A GEOGRAPHICAL INFORMATION SYSTEM IN TUSCAN WETLANDS
LAND USE CHANGES IN MODERN AND CONTEMPORARY AGE

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The object of the research project are the wetlands of Tuscany (historical outline, monitoring and evaluation of the environmental and socio-economic impact brought about by plans of tourist development and foresees the organization of environmental, socio-economic and historical data in a GIS. The aim of the project is to create a geographical database about wetlands and to realize an atlas. The data are being acquired in field surveys and analyzed with GIS tools. In particular, the work has focused on acquisition of landuse/cover data from historical cartography and remote sensing as sources.

Wetlands stand for a remarkable ecosystem in terms of environmental wealth (geomorphologic distinctive features, typical vegetation or faunal associations) and cultural heritage as evidence of human activities related to this singular environment. Tuscan wetlands preserve interesting environmental contexts, but are marred by urban and industrial expansion and stressed by pollution. Due to these observations three zones have been selected as study areas with the aim of analyzing landscapes changes.

**Case studies**

Coastal wetlands and ex-wetlands

- originating from the formation of sand-dune bars created by sediment deposits of fluvial and marine origin
- 1 coastal area around Lago di Futa, the residual coastal wetland in northern Tuscany (province of Massa and Carrara)
- 2 coastal area of Versilia, the area surrounding the Lago di Massaciuccoli (province of Livorno)
- 3 Pisa coastal plain, from the mouth of Serchio river to Livorno
- 4 coastal plain south of Livorno around Cleone
- 5 eastern Val di Cornia (province of Livorno)
- 6 Grosseto Maremma, with the areas of ex-lake Marsh

**Principal inland wetlands**

- created by the gradual process of vast level areas which became marshland because they were prevented by complex fluvial lacustrine systems
- 7 Bistione plain (province of Pisa and Livorno)
- 8 Fiorenzuola di Focagio, the most significant residual inland wetland (province of Firenze and Pistoia)
- 9 Val di Chiana, completely reclaimed during XVIII and XIX centuries with the exception of Montelupo Fiorentino and Chiusi lakes (province of Siena)

**Methodology**

Phases of the research:
- reconstruction of land use and other layers from different sources
- census and mapping of environmental and cultural heritage
- normalization and input of data in a GIS
- analysis of landscape changes through GIS tools

Layers acquired:
- land use, as principal indicator of landscape transformation
- hydrographical network
- topographic network
- road network
- settlement system
- GIS operations
- georeferencing of digital images of historical cartography
- digitalization of layers from historical cartography
- normalization of data acquired from different sources, with different scales and formats
- study of a new classification system of landuse/cover, with limited number of categories to allow the comparison and the interpretation of map data

**Results**

The comparability of information regarding past and present phenomena allows for the understanding of some transformation of the wetland and ex-wetland landscape focusing in particular on changes in land use. The most significant phenomena are:
- almost total disappearance of all the wetlands which constituted the characteristic stretch of landscape in the first half of the 19th century
- notable expansion of the urbanized areas in general, that took place mostly since the 1950s, growth of the historical urban areas of Carrara, Massa, Pisa, San Gimignano, Pieve and Grosseto
- development of bathing seaside resorts along the coast (discursive realization of road network, tourist facilities, hotels and airports)
- preservation of the wooded areas (confirmation of quantitative datum, not always corresponding to the good quality of forest environment)
- re-urbanization of some environments with the reformation of Eroded wetlands or the extensions of small areas which have survived the reclamation operations.

**Data sources**

- large scale historical cartography (15th to 19th centuries)
- historical cadastral cartography (1862-1876 and its updating until 1860)
- satellite reconnaissance (flights of 1937/1938 and satellite images)
- thematic paper cartography (land use maps in scale 1:25000 produced by the Tuscany Region in 1997)
- cadastral/landcover vector databases (ISTAT Census project 1991 and CORINE Land Cover 2000)
- historical documents
- other digital vector layers (GIS of Tuscany Region, Tuscany Forestry Inventory, REMATO project, etc.)

The analysis performed in the zones chosen as study areas has pointed out, apart from a few exceptions, the radical transformation of the wetlands, but has also permitted us to register for assessment some significant remains of past territorial settlements, as well as environmental inventory (monumental trees, rare floral and faunal species, morphological appearances, etc.) and cultural heritage (monuments, old factories and rural buildings, traces of the historic road networking, toponyms, constructions linked to the hydraulic works of the past, etc.) and qualitative attributes (land use) taken from the Tables and inserted into the database.