LAND-USE SYSTEM OF HUNGARY
Working out of the land-use zone system for Hungary in the interest of the discussions for accession to the European Union

ÁNGYÁN József - PODMANICZKY László
NÉMETH Tamás - BÜTTNER György
TAR Ferenc - FÉSŰS István
VAJNÁNÉ MADARASSY Anikó - ÓNODI Gábor
KLÁR Zoltán - SKUTAI Julianna
GRÓNÁS Viktor - LŐRINCZI Renáta
NAGY Gábor - BALÁZS Katalin BELÉNYESI Márta
Szent Istvn University Göd¨llő,
Institute of Environmental Management,
2103 Gödöllő, Péter K. u. 1.,
Tel./Fax: 06-28-415-383,
E-mail: angyanj@svr-sun.ktg.gau.hu,
http://www.ktg.gau.hu

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1 THE PROBLEM AND ITS PRINCIPAL BACKGROUND

1.1 CATEGORIES OF ZONALITY AND THE CHANGES IN THE SUPPORT SYSTEM OF THE EUROPEAN UNION

The 2078/92/EEC Decision of the **CAP reform** in 1992 **made it compulsory to form such subsidizing systems as would promote the integration of environmental and landscape protection and nature conservation into the system of agricultural production for all member states**. Whilst, as a consequence of **the liberalization process in world trade** inspired by the WTO in accordance with the GATT Agreement (Uruguay Round) in 1995, **agricultural production will probably be concentrated in those areas where it is most profitable and the comparative ecological advantages are the most favoured**. As a consequence of this one of the main topics of the new WTO discussions in 1999 may be **how can the subsidies formerly devoted to the producers depending on production** be converted into subsidies **supporting rural development and the non-productive** (i.e. environmental, ecological, social, employment, cultural etc.) **functions of agriculture**.

The **resettlement process of agricultural and rural development policy** of the EU and its adaptation may only give advantages for Hungary if the **special conditions of the different measures to be taken are precisely determined i.e. a land-use zone system** shall be formed which

- completely takes into consideration either the agricultural production or non- productive potentials of different regions,
- classifies the different areas of the country along these coordinates, and
- applies different strategies for agricultural and rural development in the different zones that have been formed in accordance with the above mentioned methods.

Given the common need for **zonality** that characterizes both **nature conservation and agriculture**, the categories of this system can be summarized as follows:

1. **Basic nature conservation zones**: areas that can be used exclusively for special functions of nature conservation and totally restricted for other types of land-use.
2. **Buffer zones of nature conservation and protection zones for water bases**: areas that are cultivated with respects to the guidelines for landscape and environmental protection, mainly used for environmental, employment, cultural and recreational functions.
3. **Mixed zones**: areas that can be used for agricultural production with special additional protective functions, cultivated by ecological and other extensive-type farming systems, with ESA areas and undisturbed biotop network systems.
4. **Zones for agricultural production**: areas that are used for agricultural production in the form of integrated and sustainable production systems.
5. **Non-cultivated land**: urbanized areas with infrastructural, service and industrial functions.

The first three categories of the land-use system are likely to be the main objectives of the subsidies, therefore such **projects** should be developed and initiated which conform with the supporting priorities. The fourth of the above mentioned categories is the **zone of the agricultural production**, which is classified as a **market competitive category** as a result of the GATT-WTO transformation process. **Direct subsidies** for production should not be applied. Its comparative ecological advantages shall be asserted at the market, so only the areas with the **best agro-ecological conditions** shall be involved in this category. **Subsidies** can be taken into account only for the supplementary functions (such as development and maintenance a biotope network system operating in 7-12 % of the agricultural land, or rural employment, social and cultural functions etc.). The amount of these subsidies would **depend on the proportion of these supplementary functions**.

In order to meet the conditions of this concept and to establish the circumstances required, the Hungarian target areas for these subsidies shall be determined, on the basis of particular analyses, and the possible methods for transforming the land-use system shall be worked out. It is necessary not only for EU-accession, but also for our own inland development process, and for the increasing need for harmonization in the different fields of agricultural production, nature conservation and rural development.

1.2 THE LAND-USE PYRAMID

The basic elements of **the concept that integrates the land-use and nature conservation in compliance with the conditions of the given region** are shown in **Fig. 1.**

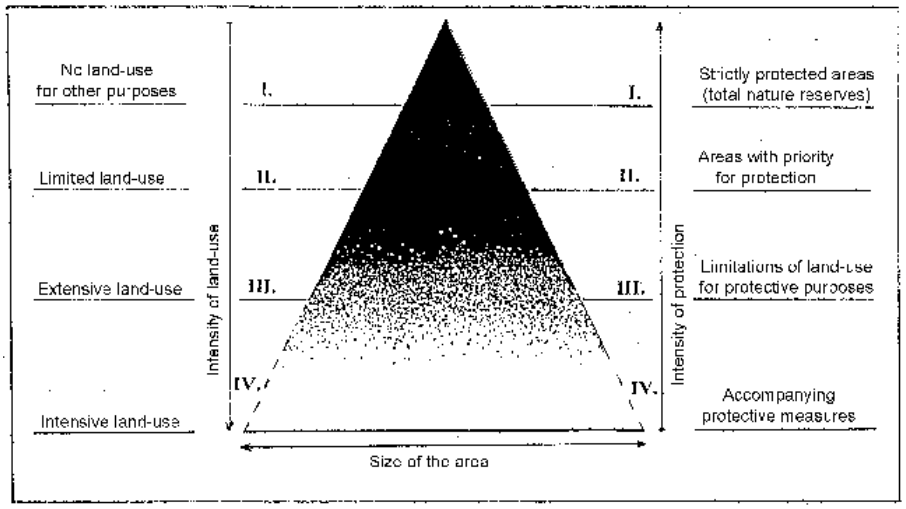


Figure 1: The land-use pyramid (adapted from Erz,1978)

I. At the top of the land-use pyramid are those areas - with regionally different sizes - which shall be classified categorically as areas for nature conservation (i.e. nature reserves, landscape protection areas or basic areas of biosphere reserves). These areas are characterized by the total prohibition of land use for any other purposes.

II. The areas with special need for land use limitations (such as the buffer zones around the basic zones) are standing underneath the above mentioned category of the pyramid. In this case land-use is restricted to such types of agricultural production which lend themselves to nature protection.

III. Beneath these two levels, the areas with different limitations in land-use (such as protection areas of water catchments and buffer zones) can be found, where semi-intensive production may be allowed as well, so long as these comply with the given limitations.

IV. Finally, the broad base of the pyramid is composed of the zone of agricultural production, either semi-intensive or intensive, but in both cases it shall be environment- friendly and adjustable to the environment and to the area of production. Its vertical extent depends on the location of the given region (i.e. an area for intensive agricultural production with high production capacity or area with high capacity for environmental protection but low in agricultural production. The degree of intensity is determined by the capacity for environmental protection and the sensitivity of the values to be protected.

2 THE MAIN OBJECTS OF THE STUDY

The realization of the concept outlined above i.e. the **basic aim in developing Hungary's integrated land-use zone system** is to develop an objective and ecologically-based analysis in several respects, to evaluate the suitability of these areas for agricultural production (i.e. agricultural potential) and environmental sensitivity, and to make a comparison between these two sides in order to balance natural resources (agricultural and environmental standards). **The land-use zone system** can be developed **by comparing the standards of suitability for agricultural production and of environmental sensitivity**. This **zone system can**:

- give help to the **discussions on EU-accession** in agricultural issues by giving an objective land-use base to these issues;
- indicate the potential Hungarian **target areas** of the **EU subsidizing system**;
- be a basis of a regionally different but harmonized **agricultural, rural and environmental policy**;
- provide a direct base in the field of land-use for a long-term **national rural development concept**;
- can help in the development of a **sustainable land-use structure**, which is **adjusted to the ecological conditions**, and also in the realization of the sustainable development in practice.

In October, 1997, the **Institute for Environmental and Landscape Management** of the Gdll University of Agriculture (GATE-KTI) and its partner institute, the **Research Institute for Soil Sciences and Agrochemistry** of the Hungarian Academy of Science (MTA-TAKI) were charged by the EU-Harmonization Committee for Protection of Agricultural Environment, Forestry, Bio-farming and Wild production of the Hungarian Ministry of Agriculture to undertake examinations for the development of Hungary's land- use zone system, by the participation of the institutes, ministry offices and other institutions involved in these problems. According to these aspects the **following questions arose**. Our task was to **give the answer** or to seek the answer for these questions **by giving the information requiredfor decision making**.

1. What changes can be observed in the suitability of agricultural production, agro- ecological standards and environmental (zoological, soil and water protection) sensitivity of Hungary's area?
2. How can the problem of harmonizing the land-use of areas with low agricultural potential or changes in the degree of intensity and the land demand of environmental protection and nature conservation be solved?
3. What categories can be developed for the regions of the country through comparing these two standards?
4. Where and to what extent can the areas with protection priorities, agricultural priorities and the double priorities be found, i..e. where can the protective, extensive and intensive agricultural zones be identified?

5. What are the effects of this categorization on agricultural land?
6. Which agricultural and arable lands are to be placed in the intensive farming category, where there is a need for decreasing the intensity of farming, and where there is a need for changes in the land-use system or for the formation of a protective land-use system?

3 DATABASE AND METHODOLOGY OF THE EXAMINATIONS

During our examinations we mostly used regional databases with regard to the environment, terrain, soils, climate, water resources, living creatures and their species, habitats and also the land-use forms. For the processing of this data GIS methods were applied.

Two of our databases (NECONET and CORINE Land Cover) will be presented in more details after the list of the database resources used, because of their European connotations.

3.1 THE DATABASE OF THE EXAMINATIONS AND ENVIRONMENTAL FEATURES

3.1.1 Variables and databases used for evaluation and qualification of the suitability for agricultural production

A. **PARAMETERS OF CONFIGURATION for THE TERRAIN AND SOILS**

1. **Categories of slopes**
   Resource database: Hungary's Digital Database of the Terrain, FMI Map Database, S=1:100 000
2. **Degree of soil value (100 point system)**
   Resource database: AGROTOPO Map, MTA-TAKI (Hungarian Academy of Science Research Institute for Soil Sciences and Agrochemistry), S=1:100 000
3. **Average gold-crown value of arable land**
   Resource database: Map of Settlement details (Hungarian Ministry of Agriculture)
4. **The type and sub-type of soils**
   Resource database: AGROTOPO Map, MTA-TAKI, S=1:100 000
5. **The physical type of the soil**
   Resource database: AGROTOPO Map, MTA-TAKI, S=1:100 000
6. **Water-management features of the soil**
   Resource database: AGROTOPO Map, MTA-TAKI, S=1:100 000
7. **The reaction and lime-content of the soil**
   Resource database: AGROTOPO Map, MTA-TAKI, S=1:100 000
8. **The organic matter supply of the soil (t per ha)**
   Resource database: AGROTOPO Map, MTA-TAKI, S=1:100 000
9. **The thickness of the productive layer**
   Resource database: AGROTOPO Map, MTA-TAKI, S=1:100 000

B. **CLIMATIC PARAMETERS**

1. **Energetic potential of agricultural production**
   Resource database: Map database of Debrecen University of Agricultural Sciences by Gbor Szsz
2. **Climatic potential of agricultural production**
   Resource database: Map database of Debrecen University of Agricultural Sciences by Gbor Szsz
3. **Standard for climatic suitability of corn production**
   Resource database: Map database of Gdll University of Agricultural Sciences, Institute for Environment and Landscape Management by Jzsef ngyn
4. **Climatic standard for the quality of wheat production**
   Resource database: Map database of Gdll University of Agricultural Sciences, Institute for Crop Production by Mikls Szab

5. **Climatic standard for the quantity of wheat production**
   Resource database: Map database of Gdll University of Agricultural Sciences, Institute for Crop Production by Mikls Szab
6. **Standard for climatic suitability of malting barley production**
   Resource database: Map database of Gdll University of Agricultural Sciences, Institute for Crop Production by Balzs Alapy

3.1.2 Features and databases used for evaluation of environmental sensitivity

A. **FLORA AND FAUNA**

1. **Hungary's areas under nature conservation**
   Resource database: Map database by the Office of Nature Conservation of the Ministry for Environmental Protection and Rural Development, S=1:100 000
2. **National Ecological Network (NECONET)**
   Resource database: Map database by the Office of Nature Conservation of the Ministry for Environmental Protection and Rural Development, S=1:500 000
3. **Regions recommended to qualify as sensitive**
   Resource database: MME Map database (by Szabolcs Nagy), S=1:100 000
4. **Ramsari regions**
   Resource database: VITUKI Map database (Research Institute for Watermanagement), S=1:100 000
5. **Bird habitats of international importance**
   Resource database: MME Map database (by Szabolcs Nagy), S=1:100 000
6. **Important regions for endangered meadow bird species**
   Resource database: Map database by the MME Monitoring Center, S=1:100 000

B. **SOIL**

1. **Degree of erosion** Resource database: MTA-TAKI Map database, S:1:100 000
2. **The physical type of the soil**
   Resource database: AGROTOPO Map, MTA-TAKI, S:1:100 000
3. **Quality of clay minerals**
   Resource database: MTA-TAKI Map database (by Pl Stefanovits), S:1:100 000
4. **The reaction and lime-content of the soil**
   Resource database: AGROTOPO Map, MTA-TAKI, S:1:100 000
5. **The organic matter supply of the soil (t per ha)**
   Resource database: AGROTOPO Map, MTA-TAKI, S:1:100 000

C. **WATER**

1. **Groundwater protection areas**
   Resource database: VITUKI Map database, S:1:500 000
2. **Surface water protection areas**
   Resource database: VITUKI Map database, S:1:500 000

3.1.3 Databases of land-use and land cover

A. **Database CORINE Land Cover**

Resource database: FMI Map Database, S:1:100 000

B. **Digital database of Hungary's forest areas**

Resource database: Map Database of the Office of Forestry of the Ministry of Agriculture, S:1:20 000

3.1.4 National Ecological Network (NECONET)

3.2 INFORMATION PROCESSING METHODS

3.2.1 Steps of creating the analyzing system

The **following steps and logical order were followed during the regional analysis** of the databases listed above:

- The above mentioned **28 environmental standards were classified**, all variables and categories have been **weighted according to their role in the determination of agricultural production and environmental sensitivity**, and in the decision process of agricultural suitability and environmental sensitivity of the area in question. For this weighting method we used the results of our former analyses and examinations (ngyn, 1991), and also the priority standards given by certain experts and institutes that developed the databases.
- **The area of the country was divided into 9,3 Million 1 hectare squares by grid with a cell size** (breaking down) **of 100x100 metres**, then the values of environmental features were determined for each hectare of the country, by placing this grid onto the **map of regional distribution** of the described variables. By this method **28 values of environmental features were produced for each cell**.
- The 15 standards of agricultural suitability and the 13 standards of environmental sensitivity were **summarized by observation units** (1 hectare), then these values **were shown on a map**. By this method each hectare of the country was placed on a scale **of agricultural suitability and environmental sensitivity** between the values of 0 to 99.
- The values of environmental sensitivity (VES) were subtracted from the values of the agricultural suitability (VAS) in each cells, then 100 were added to the difference, i.e. (VAS-VES)+100. Thus we derived scale with the values between 0 and 198, where the values under 100 reflect to the determinant role of environmental sensitivity, the values above 100 reflect determinant role of the agricultural suitability . At the two extremes of this scale the well-determined areas (agricultural and environmental areas) can be found, in the middle of the scale the mixed/intermediate areas (areas with extensive production limited by environmental features) are situated. The values were shown on a summary map.
- By this summary map (either with agricultural and environmental values) three scenarios were worked out in order to develop a land-use zone system in which
  - areas with a value less than 100 were ranked into the **protection zone**,
  - areas with a value between 100 and 120, 100 and 125, and 100 and 130 were ranked into the **extensive agricultural zone**, and
  - areas with a value more than 120, 125 and 130 were ranked into the **intensive agricultural zone**.
- The distribution of the present agricultural areas and the total arable land were also examined.
- After all, a proposal was made on the basis of the second scenario for the directions and scale of the changes in **land-use**.

3.2.2 Technical steps of the analysis

For the analysis we applied a variant of the Arc/Info (GIS) software running on a SUN computer. The technical steps of the processing were as follows:

1. **Developing the map of slope categories** by using the digital database of the terrain in accordance with the following:
   a) converting the Coverage of the contour lines into TIN;
   b) interpolation of the TINs into quadratic GRID, i.e. LATTICE;
   c) from the GRID processed in this way, which shows the terrain the Arc/Info could easily calculate the value of angles of the slopes **(Map 1. and 2.)**
2. **Convertion of COVERAGE - GRID** (vector-raster). We used 100 metres breakdown, so the size of the territorial units used were 1 hectare.

3. **The completion of operations between coverages (overlays)**. The program carries out a quick counting with GRIDs, it is called MAP ALGEBRA. With its help we could synthesize totally different GRID basic maps bearing mainly qualitative information.

4. **The colouring of the maps** was carried out by ArcView 3.0a PC software, for printing an HP DesignJet 650C plotter was used.

4 RESULTS

4.1 THE SUITABILITY OF HUNGARY'S LANDMASS FOR AGRICULTURAL PRODUCTION

By summarizing the nine soil parameters using GIS methods, Hungary's map of **standards of soil suitability for agricultural production** was built up. The processing of the six complex climatic parameters resulted the country's map of **standards of climatic suitability for agricultural production**. Statistical data of areas with different conditions are summarized in **Table 2. and 3.**

Standard categories	Total	Agricultural land
< 10	0.92	0.11
11 - 20	8.17	3.35
21 - 30	39.63	36.60
31 - 40	35.54	39.29
41 - 50	15.44	20.22
> 50	0.30	0.43
Total	100.00	100.00

Table 2: Suitability of soils for agricultural production (osztlygyakorisg %)

Standard categories	Total	Agricultural land
< 10	14.07	9.76
11 - 20	63.16	63.45
> 20	22.77	26.79
Total	100.00	100.00

Table 3: Climatic suitability for agricultural production (osztlygyakorisg %)

By combining the standards of climatic and soil suitability - i.e. by summarizing the weighted values of the 15 characteristics - the country's **map of suitability for agricultural production** was developed **(Map 1)**. The statistical evaluation of this map is shown in **Table 4**.

On the grounds of this table and the map, when measuring on a scale between 0 and 99, it can be stated that 35 % of Hungary's total land and 43 % of its total agricultural land have excellent qualities for agricultural production.

4.2 THE ENVIRONMENTAL SENSITIVITY OF HUNGARY'S AREA

The 13 parameters - with regard to flora and fauna, soil and water bases - used for the estimation of environmental sensitivity were summarized by groups. The maps of environmental sensitivity of the country with respect to flora and fauna, soils and water bases were developed, with statistical evaluation shown in **Table 5, 6 and 7**.

By combining the 13 parameters, the **map of synthetic environmental sensitivity of Hungary's landmass** was developed (**Map 2**). The statistical evaluation of this map is summarized in **Table 8**.

On the grounds of this table and the map, when measuring on an environmental sensitivity scale between 0 and 99, it can be stated that 21-22 % of Hungary's total land and nearly 13 % of its total agricultural land is situated on definitely sensitive land.

Standard categories	Total	Agricultural land
< 10	0.00	0.00
11 - 20	1.20	0.16
21 - 30	5.52	1.63
31 - 40	18.79	14.10
41 - 50	39.23	40.84
51 - 60	21.03	24.39
61 - 70	13.60	18.01
> 70	0.63	0.87
Total	100.00	100.00

Table 4: Hungary's suitability for agricultural production (osztlygyakorisg %)

Standard categories	Total	Agricultural land
< 10	65.75	74.63
11 - 20	24.28	19.20
21 - 30	7.75	5.22
31 - 40	2.00	0.89
> 40	0.22	0.06
Total	100.00	100.00

Table 5: Environmental sensitivity with respect to living creatures (as a percentage for each class)

Standard categories	Total	Agricultural land
< 10	22.52	25.59
11 - 20	69.09	67.76
> 20	8.39	6.65
Total	100.00	100.00

Table 6: Environmental sensitivity with respect to soil types (as a percentage for each class)

Standard categories	Total	Agricultural land
< 10	69.66	75.05
11 - 20	27.95	24.20
> 20	2.39	0.75
Total	100.00	100.00

Table 7: Environmental sensitivity with respect to water bases (as a percentage for each class)

Standard categories	Total	Agricultural land
< 10	1.08	1.48
11 - 20	17.32	22.86
21 - 30	29.02	33.61
31 - 40	31.42	28.82
41 - 50	14.17	10.26
51 - 60	5.27	2.49
61 - 70	1.57	0.45
> 70	0.15	0.03
Total	100.00	100.00

Table 8: Environmental sensitivity of Hungary's area (as a percentage for each class)

4.3 COMBINATION OF THE STANDARDS OF AGRICULTURAL SUITABILITY AND ENVIRONMENTAL SENSITIVITY

Fig. 5. shows the distribution of the 9,3 million territorial units in the coordinate system of value scales for environmental sensitivity and agricultural suitability.

A very important conclusion can be drawn from this figure, not only a methodological question, but also a question of rural development and zonality, namely that in the vast majority of the areas, an increase of the agricultural potential goes together with a decrease in environmental sensitivity. By the combination of these two considerations, most of the areas can be classed into the given zone without any modifying of the agricultural and environmental considerations. In other words **the environmental and agricultural interests in most of the areas are not in conflict, these two considerations can be combined well in a common zone system of land- use, and can be considered as regionally compatible**.

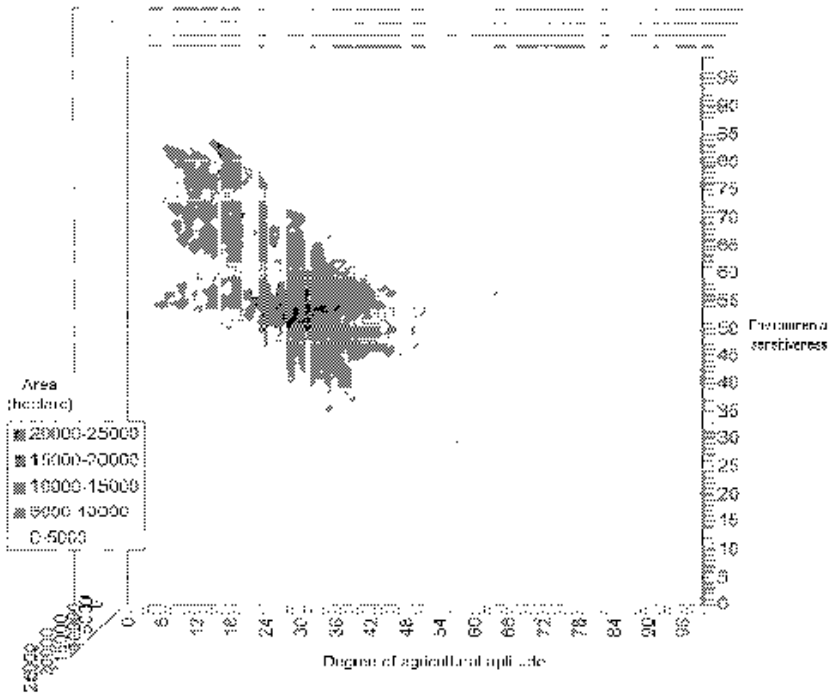


Figure 5: Distribution of areas on a scale of environmental sensitivity and agricultural suitability values

By the combination of the values of environmental sensitivity and agricultural suitability performed by the methods mentioned earlier, we produced the **basic map of zonality for Hungary's area**, which incorporates each hectares of the country on a scale of environmental sensitivity and agricultural suitability, with the values between 0 and 198 (**Map 3.**). The statistical evaluation of this map and the regional proportion of its categories is summarized in **Table 9**.

On the grounds of this map and this table, it can be stated that for more than 20 % of the total land of the country and for about 12 % of the total agricultural land the environmental sensitivity far exceeds the agricultural potential of the area.

4.4 LAND-USE SCENARIOS AND EXAMPLES FOR ZONALITY

By using of the basic zonality map (the scale between 0 and 198) presented in the previous chapter **the borders of the land-use zones for protection, extensive agricultural production and intensive agricultural production may be drawn at different values**. **Three scenarios** were established **as examples** for utilizing the land-use zones.

Standard categories	Total	Agricultural land
< 60	0.42	0.04
61 - 70	1.09	0.10
71 - 80	2.06	0.56
81 - 90	5.84	2.53
91 - 100	11.78	7.96
101 - 110	18.99	16.76
111 - 120	18.33	19.44
121 - 130	15.08	17.91
131 - 140	12.33	15.62
141 - 150	10.18	13.65
151 - 160	3.88	5.42
> 160	0.01	0.01
Total	100.00	100.00

Table 9: The position of Hungary's areas on a scale of environmental sensitivity and agricultural suitability (%)

4.4.1 First scenario

In case of the first scenario we supposed that the areas with the values under 100 points are to be protection zones, areas between 100 and 120 points are to be zones for extensive agricultural production, and those areas with more than 120 points are to be zones for intensive agricultural production. The zone map determined by this assumption is shown in **Map 4**. The statistical evaluation of this map is summarized in **Table 10 and 11**.

On the base of this data not only the **total area of the different zones** can be determined, but also their **exact placement**. The possibility for further analyses arose by comparing this zone map with the present situation of Hungary's agricultural land. For this purpose of this analysis we used the required overlays (coverages) from the **CORINE Land Cover database**. When removing the areas of non-agricultural land from the total area of the zones, it can be stated that nearly 4 % of Hungary's **agricultural land** (about 230 000 hectares) can be classed into the protection zone, more than 26 % (about 1,6 million hectares) into the zone of extensive production, and more than 70 % (about 4,3 million hectares) into the zone of intensive production.

Land-use-zone	Total	Agricultural land
Protections zones (%)	10.36	3.73
Zones for extensive agricultural production (%)	31.80	26.15
Zones for intensive agricultural production (%)	57.84	70.12
Total	100.00	100.00

Table 10: Suggestion for the development of a land-use zone system in three categories (First scenario)

Land-use-zone	Total	Agricultural land
Protections zones (ha)	963602	228148
Zones for extensive agricultural production (ha)	2958579	1601202
Zones for intensive agricultural production (ha)	5380819	4292650
Total	9303000	6122000

Table 11: Suggestion for the development of a land-use zone system in three categories (First scenario)

4.4.2 Second scenario

In the case of the second scenario we supposed that the areas with the values under 100 points are to be protection zones, areas between 100 and 125 points are to be zones for extensive agricultural production, and those areas with more than 125 points are to be zones for intensive agricultural production. The zone map determined by this assumption is shown in **Map 5**. The statistical evaluation of this map is summarized in **Table 12 and 13**.

Land-use-zone	Total	Agricultural land
Protections zones (%)	10.38	3.74
Zones for extensive agricultural production (%)	41.15	35.88
Zones for intensive agricultural production (%)	48.47	60.37
Total	100.00	100.00

Table 12: Suggestion for the development of a land-use zone system in three categories (Second scenario)

Land-use-zone	Total	Agricultural land
Protections zones (ha)	966095	229257
Zones for extensive agricultural production (ha)	3827954	2196834
Zones for intensive agricultural production (ha)	4508952	3695909
Total	9303000	6122000

Table 13: Suggestion for the development of a land-use zone system in three categories (Second scenario)

When removing the areas of non-agricultural land from the total area of the zones (**Map 7**), it can be stated that nearly 4 % of Hungary's **agricultural land** (about 230 000 hectares) can be classed into the protection zone, more than 35 % (about 2,2 million hectares) into the zone of extensive production, and more than 60 % (about 3,7 million hectares) into the zone of intensive production.

4.4.3 Third scenario

In case of the third scenario we supposed that the areas with the values under 100 points are to be protection zones, areas between 100 and 130 points are to be zones for extensive agricultural production, and those areas with more than 130 points are to be zones for intensive agricultural production. The zone map determined by this assumption is shown in **Map 6**. The statistical evaluation of this map is summarized in **Table 14 and 15**.

Land-use-zone	Total	Agricultural land
Protections zones (%)	10.38	3.74
Zones for extensive agricultural production (%)	49.85	45.62
Zones for intensive agricultural production (%)	39.77	50.64
Total	100.00	100.00

Table 14: Suggestion for the development of a land-use zone system in three categories (Third scenario)

Land-use-zone	Total	Agricultural land
Protections zones (ha)	966095	229257
Zones for extensive agricultural production (ha)	4637129	2792697
Zones for intensive agricultural production (ha)	3699776	3100046
Total	9303000	6122000

Table 15: Suggestion for the development of a land-use zone system in three categories (Third scenario)

When removing the areas of non-agricultural land from the total area of the zones (**Map 7**), it can be stated that nearly 4 % of **Hungary's agricultural land** (about 230 000 hectares) can be classed into the protection zone, more than 45 % (about 2,8 million hectares) into the zone of extensive production, and more than 50 % (about 3,1 million hectares) into the zone of intensive production.

4.4.4 Qualification of the present situation of arable land

The country's arable land is about 4,7 million hectares. When comparing this area with the scales of agricultural suitability and environmental sensitivity shown in the Maps 1 and 2, by using the CORINE Land Cover database, we derived the results summarized in **Table 16**.

Standard categories	Agricultural suitability		Environmental sensitivity	
	%	1000 ha	%	1000 ha
< 10	0.00	0.0	1.83	86.3
11 - 20	0.09	4.2	26.86	1266.2
21 - 30	1.19	56.1	36.02	1698.0
31 - 40	11.61	547.3	25.56	1204.9
41 - 50	37.65	1774.8	7.78	366.7
51 - 60	26.57	1252.5	1.61	75.9
61 - 70	21.80	1027.7	0.33	15.6
> 70	1.09	51.4	0.01	0.5
Total	100.00	4714.0	100.00	4714.0

Table 16: Agricultural suitability and environmental sensitivity of arable land

It can be stated on the base of the data shown in this table, that nearly 50 % of our country's arable land has an outstanding agricultural potential, which means that its agricultural suitability is above the average. But it is also has to be pointed out, that about 10 % of the arable land is situated on areas especially sensitive to environmental disturbance. When comparing the country's arable land with the common standard value map, we get the data shown in **Table 17**.

Standard categories	%	1000 ha
< 60	0.01	0.5
61 - 70	0.07	3.3
71 - 80	0.32	15.1
81 - 90	1.61	75.9
91 - 100	6.03	284.3
101 - 110	13.50	636.4
111 - 120	18.29	862.2
121 - 130	18.99	895.2
131 - 140	17.76	837.2
141 - 150	16.54	779.7
151 - 160	6.85	322.9
> 160	0.02	0.9
Total	100.00	4714.0

Table 17: Hungary's arable land on a scale of environmental sensitivity and agricultural production

Land-use zone	Scenarios		
	1	2	3
Protection zones (1000 ha)	111.3	111.3	111.3
Zones for extensive agricultural production (1000 ha)	981.3	1408.9	1860.5
Zones for intensive agricultural production (1000 ha)	3621.4	3193.8	2742.2
Total	4714.0	4714.0	4714.0

Table 18: The distribution of arable land in the supposed land-use zone system with three categories (summary)

Table 18. summarizes the data about the proportion of arable land within the protection zone, and the zones for extensive and intensive agricultural production. in the case of different scenarios. **Map 8.** shows the regional distribution in the case of the second scenario.

Depending on the different limiting values of the three zones in case of the different scenarios, the land which may remain in the zone of intensive production will be between 2,7 million and 3,6 million hectares.

After getting these results we can examine - with the arable land as an example- the planning problems of given areas in case of **changes in land-use and the degree of intensity**. For the purposes of these examinations we can use the previously determined standard values and the limiting values of the **second scenario**.

4.4.5 Possible changes in land-use

When planning the degree and the direction of changes of the arable land, a possible starting point can be the **standard scale of agricultural suitability and environmental sensitivity**.

The main element of our concept was to take the areas which present **the worst case values on this scale as a possible area for afforestation**. We chose those areas from the country and county wide afforestation plan developed by the Planning Office of Green-belt Areas of the Pilis Forest Park Co., which were situated in the lower regions of the scale. The planned area of the forest land (762 000 hectares) was determined through a scale relating to the whole area of the country and also from the worst agricultural lands according to those values given by the different counties. The **afforestation plans** made by using these two methods are shown in the **Map 9 and 10**. When compared to the present data of coverage, it can be stated that the afforestation plan affects 533 000 hectares of the worst quality grassland, and 229 000 ha of the worst quality arable land from the present size of agricultural land.

From the nearly 5,3 million hectares of remaining agricultural land about **260 000 hectares is used for horticultural crops, fruits and grapes**, and **615 000 hectares is used for the remaining grassland**. After the conversion of the 762 000 hectares of land of the worst quality into forest, the planning of **the new areas of grassland** succeeded. For this purpose those areas were taken into consideration which had the **next smallest agricultural potential values and the greatest values of environmental sensitivity**. The total size of this area was 788 000 hectares. This area reduced the total area of arable land (**Map 11**).

Assuming the **second scenario, and its limiting value of 125, 500 000 hectares** of land from the **remaining 3.7 million hectares of arable land** would be used in the zone of extensive production, as **extensive arable land**. The area of the remaining **3,2 million hectares with the greatest agricultural potential and smallest environmental sensitivity** values will represent the area of **intensive arable land (Map 12)**. The **new** land-use structure is illustrated in **Map 13**, its data is summarized in Table 19.

Land use		area (1000 hectares)	
		present	according to 2nd scenario
Arable land		-	3194
	intensive:	-	503
	extensive:	4714	3697
	total:		
Horticultural crops+fruits+grapes		260	260
Grass	real data:	-	615
	plan (new):	-	788
	total:	1148	1403
Total Agricultural Land		6122	5360
Forests	actual data:	-	1828
	planned (new):	-	762
	total:	1828	2590
Reeds and Fish farms		68	68
Total Agricultural Area:		8018	8018
Non-cultivated Land:		1285	1285
Total Land:		9303	9303

Table 19: Changes in the land-use structure and in the size of their area as a result of the second scenario

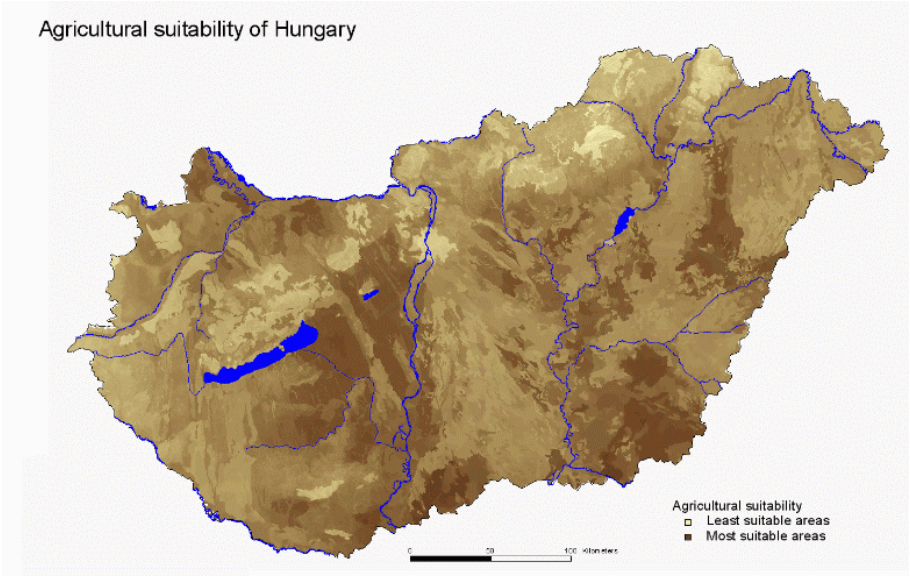
In order to realize the second scenario the following conversions had to be made for the development of the land-use ratio determined through this scenario:

- a conversion of 533000 hectares of grassland $\rightarrow$ into forest,
- a conversion of 229 000 hectares of arable land $\rightarrow$ into forest,
- a conversion of 788 000 hectares of arable land $\rightarrow$ into grassland, and
- a conversion of 503000 hectares of intensive arable land $\rightarrow$ into extensive arable land

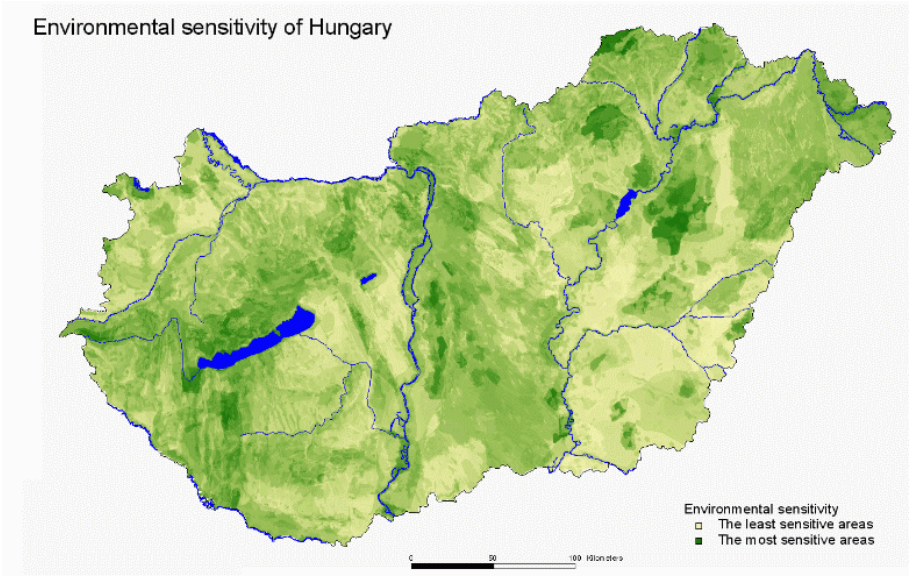
This conversion would affect roughly 2 million hectares of land, that means 25 % of the total agricultural land of the country and 21 % of its total land.

5 Appendix: Maps

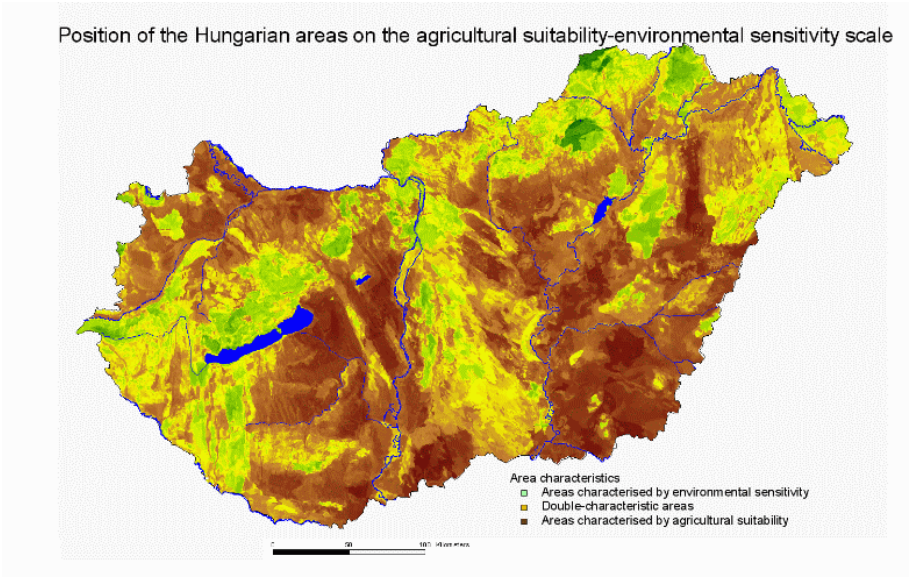
Map1: Agricultural suitability of Hungary



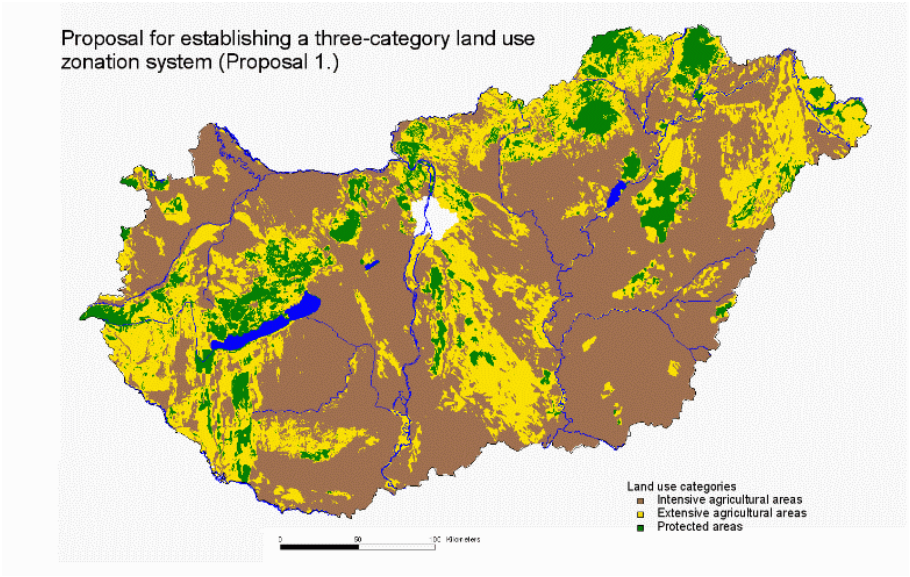
Map2: Environmental sensivity of Hungary



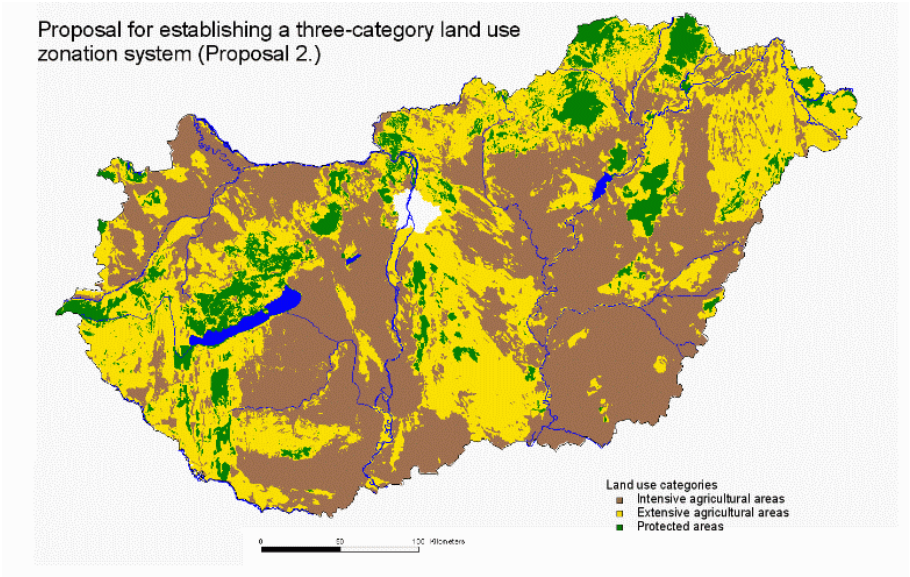
Map3: Position of the Hungarian areas on the agricultural suitability - environmental sensivity scale



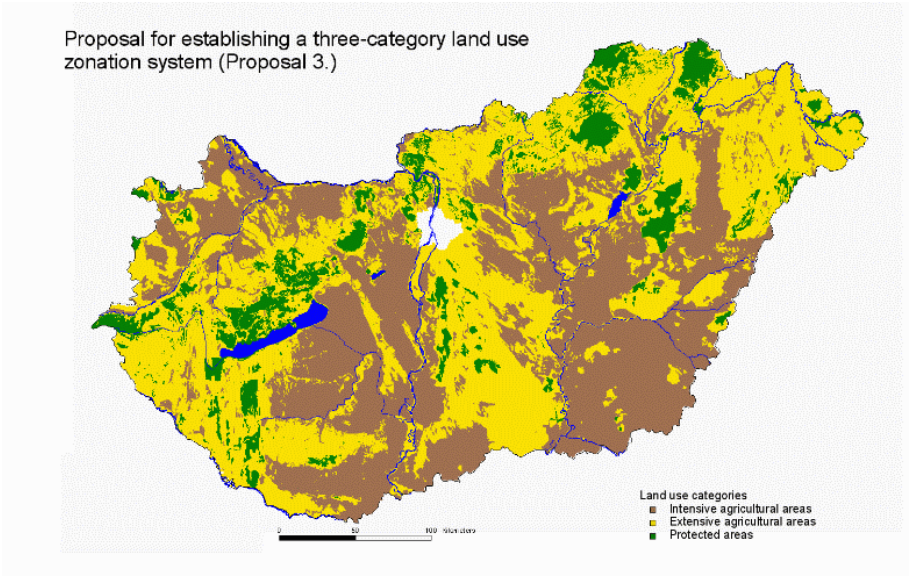
Map4: Proposal for establishing a three category land use zonation system (proposal 1.)



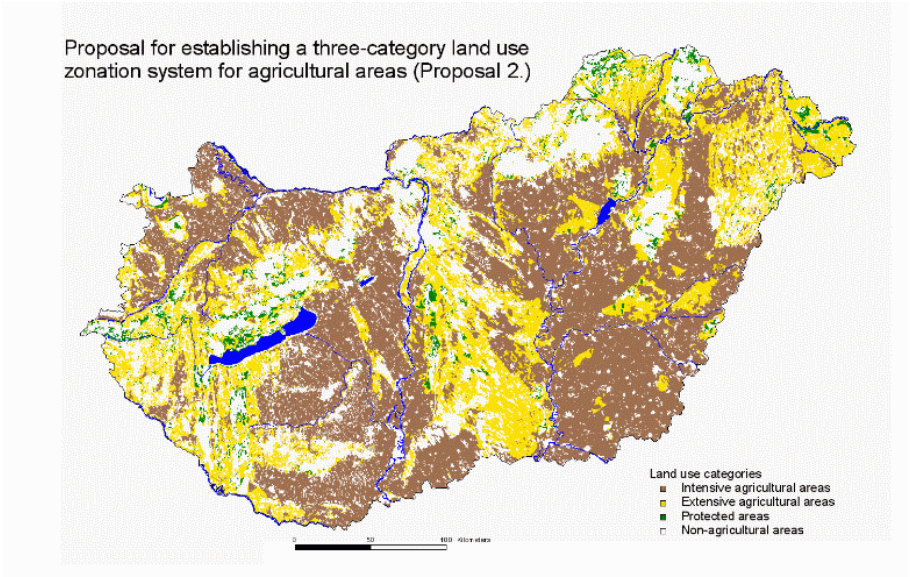
Map5: Proposal for establishing a three category land use zonation system (proposal 2.)



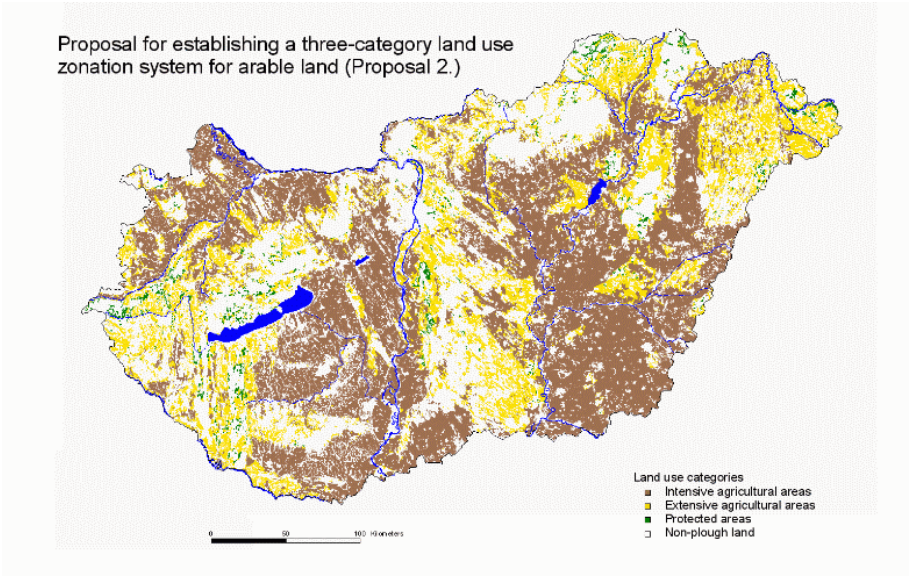
Map6: Proposal for establishing a three category land use zonation system (proposal 3.)



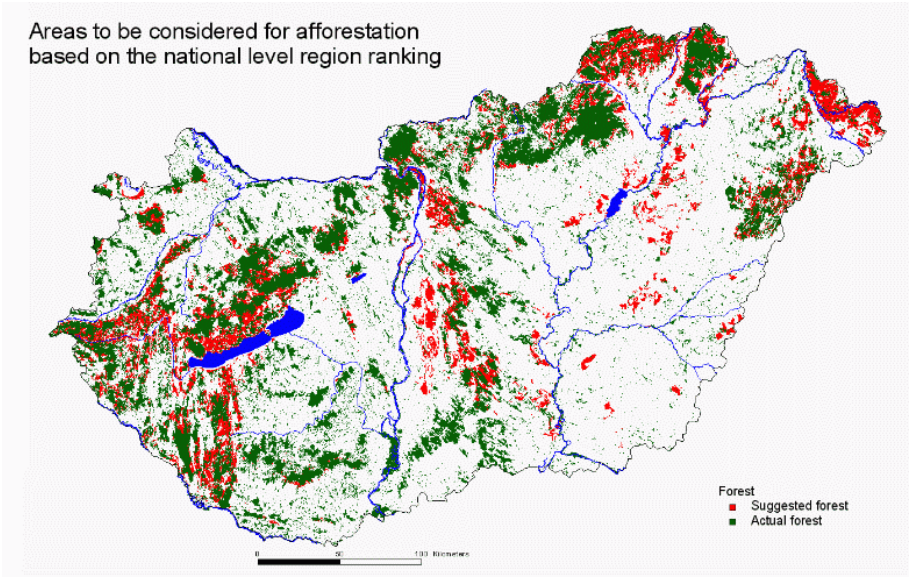
Map7: Proposal for establishing a three category land use zonation system for agricultural areas (proposal 2.)



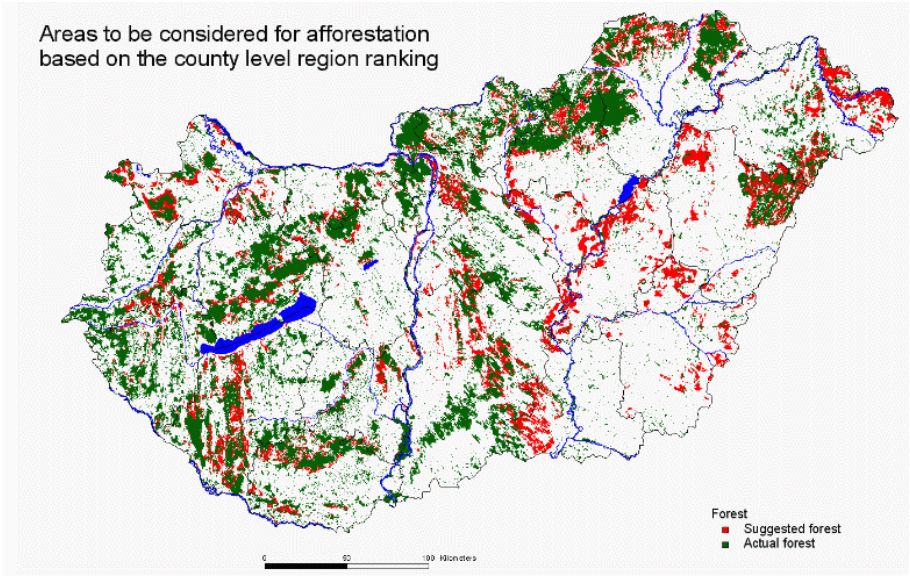
Map8: Proposal for establishing a three category land use zonation system for arable lands (proposal 2.)



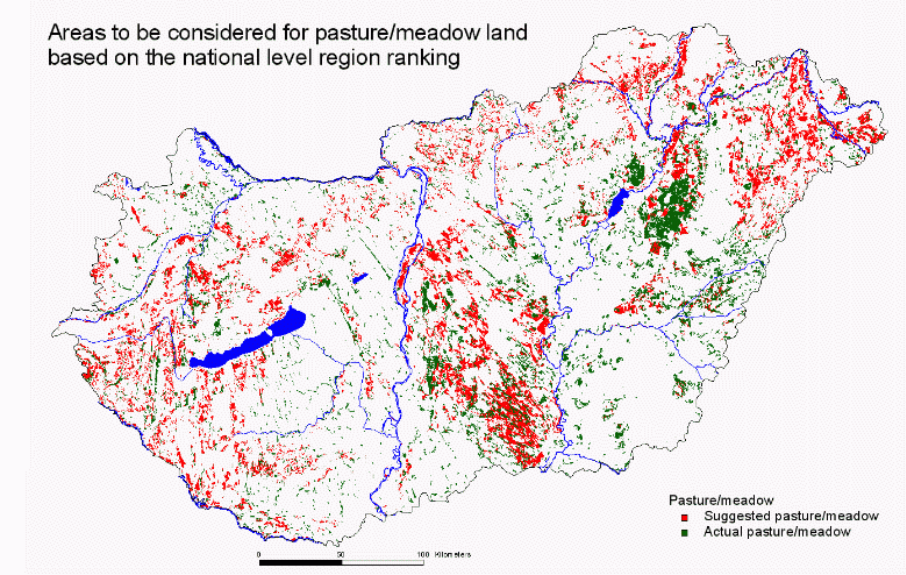
Map9: Areas to be considered for afforestation based on the national level region ranking



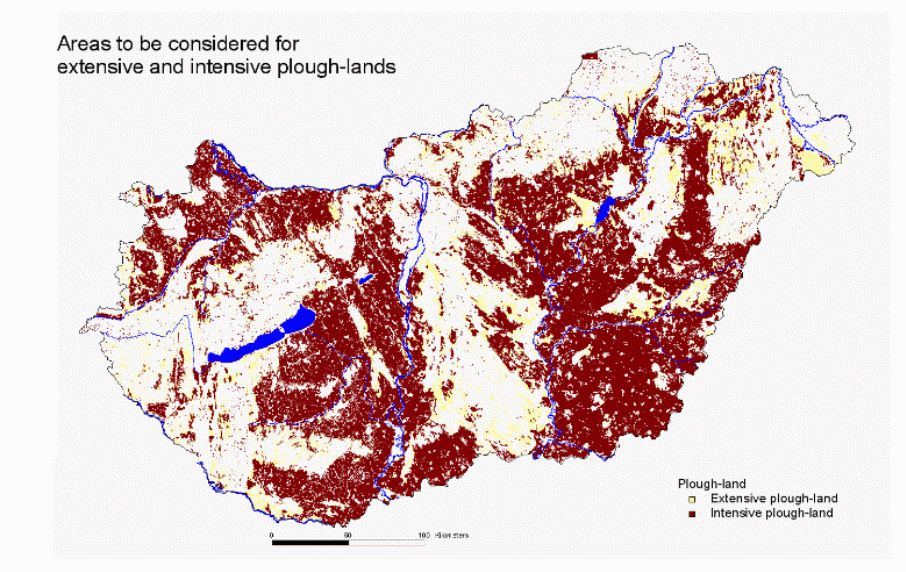
Map10: Areas to be considered for afforestation based on the country level region ranking



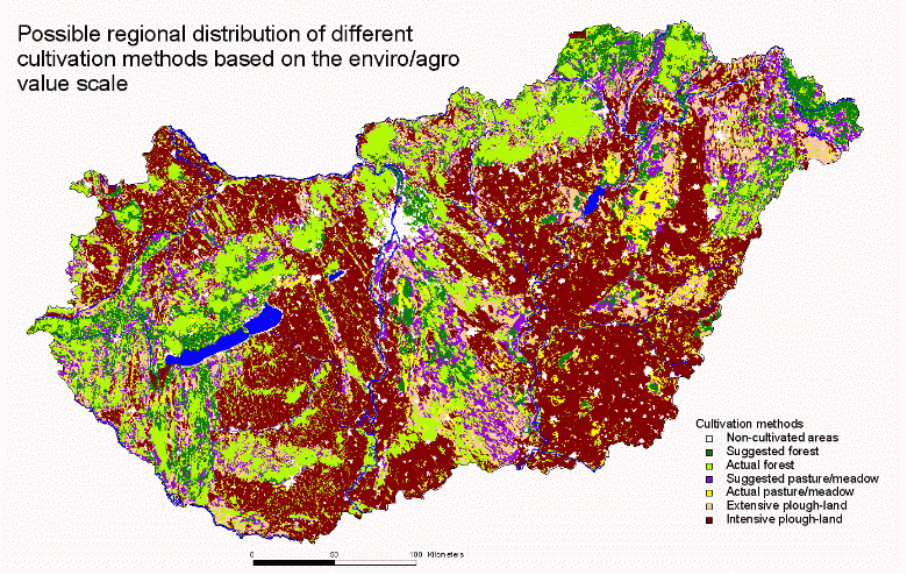
Map11: Areas to be considered for pature/meadow land based on the national level region ranking



Map12: Areas to be considered for extensive and intensive plough-land



Possible region distribution of different cultivation methods based on the enviro/agro value scale



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