map Calculator.

- **Parameters referring to the flora and fauna defined by on-site surveys and evaluation**

The current condition of habitats was investigated with the help of nature-lovers knowing the surroundings of the area, fowlers and colleagues of Duna-Dráva National Park. Information was also obtained from relevant researches of university students.

The objective was to establish an extendable and flexible database which can also be used later for the planning of ecological network. Accordingly, the NRW method was chosen out of different habitat evaluation systems (SCHULTE and MARKS, 1985; AMANN and TAXIS, 1987; NRW, 1992) after implementing test procedures on the site.

The advantage of NRW method is that it defines the tasks to be executed later in order to develop and maintain the different habitats. The evaluation system consists of a general datasheet and an evaluation sheet where scores are defined. The questions on the evaluation sheet involve the name of protected, rare and characteristic plant species in the foliage, bush and grass level, as well as topographical data, farming system, foliage cover, rate of decayed or dead trees, habitat structure, age of trees, importance of habitat considering the soil and water, and other observations (e.g. nesting places of birds, effect of farming systems on the habitat, phytocoenoses indicating degradation, presence of transition zone, existence of definite edges, etc.) The habitats were scored and categorized (into five categories from the most valuable ones to the less valuable ones) on the basis of their replaceability, naturality, richness in structures and species, rareness / endangeredness, prevalence / representation and avifaunistic importance.

Before accomplishing this procedure, the habitats were mapped using an aerial photograph. The integration of the topographic map (EOV sections) and the aerial photograph carried out by GIS was promoted by the digital stereo aerial photo pair which were taken in 1999. The draft map produced this way was corrected on the site. The habitats were defined on the basis of ÁNÉR habitat classification (FEKETE et al, ed, 1997). Boundaries of habitats were mechanically drawn on the draft map and digitized afterwards. Every data gathered at the habitats was recorded in the attribute chart providing a multilateral database. This database can be extended by the data obtained from surveying the fauna, which was not included in this examination.

- **Definition of areas cultivated with extensive farming methods**

  The areas cultivated with extensive methods were defined on the basis of an aerial photograph, EOV maps and on-site visits by matching the aerial photo and the draft map with field information tools.

- **The nature protection area planned**

  The Department of Settlement Development of the Self-government of the City of Bonyhád provided information about the fact that the 150-year-old oak stock, which was regarded and evaluated as a separate unit in our habitat evaluation as well, will be declared as nature protection area in the future.

### *2.2.2. Development of agricultural eligibility – environmental sensitivity scale*

The maps of weighted field characteristics were created by weighting the parameters in accordance with their role in the agricultural eligibility and environmental sensitivity of the area. For the collection of the features of the area, the database and weighting system of the national zone system were considered. This national zone system was developed on the basis of expansive investigations and relation-analyses (ÁNGYÁN, 1991) as well as priority values defined by the institutes and professionals creating the databases. In the case of the area examined, 23 variables had to be categorized and evaluated.

The agricultural value number of the area examined was determined by the field information summing of weighted characteristics (parameters of soil, climate) relating to agricultural eligibility, while the environmental sensitivity value number of the area was defined by the field information summing of weighted characteristics (soil, water, flora, fauna) referring to environmental sensitivity. The value of environmental sensitivity was deducted from the value of agricultural eligibility using field information tools, then the result of this operation was increased by 100, creating the agricultural eligibility - environmental sensitivity scale. The two extremities of the scale refer to the areas that are applicable most for agricultural production, and the areas that are sensible most from environmental point of view, respectively. The mid-values of the scale refer to fields with transitional characteristics.

On the basis of the scale, different value categories can be defined and scenarios (intensive farming zone, extensive farming zone, protection zone) can be examined. Within the frame of this work, two extreme and one moderate zones were modelled in three different scenarios. By placing the map showing current land use (digital map prepared on the basis of EOV map with scale 1:10000, aerial photo and site visit) on the zone pattern of the second (intermediate) scenario, we can define the cultivation branches and the areas that need to be converted into a more extensive farming system to enable the establishment of a utilization which conforms to the landscape features.

### *2.2.3. Historical maps on the agricultural eligibility – environmental sensitivity scale*

The constant plough-lands and constant forests revealed by the analyses of historical maps were positioned on the agricultural eligibility – environmental sensitivity scale to examine whether the areas cultivated as arable land for hundreds of years are of high agricultural potential and whether these areas have eroded to a large extent by now owing to their monotonous use as plough-lands and have become environmentally sensitive. Similar questions arose in the case of constant forests: have they been used as constant forests because they are actually environmentally sensitive? These analyses were executed by recoding the attribute charts of digital constant maps followed by their deduction from the agricultural eligibility – environmental sensitivity scale.

Field information and other computer **softwares** used for **zone analyses** were as follows:

- Arc View 3.0 field information software,
- Arc Info field information software,
- ERDAS field information software,
- Excel spreadsheet software.

# 3. RESULTS

## 3.1. Results of historical map analyses (1782-2001)

### *3.1.1. Changes in the structure of land tenure of István grange periphery*

At the end of the 17th century the settlement of Bonyhád adjoining István grange periphery was uninhabited. The Bonyhád basin and the surrounding hills were populated by Hungarians, Serbs and Germans from the vicinity of Fulda in two generations. Organized colonization was carried out in 1721 when squire Kersnerich settled Hungarian villains into his estate in Bonyhád, and in 1724 when baron Schilson called German settlers into his villages including Bonyhád. Former hereditary villainage could not be restored in this depopulated region at the beginning of the 18th century, a contractual landlord-villain relationship was established instead.

In Bonyhád 589 families lived in 1787. The number of nobles in county Tolna was 375 people around 1754-55. The estate structure in the middle of the 18th century was as follows: approximately 60% of the county's area belonged to the aristocracy, 20% to the church and another 20% to the gentry. The most important families of this latter group were the Dőry, Perczel and Kliegl, who were the most significant landowners beside count Apponyi from the 1770s (SZITA-SZŐTS, 1996).

The estate of Bonyhád changed hands several times during the Turkish thraldom, from 1723 the area was possessed by baron Schilson and Ferenc Kun, who were at the same time the landowners settling Bonyhád and its vicinity. Later, Schilson sold one half of the estate to József Perczel and his father-in-law, Sándor Gaál, and the other half to the Kliegl family in 1735. Proprietorships consolidated at this point. The estate was divided into two parts with similar sizes. This state is demonstrated by a map from 1745 showing the boundaries of the estates.

From the middle of the 18th century, the number of inhabitants increased continuously. On 5th June 1782 Emperor József gave Bonyhád the title of market-town and the privilege of organizing markets. In 1768, at the time of the first census of population, 3000 people lived there. Bonyhád had 4709 inhabitants in 1820. The abolition of serfdom was carried out in Bonyhád in 1848 in accordance with the Act made in 1841.

In the district of Völgység the estate structure seemed to consolidate by the second half of the 18th century after a period of indefinite conditions and frequent exchanges of properties. However, family estates began to break up in 2-3 generations owing to inheritance. Estates of gentry families of 10-30000 morgens broke up into estates of 2-5000 morgens in a generation, and became medium-sized properties of 400-1000 morgens in the second generation.

The estate of Perczel family was only inherited by the sons. The Kliegl property split up into three parts, the Kliegl, Salamon and Wimmersperg estate within one generation, and by the 19th century the grand-children only owned 1/72 proportion, and subsequent generations possessed 1/96 proportion. According to the census of nobles in 1847, in the area of Bonyhád lordship 27 Perczels lived. As a consequence of this, the disrupted lands of certain owners located at different and distant parts of the country. The breaking-up of the estates resulted in the indebtedness and impoverishment of nobles.

The cadastre map from 1860 demonstrates these split-up estates, the so-called strip-holdings. The compromise of 1867 accelerated capitalist improvements in Austro-Hungary.

After 1895 the rate of estates under 400 ha was considerable, while there were only few estates over 1000 ha.

The social reorganization of agriculture in 1919 did not affect the peasantry owning small lands in the area examined. On 21st April 1919 a producers' co-operative was established by 26 farm servants on 360 cadastre morgens in the farms called Hónig, Perczel and Weber puszta (the area of present-day István grange periphery) in Alsóbörzsöny. This producers' co-operative was transformed into a state farm in the summer of 1919.

In 1930 the properties are highly disrupted, the land of the village consists of twelve-thousand parts. At this period the land structure of Hungary could be characterised by huge properties (latifundia) and millions of smallholdings.

Owing to the sharing-out of fields after World War II the number of small and medium farms was predominant. At the end of 1948 the producers' co-operative was established in István grange periphery, which operated on 660 cadastre morgens in 1949 as Dózsa Népe Termelőszövetkezet. In 1957 the co-operative was renamed for Istvánmajori Mező- és Tógazdaság Termelőszövetkezet, which amalgamated with Petőfi Termelőszövetkezet in 1966. This new co-operative operated on 2433 ha and was one of the leading co-operatives in the county. In 1972 Pannónia Mezőgazdasági Termelőszövetkezet fused the smaller co-operatives in the region of Bonyhád and was established by 920 members. This co-operative operated even after the privatization procedure.

In the course of the compensation and privatization procedures a part of the lands was shared out again. By now, the minor portion of the land in István grange periphery remained in the possession of Pannónia Mezőgazdasági Termelőszövetkezet (15380 $m^2$) and the majority of the lands are owned by private people. However, all the lands are leased and cultivated by the co-operative. István grange periphery is owned by 61 people at present, the land is divided into 104 proprietary proportions.

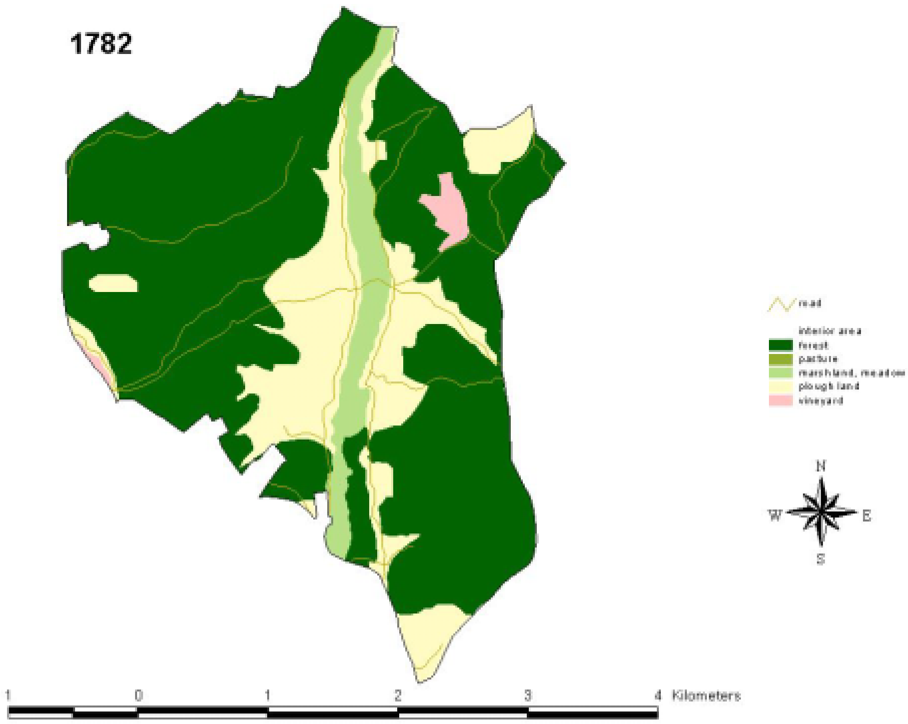
### *3.1.2. Changes in land use in István grange periphery*

The first map information about István grange periphery was provided by a map from 1745 demonstrating the boundaries of the estates. This map involved only a part of the area examined. The map and the descriptions indicate that the major part of István grange periphery was covered with nearly continuous forest. Some arable lands could be found near the winding creek called Rák, while other fields along the watercourse were fresh meadows.

In the middle of the 1700s the landscape was restructured owing to land use system introduced by the settlers who had their own farming methods, habits, knowledge and traditions also mentioned by MÁTYÁS BÉL.

The map section of the **first military survey** (Josephinische Aufnahme) created between 1782 and 1785 showed a very similar landscape to that of 1745. The major portion of the area was covered with forest, some fields on the hill-sides were planted with vine, some lands along the Rák creek were used as plough-lands, some drier areas near the creek were utilized as grasslands and hayfields, while waterlogged fields were marshlands. On the plateau above Rák creek the map indicates small plashes within the forest which replaced the drier environment, changing the local microclimate and thus increasing the level of biodiversity. These habitats were destroyed by the cultivation systems used later (grassland, plough-land). At this time 65.70% of the area was forest, 13.09% was plough-land, 12.44% was meadow and marshland, 6.84% was vineyard and 1.77% was grassland. (**Map No. 1**)

**Map No. 1:** Land use map of István grange periphery (1782)

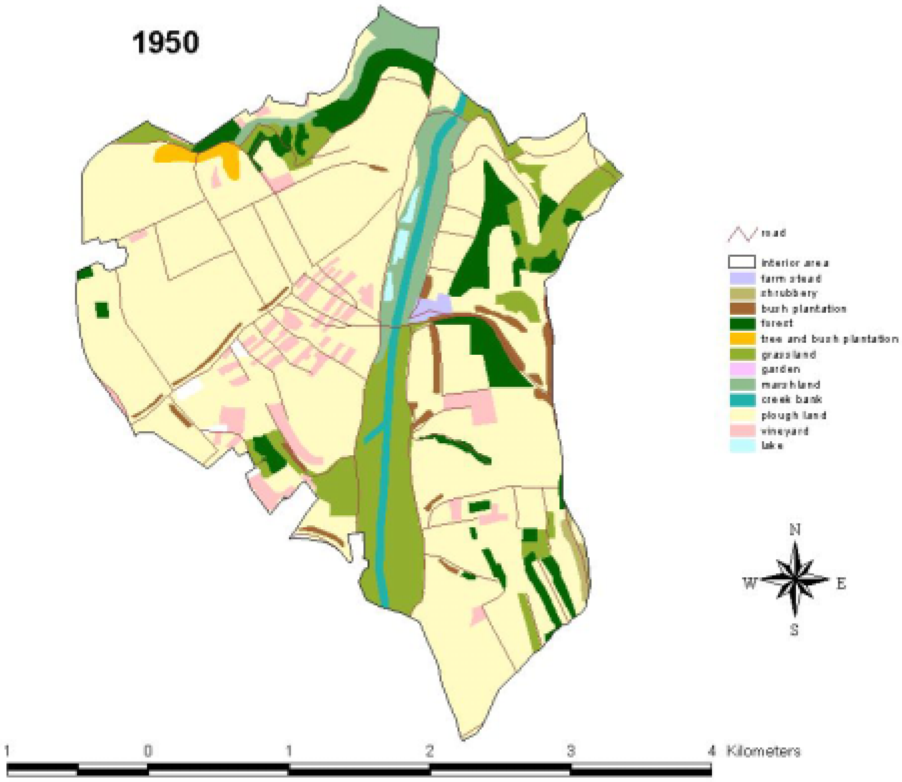



The **second military survey** was prepared in 1858 on the scale of 1:28800. After the revolution and fight for freedom in 1848 the boundaries of the settlements were reallocated and thus the previous rates of cultivation branches were modified. The portion of grasslands and plough-lands increased while the rate of forests reduced. Only patches of woods remained in the place of former continuous forests where other utilization systems were hard to be implemented owing to the topographical conditions. Mainly plough-lands (50.25%) and vineyards (12%) were formed in the place of former forests. In István grange periphery the rate of grasslands increased to 17.01%, the proportion of meadows reached 10.92%, while the rate of forests decreased to 9.37%. From ecological point of view, this state was advantageous for agriecosystems since former continuous forest had been disappeared almost completely, the ecosystems of the forest were destroyed and only minor patches of woods grew on steeper hillsides. The major part of the area became so-called "open landscape" providing place for photophilous species. Accordingly, not only light conditions changed but temperature and wind conditions i.e. microclimate altered as well.

**The cadastre map from 1860** demonstrates prominently high extent of vineyards. The large area of vine-lands was interlaced with cart-roads and built with press-houses. Reviewing every time sections, the rate and extent of vineyards were the highest at the end of the 19$^{th}$ century.

The period of intensive farming began at the turn of the 18$^{th}$ and 19$^{th}$ century and has not terminated since then. New fields were involved in production (by breaking new grounds, etc.) and meliorative measures (draining of marshlands, regulation of waters, etc.) were taken to supply increasing population. Intensive industrial agriculture was introduced, which rearranged the landscape. **In the 1950s** agricultural production became more intensive and further fields were involved in cultivation as plough-lands. The co-operatives converted previous cultivation branches into branches that were most favourable for them. Consequently, the landscape first became mosaic-like where fragments were formed and they were interlaced with bush and tree plantations and sporadical vineyards. However, the prevailing cultivation form was plough-land, and the rate of forests and vineyards decreased. The proportion of arable lands increased to 63%, while the rate of forests decreased to 8%, grasslands to 11% and vineyards to 10%. Intensive farming systems using artificial fertilizers, chemicals, more cultivation with machines interfere negatively into the life of the flora and fauna of agricultural lands. The rate of forests was on its minimum in 1950 from all the time sections examined (**Map No. 2**) (the third map of the dissertation).

**Map No. 2:** Land use map of István grange periphery (1950)




By the 1970s forest management was carried out in accordance with working plans. In consequence, major part of the forests in István grange periphery was transformed into woods having less ecological value with the exception of the 150-year-old oak stock and some other forest fragments. Intensive (industrial, conventional) farming systems changed the structure of agricultural fields as well. Former boundaries, bush and tree plantations which "disturbed" simple and effective farming were ploughed, creating huge agricultural fields sometimes exceeding the size of several hundred ha. This process often damaged the landscape and land character, destroyed the habitats. The digital map from 1989 reveals that extension of forests increased to 17%, and the area of arable lands reduced slightly to 60%. The interior area enlarged to 4%, while the rate of meadows and grasslands reduced due to the establishment of the water farm, which took areas away from the fore-mentioned cultivation branches.

The **map section from 2001** (**Map No. 3**) (the fifth map of the dissertation) represents the state 12 years after the change in the regime. Although the privatization procedure was completed and new proprietary relations were created, the landscape structure still preserves the characteristics of concentrated industrial land use with huge agricultural fields. The reason for this is that family farms were not established and most landowners let out their fields on lease. In most cases the leaseholder of these fields is the former land user, the co-operative.

**Map No. 3:** Land use map of István grange periphery (2001)

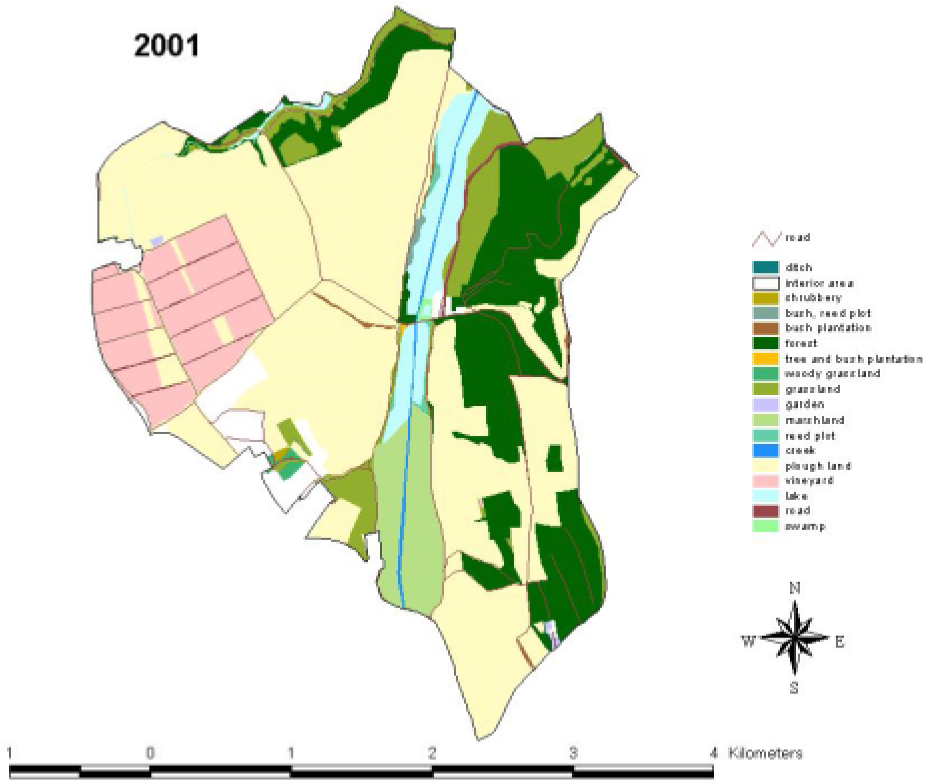


**Figure No. 1** summarizes the typical land use systems and their changes in different time periods.

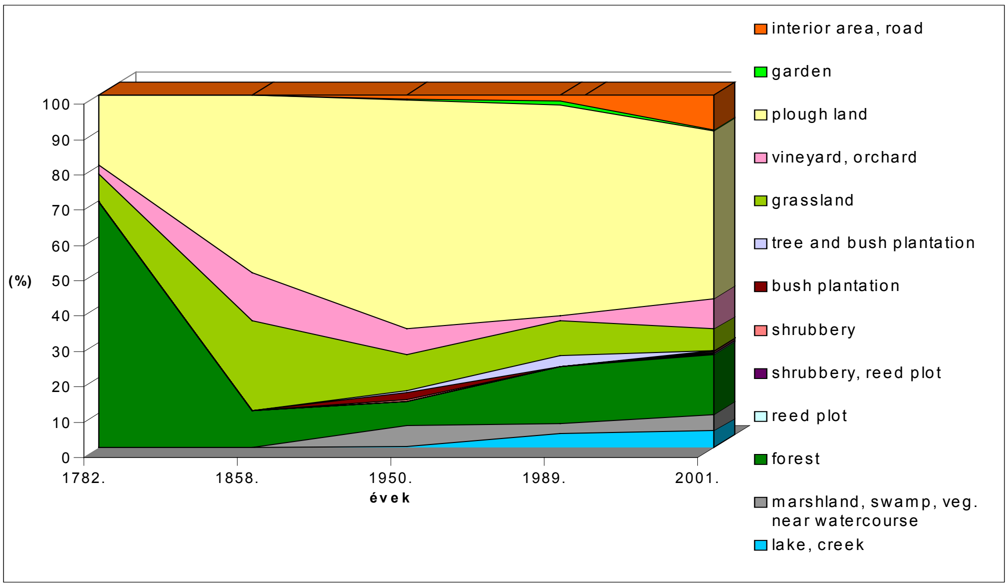



**Figure No. 1:** Changes in land use between 1782 and 2001 in István grange periphery

Before the landscape structure is changed again, it is very important to lay special emphasis on the policy that ecologically valuable and characteristic landscape elements, habitats and farming methods preserving landscape traditions should be maintained, protected and improved. Exploration of landscape features was highly assisted by historical map analysis, preparation of land use stability map, constant analysis (definition of areas used permanently for the same purposes) and revealing of extensive – intensive conversions in land use.

### *3.1.3. Land use stability map*

From ecological point of view, valuable information can be obtained by defining the areas used for the same purposes for several centuries (i.e. the cultivation branch was not changed). On the one hand, valuable habitats could develop in these fields, on the other hand, these areas determine the character and features of a certain landscape, and characteristic traditional farming methods can be preserved there. At the same time, the fields used for intensive farming as plough-lands or vineyards for centuries might have been badly damaged. These lands are uncovered for the major part of the year so they are exposed to the harmful effects of erosion and deflation. There are certain characteristic landscape elements, such as the grassland with groves in the northern part of the area examined, which require continuous or at least repeated changes in land use category. This valuable habitat has to be preserved.

**Figure No. 2** was prepared in the course of the statistical evaluation of the land use stability map (**Map No. 4**) (the eleventh map of the dissertation). This figure demonstrates the rate of changes in land use within each time interval.

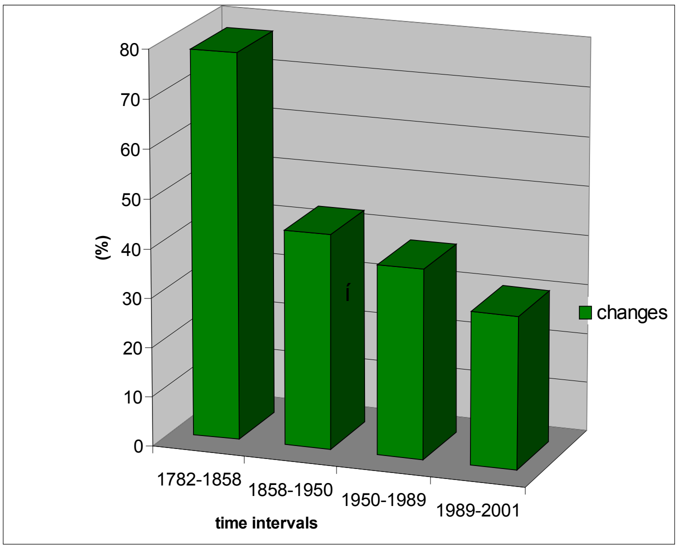
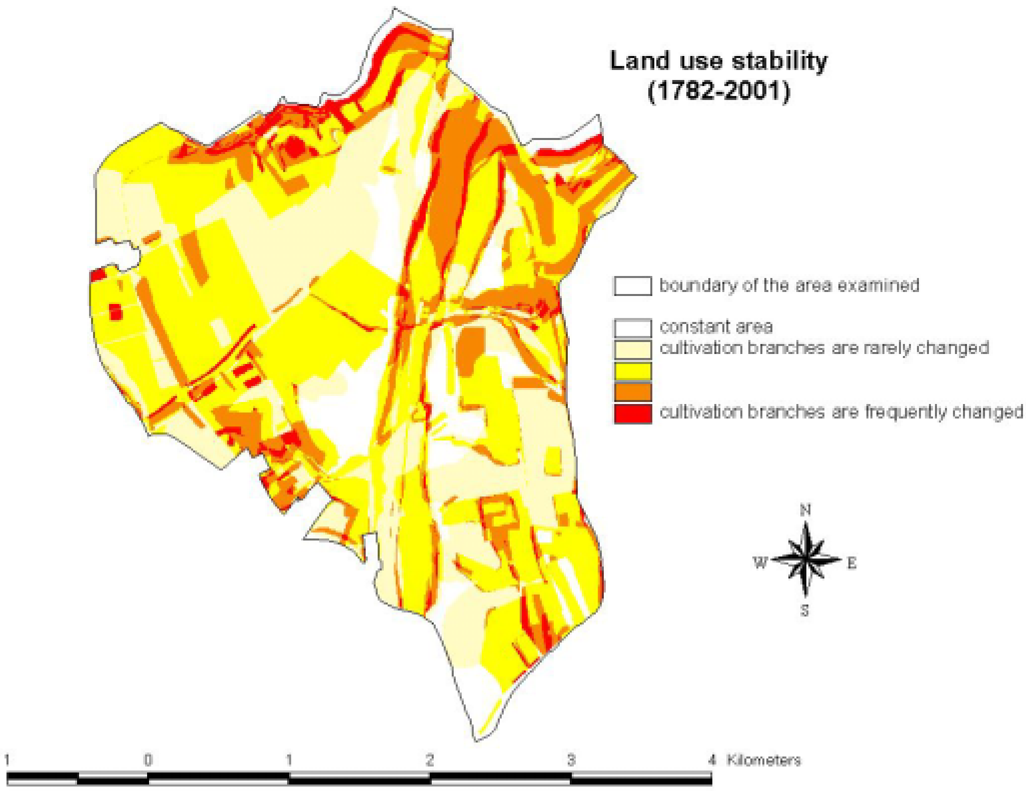



**Figure No. 2:** Total rate of changes (%) in land use within each time interval

It is apparent that the degree of changes reduces in time, meaning that the landscape was changed to the highest extent between 1782 and 1858.




**Map No. 4**

### 3.1.4. *Constant land use categories*

The land use stability map does not show the exact size and location of fields cultivated continuously in an extensive way (e.g. constant forests, marshlands, grasslands, etc.). However, their localization is of high importance for the local ecological network as they provide home for communities which adapted well to constant farming systems and form stable populations. Constantly intensive field use is very likely to have damaged the lands (e.g. the arable lands which are cultivated this way for several hundred years). The localization of these areas promotes the exploration of landscape values, traditions and damaged fields.

In István grange periphery forests can be found primarily on higher and steeper hills. Their total area is 20.36 ha. The exploration of 143-year-old groves is of high importance from ecological point of view. As a result, the valuable oak stock with trees being at least 150 years old was localized. This forest will be declared as nature protection area in the future. The total extent of 143-year-old wood patches is 27.01 ha.

Unfortunately, there are no constant grasslands in the region. Permanent grassland management was performed between 1782 and 1950 at the place of present-day fishponds and marshlands.

The total area of fields used as arable lands during the whole time period is 73.4 ha. Beside the 219-year-old plough-lands, the fields cultivated as arable land for 143 years (from 1858) can be considered as constant areas since intensive land use of one and a half centuries could cause severe erosion on both steeper hill-sides and plateaux. The extent of 143-year-old plough-lands is 426.1 ha.

Constant vineyards can be found on 8 ha.

Constant marshlands of 207 years can only be defined if meadows along watercourses indicated on the map from 1782 are involved in the examination as waterlogged habitats. In this case two major constant areas with the size of 5.3 ha can be found near the present-day fishponds.

Older solitaire trees (some 150-year-old oaks) represent further valuable habitat fragments, which can be found in constant forests where intensive forest management is being performed today. Some valuable and characteristic trees of several hundred years can be found near the present-day fisponds, which are the last survivors of former groves with soft-woods.

All things considered, it can be stated that the changes of farming into intensive systems caused significant damage to the landscape (erosion, termination of protective stability system, destroying of habitats, conversion, water regulation, etc.). At the same time, the character of landscape is determined by the land use systems of several hundred years, and communities adapted well to permanent farming methods, therefore, these fields can be the key areas of the ecological network.

### 3.1.5. *Conversions of cultivation branches (extensive – intensive processes)*

Landscape structures and utilization forms in 1782 were advantageous primarily for forest communities; 65.7% of the area was covered by woods. The landscape state in 1858 revealed a considerable change in landscape structure; continuous forests disappeared and open lands cultivated as plough-lands, vineyards or extensive pastures could be found in their place.

The map demonstrating the changes between the two dates and **Figure No. 3** clearly reflects this significant transformation. Forests could only be found on 9.37% of the land, while 50.25% of the fields was used as arable land. The total rate of areas used intensively is 67%. Typical conversions of cultivation branches are forest – arable land, forest – vineyard, forest – pasture. Conversions into more extensive systems in comparison to the state of 1782 were carried out on 9% of the total area. Such conversions could be found mainly on hill-sides where typical changes in cultivation branches were as follows: arable land – vineyard, arable land – pasture, vineyard – forest, pasture – forest. Farming systems were not changed on 24% of the land therefore these fields are called constant areas. Between 1782 and 1858 conversions in land use category (extensive – intensive changes) were executed on 76% of the total area (**Figure No. 3**)

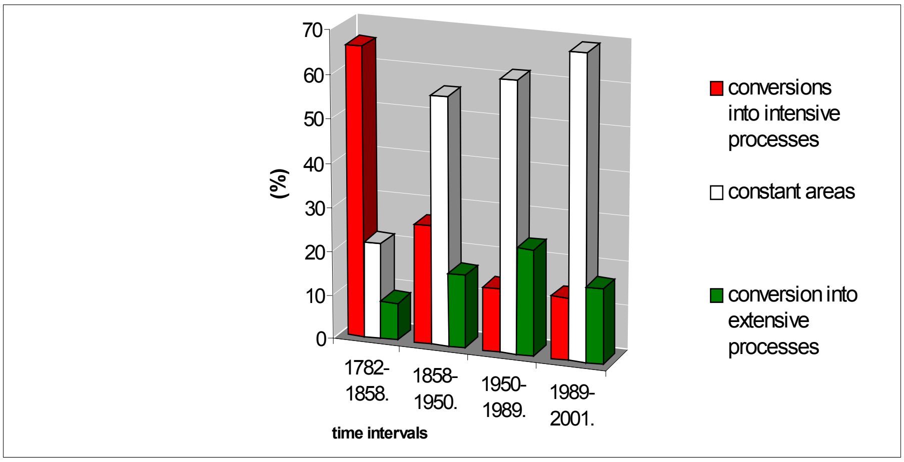



**Figure No. 3:** Conversions of cultivation branches between 1782 and 2001 (changes of extensive – intensive processes)

In the 1950s conversions into intensive cultivation branches were executed on 28% of the total area. Typical changes were primarily carried out by the conversion of former forests (forest – vineyard, forest – arable land, forest – pasture, pasture – arable land, vineyard – arable land). Conversions into more extensive systems were executed at a higher rate in this time interval than in the period of 1782-1858. Cultivation branches were changed into extensive utilization forms on 25% of the total area, including conversions of pasture – forest, pasture – marshland or vegetation along watercourse, arable land – pasture, vineyard – forest, mainly at higher and steeper hill-sides. The rate of constant areas is 58%. Between 1858 and 1950 cultivation branches were converted on 43% of the total area (**Figure No. 3**).

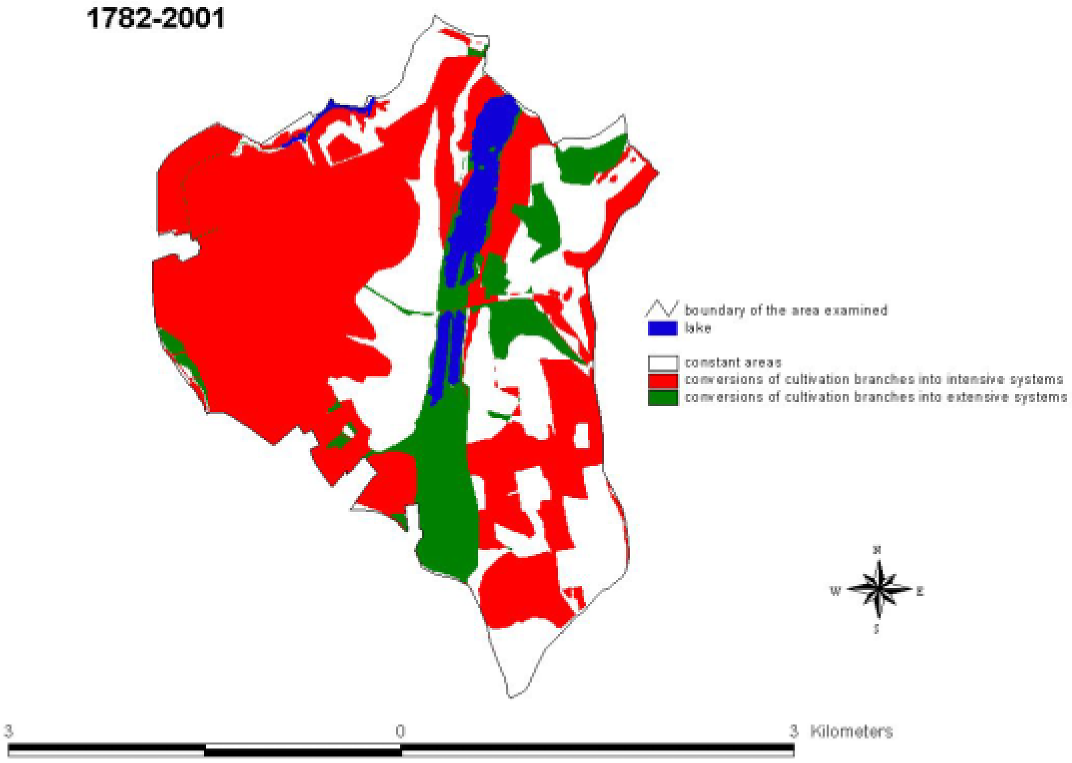
In the period of 1950-1989 conversions into intensive systems were performed on 15% of the total area. These changes were executed mainly with the objective of creating large concentrated agricultural fields. Typical conversions include vineyard – arable land, pasture – arable land, forest – arable land, forest – vineyard, creek bank – arable land. Fields were converted into more extensive systems on 26% of the total area with typical changes of arable land – forest, arable land – pasture, pasture – forest, vineyard – forest, pasture – marshland. Constant lands could be found on 62% of the total area, implying that the rate of land use category changes was 38% within this time interval (**Figure No. 3**).

Between 1989 and 2001 the most significant change is the reduction in arable lands. Conversions into extensive systems were executed on 17% of the total area, involving typical changes of arable land – pasture, arable land – vineyard, arable land – forest, pasture – forest. The rate of constant areas (70%) was the highest in this last 12 years out of all time periods examined (**Figure No. 3**), while land use changes were implemented on 30% of the area during this period, which means that the rate of conversions was 2.58% per year. Consequently, landscape changes accelerated in comparison to that of previous time intervals.

Accordingly, the extent of conversions of cultivation branches into intensive systems shows decreasing tendency in time, while changes to extensive methods increased between 1850 and 1989 and decreased afterwards. The rate of constant areas increased continuously.

**Map No. 5** (the tenth map of the dissertation) demonstrates the directions and characteristics of land use intensity changes during the whole period of 1782-2001.

**Map No. 5**




To sum up, it can be stated that the continuous intensification of land use caused considerable damage to the landscape such as:

- shrinkage of former characteristic habitats (forests, meadows, grasslands, grasslands with groves),
- disappearance of former characteristic habitats (waterlogged meadows, winding creek with several branches, springs, groves with soft-woods),
- transformation of flora and fauna which were characteristic to the water management of the landscape (construction of fishponds with dams in the valley),
- Severe or medium erosion of agricultural fields (plough-lands, vineyards) cultivated intensively for longer periods.

In spite of continuous changes, some valuable landscape elements and characteristic farming systems to be preserved have survived:

- 150-year-old oak stock (constant forest),
- old solitaire trees as the remainders of former forests (in the constant forests and near the lake),
- pasture-forest (as a result of several conversions in cultivation branches),
- constant vineyards (219-year-old),
- hundred years old chestnut-grove (also in the constant forests).

### 3.2. Results of land use zone analyses

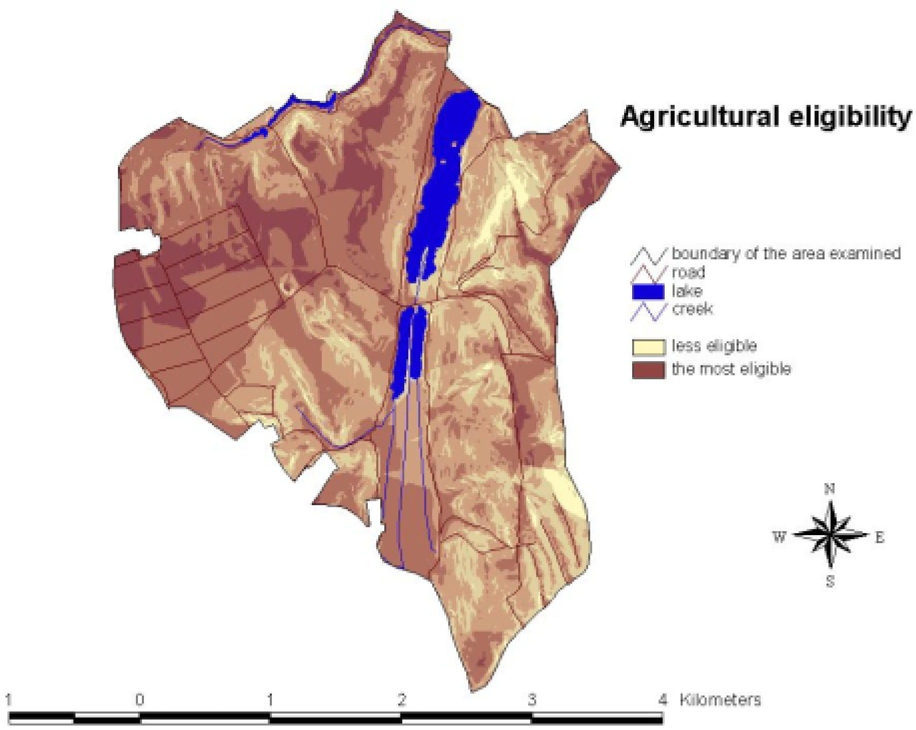
#### *3.2.1. Agricultural eligibility of the area examined*

Agricultural eligibility of the area examined was calculated by the integration of soil eligibility scores and climate eligibility scores using field information tools. In the case of the area examined 1 topographical parameter, 6 soil parameters and 6 climate parameters were available.

Agricultural eligibility map of the area examined (István grange periphery) was created by the integration of climate and soil scores, i.e. the adding up of 13 weighted parameters.

On the basis of the Agricultural eligibility map (**Map No. 6)** (the twenty-ninth map of the dissertation) and its statistical analysis it can be stated that 70% of total area (67% of agricultural fields) is considered as favourable agricultural land, which was measured on a scale with values between 0 and 62. At the same time, 30% of total area (33% of agricultural fields) was classified as land with excellent agricultural eligibility. It is apparent that farming is carried out on fields with favourable or excellent features since only 0.018% of agricultural fields belongs to value categories below 40 points.

**Map. No. 6**

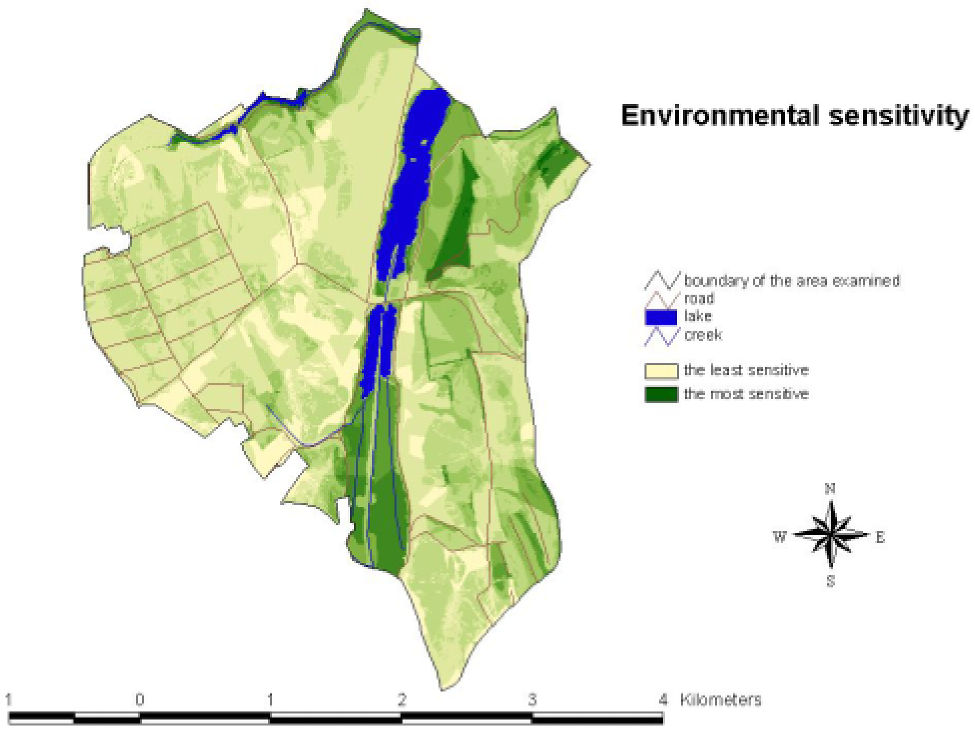



#### *3.2.2. Environmental sensitivity of the area examined*

Parameters (flora, fauna, soil, water) used for the determination of environmental sensitivity were totalized by groups, which provided maps demonstrating the sensitivity of flora, fauna, soil and water base. On the basis of these maps and their statistical analysis it is apparent that more sensitive areas can be found on 18% of the land considering the flora and fauna, while there are no sensitive areas in agricultural lands. With regard to the soil, 65.7% of the area is classified as less or moderately sensitive, while 34% of the land is highly sensitive. Taken altogether, 42% of agricultural fields is environmentally sensitive considering the soil. With respect to the water bases, 7.34% of the area examined is more sensitive, while 89% is considered less sensitive. 2.42% of agricultural fields is located on sensitive areas.

Environmental sensitivity map of the area examined was created by the integration of 10 environmental sensitivity parameters using field information tools. (**Map No. 7)** (the thirty-third map of the dissertation). On the basis of the map and its statistical analysis it can be stated that approximately 21% of the area examined (1.58% of agricultural fields) is considered as highly sensitive land, which was measured on an environmental sensitivity scale with values between 0 and 62.

**Map No. 7**




### *3.2.3. Integration of agricultural eligibility and environmental sensitivity scales*

By the integration of agricultural eligibility and environmental sensitivity values of the area examined, every field unit (raster of 5x5 meters) can be located on the agricultural eligibility – environmental sensitivity scale. To accomplish this procedure, the environmental sensitivity value of each unit was deducted from the values of agricultural eligibility, then the result of this operation was increased by 100, creating the agricultural eligibility - environmental sensitivity scale. The two extremities of the scale refer to the areas that are applicable most for agricultural production, and the areas that are sensible most from environmental point of view, respectively. The mid-values of the scale refer to fields with transitional characteristics.

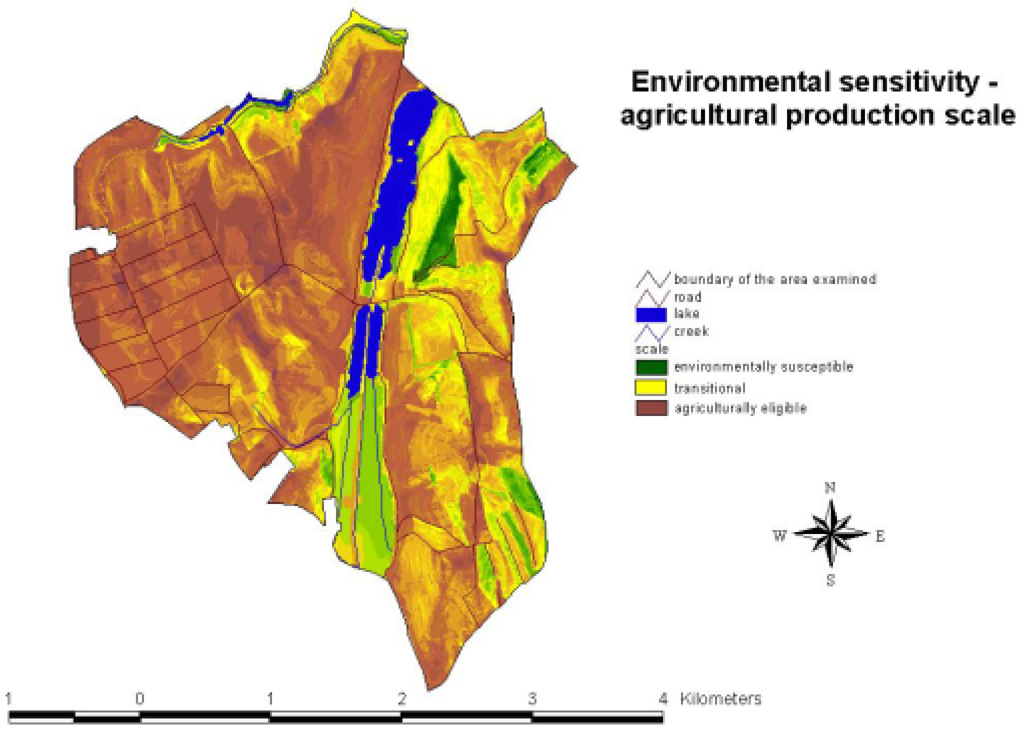
In the case of István grange periphery, agricultural eligibility is characterised by 13 parameters, while environmental sensitivity is defined by 10 parameters. The table below shows the components (field characteristics) of agricultural eligibility and environmental sensitivity scales and their weight factors.

**Table No. 4:** Summarizing table of field parameters referring to the agricultural eligibility and environmental sensitivity of István grange periphery

| AGRICULTURAL ELIGIBILITY | | |
|---|---|---|
| parameters | number of parameters | weights |
| soil eligibility | 7 | 33 |
| climate eligibility | 6 | 29 |
| **Total** | **13** | **62** |
| **ENVIRONMENTAL SENSITIVITY** | | |
| flora, fauna | 5 | 38 |
| soil | 3 | 20 |
| water | 2 | 4 |
| **Total** | **10** | **62** |

Within the agricultural eligibility – environmental sensitivity scale ranging from 38 to 162, real extreme values of the area examined are realized between 96 and 144. **Map No. 8** (the thirty-fourth map of the dissertation) demonstrates the values referring to the fields.

**Map No. 8**




On more than 11% of the total area and approximately 2% of the agricultural fields, the environmental sensitivity exceeds the agricultural potential.

### *3.2.4. Sample scenarios for land use, examples for zonality*

The lines separating the zones (protection, extensive farming, intensive farming) from each other can be drawn at different values using the basic zonal map with the scale of 38-162. Examples are shown below in the following scenarios.

#### *3.2.4.1. First scenario*

Knowing the extreme values, the limit values of the first scenario can be defined as follows:

- Protection zones (%): Areas with values lower than 120
- Extensive agricultural fields (%): Areas with values between 120-125
- Intensive agricultural fields (%): Areas with values higher than 125

In accordance with the first scenario, approximately 19% of the areas falls within the protection zone, 21% within the extensive and 61% within the intensive farming zone. Accordingly, 8.2% of present-day agricultural fields belongs to the protection zone, involving 1.41% (7.38 ha) of arable lands, approximately 11% (79 ha) belongs to the extensive farming zone, which involves 11.6% of arable lands. On the basis of the first scenario, 81% (590 ha) of the agricultural fields falls within the intensive farming zone, involving 87% of present-day arable lands.

#### *3.2.4.2. Second scenario*

In the case of the second scenario the limit values were defined as follows:

- Protection zones (%): Areas with values lower than 120
- Extensive agricultural fields (%): Areas with values between 120-130
- Intensive agricultural fields (%): Areas with values higher than 130

In accordance with this scenario, 8.2% (60.3 ha) of the areas falls within the protection zone, involving 1.41% of present-day arable lands. 31.46% of agricultural fields falls within the extensive farming zone, which involves 34.95% of present-day arable lands. While 60% (440 ha) of the agricultural fields belongs to the intensive farming zone, involving 63.6% of present-day arable lands.

#### *3.2.4.3. Third scenario*

The following limit values were determined for the third scenario:

- Protection zones (%): Areas with values lower than 120
- Extensive agricultural fields (%): Areas with values between 120-135
- Intensive agricultural fields (%): Areas with values higher than 135

According to the third scenario, 8.2% of the agricultural fields belongs to the protection zone, 78.38% (572.11 ha) to the extensive farming zone, and more than 13% (97.7 ha) to the intensive farming zone.

### *3.2.5. Proposals on the conversion of cultivation branches*

Out of the three scenarios the second one represents an average situation. Previous field inspections (evaluation of soil, water, flora, fauna) and landscape analyses (valuable landscapes) also confirm that the second scenario fulfils most the requirements related to the land use of the area. On the basis of this scenario, 205.85 ha of István grange periphery falls within the protection zone, 426.2 ha is proposed to be used as extensive agricultural fields and 469.89 ha can be considered as eligible for intensive agricultural production.

Considering cultivation branches (arable land, vineyard, grassland), the area of each cultivation branch that falls within the different zones can also be seen (**Table No. 5**). On the basis of this, proposals can be made in connection with the modifications.

**Table No. 5:** The area of each cultivation branch in different zones

| **Land use zone** | **Total** | | **Arable lands** | | **Vineyards** | | **Grasslands** | |
|---|---|---|---|---|---|---|---|---|
| | | | **area in each zone** | | | | | |
| | % | ha | % | ha | % | ha | % | ha |
| Protective area | 18.7 | 205.85 | 1.4 | 7.78 | 0.0 | 0.00 | 64.8 | 52.0 |
| Extensive agricultural fields | 38.7 | 426.20 | 35.0 | 192.33 | 12.8 | 12.65 | 30.6 | 24.4 |
| Intensive agricultural fields | 42.6 | 469.89 | 63.6 | 350.06 | 87.2 | 85.94 | 4.6 | 3.7 |
| Total | 100.0 | | 100.0 | | 100.0 | | 100.0 | |

On the basis of the zone map defined by the second scenario, approximately 470 ha (40% of the total area) falls within the **intensive zone**. These areas represent the fields cultivated with intensive methods where environmentally beneficial agricultural production can be executed.

In accordance with the zone map, 35% (192 ha) of present-day arable lands belongs to the **extensive zone**. Mainly those fields fall within this category which were highly damaged (acidification, erosion) by continuous intensive utilization or which are not eligible for intensive production due to their other features. To avoid or reduce further soil degradation, application of preservative land use conforming most to the features and limits of the landscape or the given area is proposed.

Fields with higher environmental sensitivity and lower agricultural eligibility can be defined as areas to be converted into grasslands (their values are between 120-125). Consequently, 11.73% (64.24 ha) of present-day arable lands is proposed to be changed into grasslands.

Areas with points between 125-130 having higher agricultural eligibility and lower environmental sensitivity are proposed to be used as extensive arable lands with certain limitations relating to soil protection. 23% (128 ha) of present-day arable lands belongs to this category. Accordingly, the following conversions are proposed in the case of arable lands that fall within the extensive zone:

- Conversion from arable land into grassland: 64 ha
- Conversion from arable land into extensive arable land: 128 ha.

Vineyards (12.6 ha) also belong to the extensive zone for which more extensive use is proposed.

Beside arable lands and vineyards, 24 ha of grasslands can also be found in the extensive zone at present, with which the grasslands of the zone can be enlarged.

Areas fall within the **protection zone** (values below 120) are all proposed for forestation. In the case of István grange periphery this implies the extension of existing forests. Only 1.41% (about 8 ha) of present-day arable lands and 4.6% (3.7 ha) of present-day grasslands are proposed to be forested. With regard to the total area examined, 19% (206 ha) of the land falls within the protection zone.

**Table No. 6** demonstrates the **overall** land use structure to be established.

**Table No. 6:** Land use structure to be established in István grange periphery

| Cultivation branch | Area (ha) | |
|---|---|---|
| | actual | according to the second scenario |
| **Arable land** intensive: | 550 | 353.7 |
| extensive: | - | 128.0 |
| total: | 550 | 481.7 |
| **Vineyard:** | | |
| actual: | 99 | 99 |
| planned: | - | 99-13 |
| total: | 99 | 86 |
| **Garden + orchard:** | 1 | 1 |
| **Grassland:** | | |
| actual | 80 | |
| planned | - | 64.24+13+24.4 |
| total: | 80 | 101.64 |
| **Agricultural field** | 730 | 670 |
| **Forest** actual**:** | 200 | 200 |
| planned (new): | - | 7.78+52 |
| total: | 200 | 260 |
| **Reed plot, marshland, fish-pond:** | 120 | 120 |
| **Production area:** | 1050 | 1050 |
| **Set aside:** | 52 | 52 |
| **Total area:** | 1102 | 1102 |

To accomplish the second scenario and establish the proposed land use structure the following measures should be taken:

- To convert 128 ha of *intensive arable land* into *extensive arable land*,
- To convert 64 ha of *intensive arable land* into *grassland*,
- To convert 8 ha of *intensive arable land* into *forest*,
- To convert 13 ha of *vineyard* into *grassland*,
- To convert 52 ha of *grassland* into *forest*,
- To convert 3.7 ha of *grassland* into *arable land* because of their favourable agri-ecological potentials.

Accordingly, the total size of the fields to be converted is 268 ha, involving 24.3% of the total area.

### 3.3. Comparison of constant arable lands and forests shown in historical maps with the agricultural eligibility – environmental sensitivity scale

The fields that are proved to be used constantly as arable lands or forests were localized on the agricultural eligibility – environmental sensitivity scale. On the basis of this, it can be stated that constant arable lands were established on fields with favourable or excellent agricultural potential, complying to local conditions. Therefore, it is not a coincidence that these lands are being used as plough-lands at present and the major part of these fields (401.79 ha, i.e. 73% of present-day arable lands) belongs to the intensive agricultural zone.

It can also be stated that 93% of 219-year-old forests falls within the category of environmentally sensitive areas, which highly contributes to their utilization as traditional forests.

## 4. NEW SCIENTIFIC RESULTS

Historical and land use zone analyses have conduced the following new scientific results:

- On the basis of maps originated from different time sections of a long period (219 years), constant areas with unchanged utilization forms were defined using field information tools. These constant areas are key elements of the local ecological network.
- Land use stability map of the sample area was prepared. Conversions and processes executed in the area and their effect on landscape structure were analysed for a time period exceeding two hundred years.
- A new local land use database was created about the area examined, which can serve as a sample for local land use zone analyses.
- The methods of national land use zone analyses were improved and proposals were made on the establishment of local land use zone system of the area. These systems were analysed in accordance with different scenarios.
- The main reasons for the permanent existence of constant arable lands and constant forests were revealed by the comparison of the results of historical surveys and land use zone analyses.

# 5. CONCLUSIONS AND PROPOSALS

Historical analysis of land use and simultaneous examination of agricultural eligibility and environmental sensitivity can promote the development of agricultural land use systems with the intensity and form that comply with the ecological features of the area, as well as the conversions in cultivation branches.

In comparison to national land use zone analyses, information has to be refined and further information has to be collected at farm level to enable the establishment of a sustainable land use structure which conforms to landscape potentials, traditions and values.

The following **proposals** can be made in relation to the **conversion of cultivation branches and land use** of István grange periphery in Bonyhád on the basis of historical and zone analyses.

- Conversion of cultivation branches is proposed to be implemented on a total area of 268 ha, from which 264 ha should be converted into a more extensive system. With regard to the local ecological network, waterlogged habitats (marshland, lake, shore, creek, creek bank) and dry habitats (forest, grassland, shrubbery, boundary, tree plantation, grove, extensive plough-land, extensive orchard) are of high importance. Therefore, this project measurably contributes to the extension of the elements of local ecological network by the conversion of 264 ha into more extensive land use. Consequently, the bases of sustainable field structure are assured in the given landscape, since the elements of ecological network are mainly composed of environmentally sensitive areas. Establishment and localization of corridors and stepping stones between the elements, improvement of the structure of existing habitats, determination of their buffer zones are the tasks of concrete ecological network planning. Further information is provided to this planning procedure by the evaluation sheets of existing habitats (habitat evaluation and mapping).
- From the area of 264 ha to be converted 77 ha is proposed to be changed into grassland, resulting in the extension of total grasslands to 102 ha. These fields can participate in the target program for extensive grasslands introduced within the horizontal programs of National Agri-environmental Programme. Nature protection value of grasslands is well demonstrated by the fact that one third of the protected species in the area can be found there, and several endangered phytocoenoses are also recorded in the grasslands. This is the reason why their proper management is important by this grassland management target program which supports the preservation of existing valuable grasslands and the conversion of fields withdrawn from cultivation into grasslands.
- From the area to be converted 60 ha is proposed to be forested, thus the total area of forests would be 260 ha. The users and owners of the area can submit their applications for the forestation procedure of lands to the Ministry of Agriculture and Rural Development. The application program involves forestation, conversion of forest structure and planting of trees with the general aim to increase the extent of forests, improve their quality and develop the protective, economic, health-social, touristic, educational-research function of forests in Hungary.
- A total area of 128 ha is proposed to be converted into extensive arable lands. These fields cultivated extensively serve as habitats with the tasks of soil, water base and habitat protection (buffer).
- In István grange periphery, waterlogged habitats play an important role in landscape management. In the course of historical map analyses it could be seen that there used to be waterlogged, fresh meadows in the valley. Now fishponds, marshlands and reed plots can be

found there, providing substantial habitats for waterfowls. Target programs dealing with waterlogged habitats subsidize the preservation of these areas. Waterlogged habitats related to agriculture are of high importance. Their impact on production, environment-ecology (nature conservation) and landscape protection is advantageous. This target program includes several fields: flood-basins, banks of watercourses, other natural waterlogged habitats, fishponds, reed plots, etc. Environment and nature protection objectives are accomplished by applying different management systems in each habitat.

On the basis of the experience gathered in the course of preliminary examinations the following **proposals** can be made on the **methodical improvement of land use zone analyses establishing the development of local zone system**.

- A more detailed survey of the flora and especially the fauna is proposed. It is required to complete the habitat evaluation database with the results of these examinations. The information obtained this way can be involved in the planning of local ecological network (selection of target species).
- It is important to continue the determination and specification of local ecological network elements. These were partially defined in the course of habitat evaluation and determination of zones (protection and transitional zones).
- Very little data is available on waters (especially in the case of subsurface waters), therefore, further information is required in relation to the establishment of the local database on water management.
- Thematic expansion of database with economic-social (employment, etc.) viewpoints is also proposed, providing opportunities for the utilization of certain parts of the area for other purposes (tourism, recreation).
- Further improvement of the evaluation system is also proposed.
  - The spreading of local zone system throughout the country would be promoted if the present-day national evaluation system was completed with the field parameters to be considered at farm level. Therefore, the extension of field parameters is proposed so that local parameters and their weights were involved.
  - It is advisable to indicate which parameters can be replaced by other similar parameters at local level at certain examination levels (soil, flora, fauna, water, climate).
  - This would accelerate the work since the person preparing the local zone classification could gather data in accordance with the evaluation system and obtain proposals on what further information is necessary for getting proximate data in the case of each parameter if some certain elements (databases) are not available.
  - A database system extended this way contains the possible field parameters and their weights as a unified catalogue. This system would ensure the comparison of local zone classifications of different regions.

## 6. LIST OF PUBLICATIONS IN CONNECTION WITH THE SUBJECT OF THE DISSERTATION

### Journal articles

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**Lőrinci, R.** (**1999**): A biotóptérképezés és -értékelés módszere a lokális ökológiai hálózattervezésben. V. Ifjúsági tudományos fórum, 30-34. p. 1999, Keszthely, 448 p. (*Habitat mapping & evaluation for local ecological network planning; V. Scientific Student Forum, p30-34, 1999, Keszthely, p448*)

**Lőrinci, R.** - Balázs K. (**2001**): A táj adottságaihoz, hagyományaihoz illeszkedő földhasználati rendszer kialakítása Bonyhád mellett, István-major külterületen, XLIII. Georgikon Napok, „Vidékfejlesztés – Környezetgazdálkodás – Mezőgazdaság" tudományos konferencia, 219-225. p. Keszthely, 2001. szeptember 20-21. 1168 p. (*Establishment of a land use system conforming to landscape features and traditions in the environs of Bonyhád, in István grange periphery; XLIII Georgikon days, Scientific conference on Rural development, Environment management and Agriculture, p219-225, Keszthely, 20-21 September 2001, p1168*)

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**Lőrinci, R.** – Balázs, K. (**2001**): Landscape Evaluation: the First Step of Ecological Infrastructure Planning – A case study of István grange periphery. International Association for Landscape Ecology (IALE) European Conference – Development of European Landscapes, Stockholm, p734-741, Sweden, 30 June 2 July 2001 – Tartu, Estonia, 3-6 July 2001, p804

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