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Landscape and GIS – Development of the Hungarian Agri-Environment Monitoring and Information System

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Abstract: Landscapes with their rather uniform biophysical properties and defined less and more as natural spatial units should be the area which is normally completely characterized by specific environmental problems. In this article the authors try to present the Hungarian Agri-environmental Monitoring and Information System, and to point out the method used at the selection of sampling sites.

***Key words*:** landscape, spatial units, Hungarian Agr-environmental Monitoring and Information System

Introduction

The environmental aspects of land management in the Hungarian agriculture earned a high priority in the National Rural Development Plan (NRDP) after the country joined the European Union in 2004. The agri-environmental measures (AEM) of the agricultural subsidy system require complex, knowledge-based and wide-ranging activities and form the essential background of the agri-environment monitoring- and assessment system promoted by the EU. The special report of the European Court of Auditors (Official Journal, 2005) concerning rural development and verification of agri-environment expenditure highlights that "if a measure cannot be adequately checked, it should not be the subject of public payment" and that "premia justification must focus on sufficiently controllable measures" (Article 18(3) of Regulation (EC) No 817/2004 relates exclusively to AE.). An appropriate evaluation system demands an integrated Agri-environmental Monitoring and Information System (AMIS) which aims to provide the IT background to the monitoring activities related to the area based measures of the NRDP (OECD 2000).

The AMIS has to ensure to meet the requirements related to the collection, storage, processing, analysis and display of data related to AEM so that the system is suitable for the follow-up and detection of AEM objectives implementation preferably in numerical form and with area effects (Podmaniczky et al, 2008). According to the long term agricultural policy of the European Community that was characterised by the so called "green revolution" including all activities to increase agricultural production (PIORR, 2003) the general aims of the National Rural Development Plan (2006) are formulating the following goals:

1. Maintenance and improvement of environmental status quo, reducing environmental impact of agricultural

activities;
2. Sustainable land management supporting development of environmentally conscious farming better suiting to natural endowments;
3. Supporting increase of incomes in rural areas;
4. Development of environmentally friendly agriculture, rationalization of land use;
5. Promoting harmonization between habitat capability, economic viability and market conditions.
Beyond the general aims the NRDP targets specific goals:
1. Preservation and improvement of physical, chemical and micro-biological characteristics of soils; (2) revitalization of degraded lands, mitigation of environmental stress of agriculture;
2. Supporting forestation, increasing the ecological conditions of forests, promoting the socio-economical and recreational roles of forests;
3. Protection and conservation of biodiversity of Environmentally Sensitive Areas;
4. Development of supporting tools for the NATURA 2000 network.

Subdivision of Agri-environmental Measures

The Agri-environment measures of NRDP can be implemented through several schemes with different levels of commitments, grouped as follows: (1) agri-environment measures on arable land, (2) agri-environment measures on grassland, (3) agri-environment measures in permanent cultures, (4) supplementary agri-environment measures, (5) agri-environment measures on wetland habitats, (6) agri-environment measures for livestock. Applications can be submitted targeting horizontal and zonal schemes within the measures (figure 1).
The AMIS basically consists of two modules: (1) the agri-environmental field monitoring module which aims at directly detecting changes in the environment using field measurements; (2) the information module based on data from a representative sample of the farms' field registers. This second module is based on registering farming practices which are included in the book of Farming Records lead by the farmers and are containing all information concerning agricultural activities including: whole farm management involving the overall farming system; and farm management aimed at specific practices related to nutrients, pests, soils, and irrigation (Podmaniczky et al, 2008, Körtáj 2008).

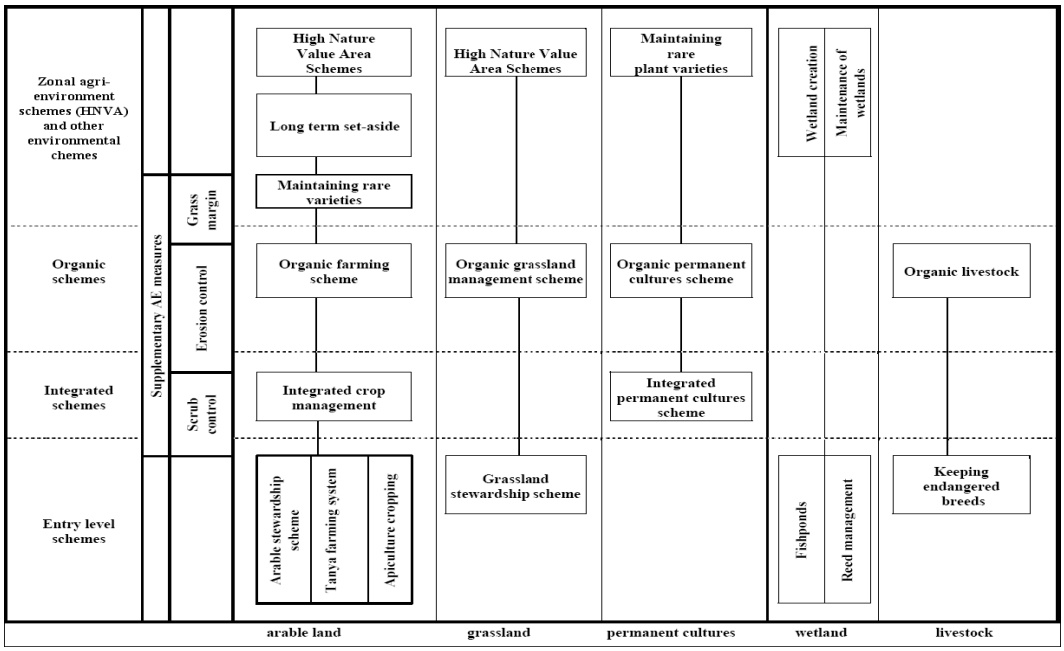

Fig. 1. Overview of agri-environment schemes (NRDP, 2006)

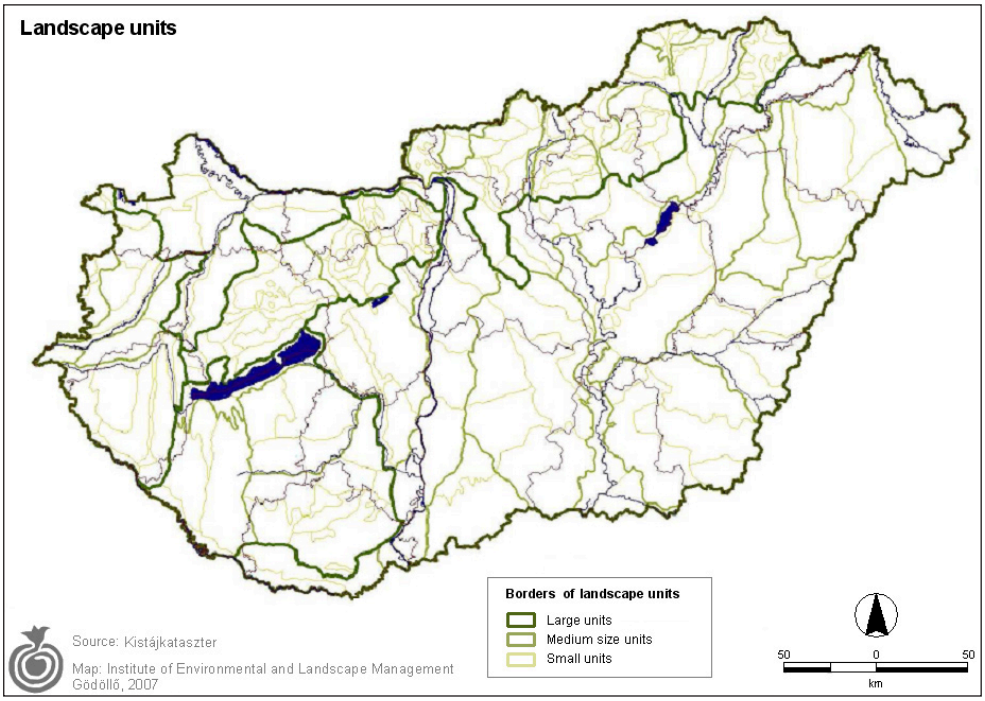

Fig. 2. Landscape units of Hungary

Selection of sampling sites of the field monitoring

Monitoring needs first of all precise and long-term data collection and analysis all changes at the different landscape level and at different time and spatial scale. Taking in account this paradigm, the main principle for the selection of the sampling sites of the AMIS monitoring module was the representativity of AEM for the small landscape area units. We have to mention: there are 230 small landscape units in Hungary (figure 2).

Covering the country with a 5 by 5 km grid the following further aspects were also considered at the selection of the sampling sites beyond the main principle:

• number of parcels participating in AEM, and area coverage contracted in AEM (figure 3),

• diversity of AEM schemes and appearance of individual AEM schemes In many cases the schemes cover multiple objectives, especially concerning biodiversity, habitat and landscape conservation; and focus on the biophysical and cultural features in a local context; e.g. grassland management for corncrake habitat development, maintenance of wet grasslands, bogs, marshlands, maintenance of rare plant varieties (Körtáj, 2008),

• relation to the sampling quadrates of the National Biodiversity Monitoring System. This system provides data and relevant information regarding on the state and change of the living world at different levels of organization to help environmental policy and practice.

• relation to the sampling quadrates of the Common Birds Monitoring System. The main goal of this system is to use common birds as indicators of the general quality of landscape using scientific data on changes is breeding population. The Common Bird Monitoring System covers all Hungary with a 2.5 by 2.5 km grid, that means 691 quadrates (figure 4),

• relation to Natura 2000 areas. Approximately 21.1% of Hungary is part of European Union's Natura 2000 network.

• presence of sampling points in the Soil Information Monitoring System. This monitoring system was set up in 1991 in order to: (1) define of soil state features, soil functions, soil processes, soil threats and degradation processes which can be related to the presumable improving effects of the various agri-environmental target

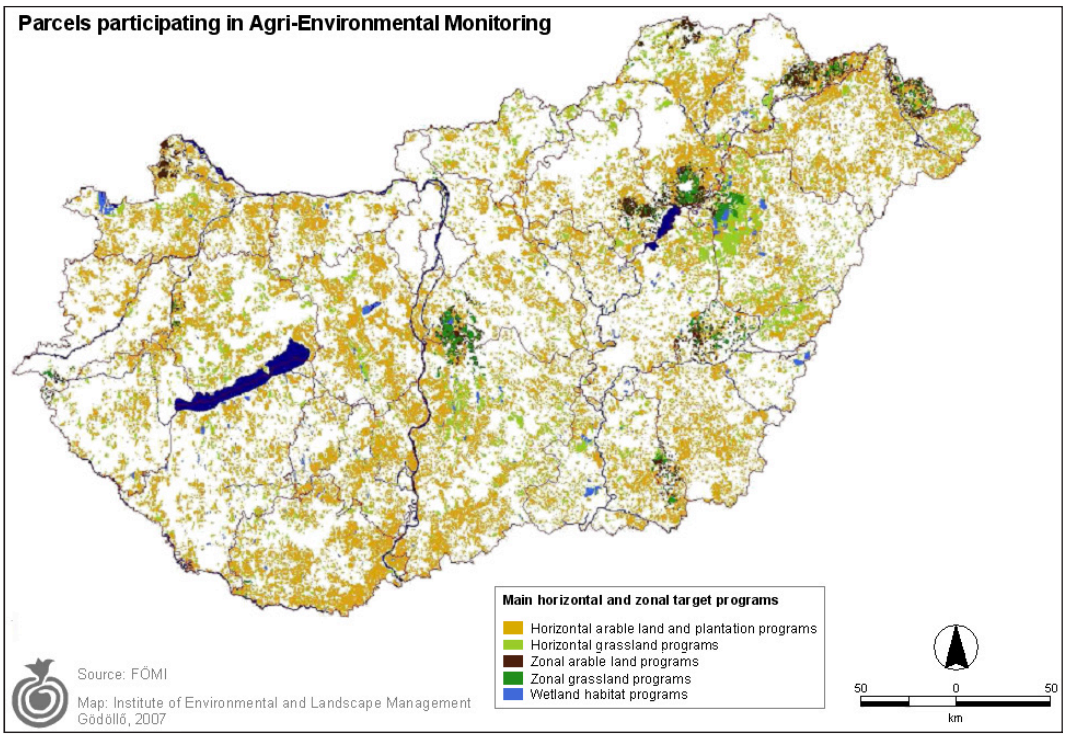

Fig. 3. Parcels participating in Agri-Environmental Measures and Monitoring (Körtáj, 2008)

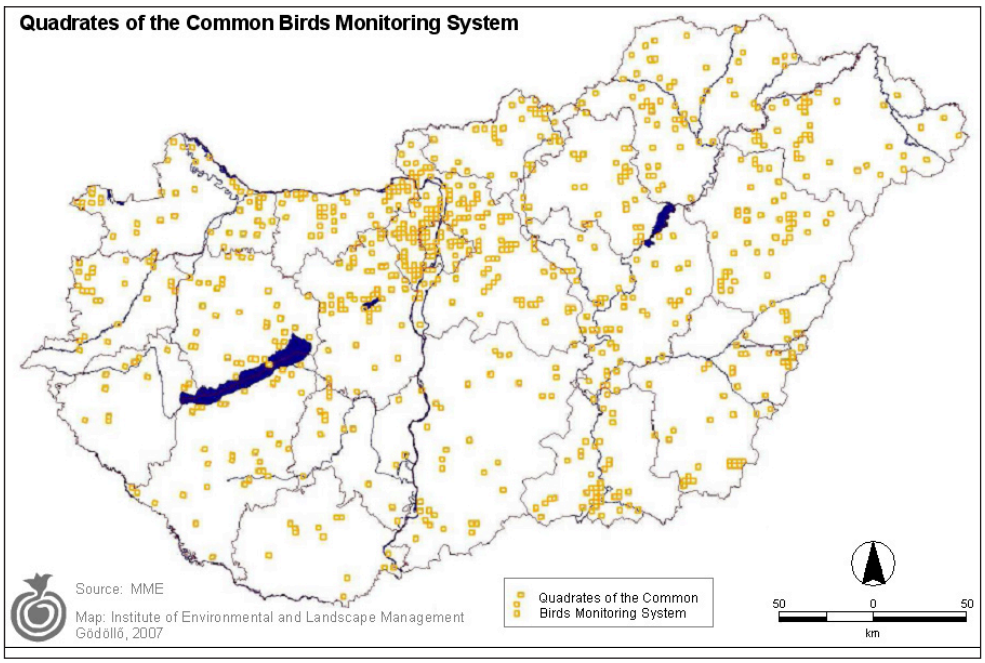

Fig. 4. The Common Birds Monitoring System's quadrates

projects in order to be monitored; (2) work out of a complex, hierarchic sampling strategy (definition and designation of sampling units representing multipurpose spatial representativity; determination of their number and spatial distribution); (3) select of appropriate soil indicators; (4) elaborate of protocols for the measurement parameters of the selected indicators; (5) insure the spatio-temporal redistribution of measurements along the predefined sampling units and over time; and (6) estimate of financial aspects of the actuation of the system (Horváth et al., 2007).

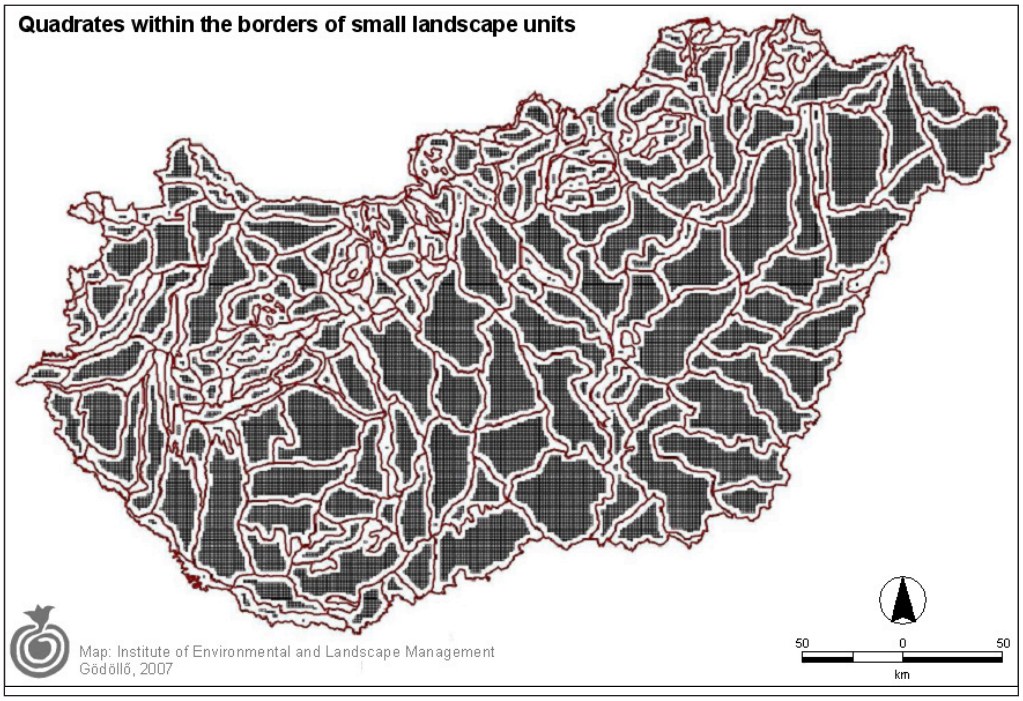

Fig. 5. Quadrates within the borders of small landscape units

The sampling sites were selected through the following steps:
Step 1: selection of sampling quadrates in each small landscape district. Out of the original 91,742 quadrates and 230 small landscape units 38,720 quadrates and 175 regions fulfill the selection criteria (figure 5).
Step 2: determine whether the area coverage of arable and grassland schemes reach up to 5% of each quadrate (24,518 quadrates in 152 units, and 7,377 quadrates in 103 landscape units).
Step 3: selection of quadrates where arable and grassland quadrates overlap (results 5,128 overlapping quadrates in 83 units).
Step 4: selection of quadrates that are not overlapping according to Step 3 but are still in conform with the sampling criteria (1,843 in 69 units, and 212 quadrates in 20 units).
Step 5: selection of further quadrates based on expert opinion (7,183 quadrates based on selection criteria and expert knowledge, and 157 small landscape units involved).
Step 6: selection of the final set of sampling sites (figure 6). The overlay analysis of databases resulted in the following AMIS sampling sites: 144 quadrates chosen from pedological point, 124 from botany point and 76 quadrates selected based on both aspects (Podmaniczky et al, 2008) (figure 7 and. figure 8).
As a summary we might emphasize that the data from the AEIS field monitoring module and the data from the farming records can be analyzed for correlation in order to be able to assign more realistic weights to farming practices when evaluating effects on the environment. As a result, it may provide a scientifically well grounded basis for the assessment of ecological performance of farming, and in same time it seems to be the most suitable for documentation landscape changes (Podmaniczky et al, 2008).

Comparison of monitoring data with farming field records provides opportunity not only for monitoring the changes in the status of the environment but also for identifying agri-environmental farming practices that serve best these positive environmental changes. At the same time the quantification of the ecological performance is ensured as well.

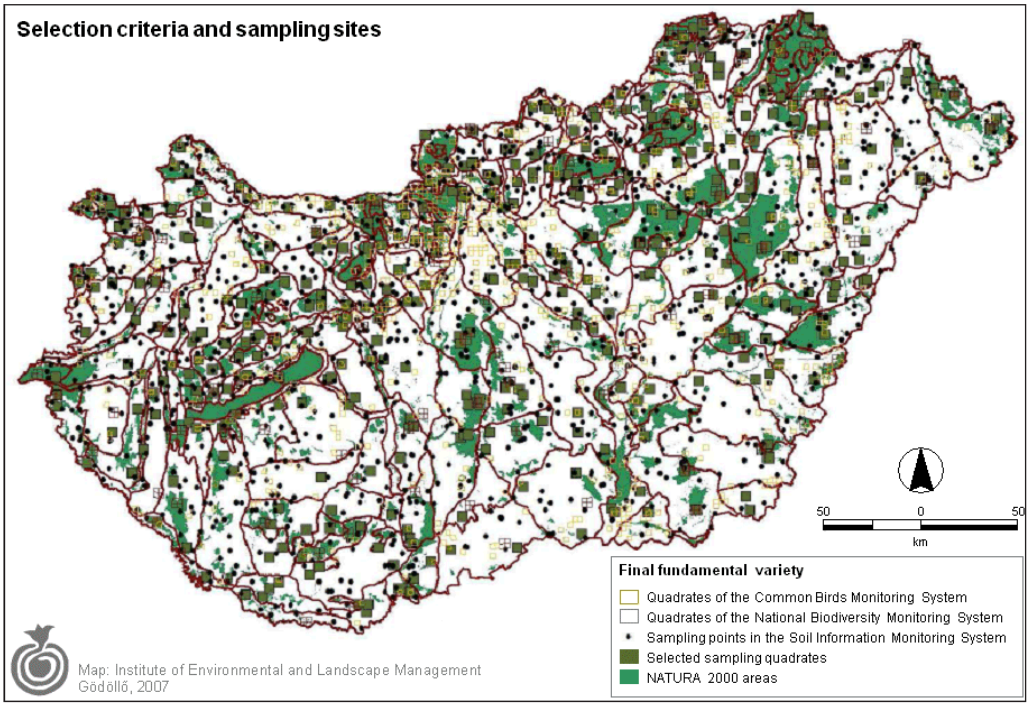

Fig. 6. Selection criteria and final sampling sites

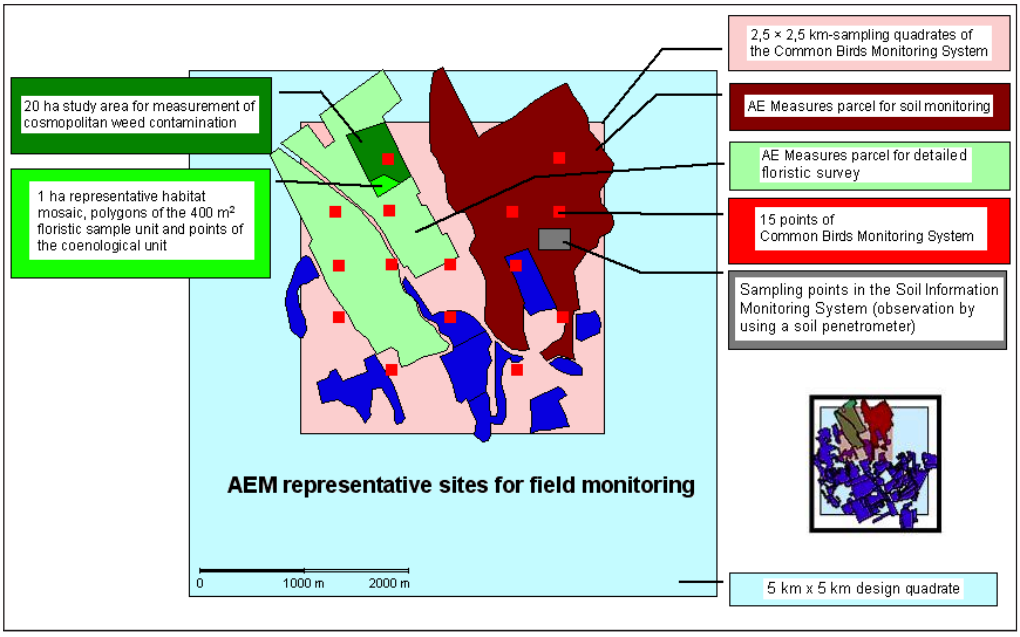

Fig. 7. Agri-environmental Monitoring sites for field monitoring

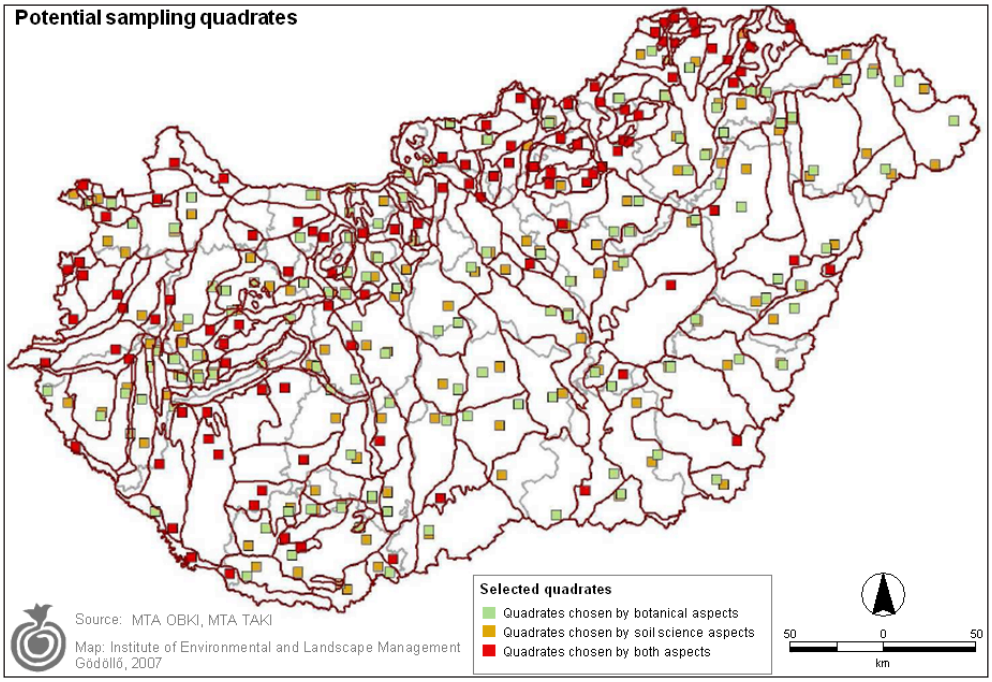

Fig. 8. Final sampling quadrates

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