Application of Geo-Information System for Land Management

Case Study: Valtos Area, West. Greece

A. Trikatsoula, F.Tsouloucha, E.Vavoulidou and S.Theocharopoulos

NAGREF, Soil Science Institute of Athens

1. Summary

In an agricultural area in western Greece was applied a Geo-Information system in order to show the present situation and design various scenarios of Land management and their influence to environment. Database in GIS was designed for soil and water information, also climatic data, landuse and socio-economic aspects were incorporated. The selected information from semi-detailed soil survey of the area were stored and manipulated in the system. For every mapping unit was stored the following data: drainage, slope, erosion, soil texture (in three depths), CaCO3, pH, water inflitration, salinization, soil taxonomic unit. Also in points of the existing wells was collected data for : water quality and quantity.

2. Introduction

In Mediterranean countries, with semi-arid climate, the main problems for agricultural development are erosion and lack of irrigation water. Especially in lowland coastal areas the extreme use of available water from drillings causes irreversible problems of salinization. Also due to climatic conditions the most of the crops demand irrigation during the summer period. So, the main problem is to propose a land management system resulting in development, increase of agricultural income, and at the same time monitoring its influence in the environment

The use of GIS in order to manipulate different kind of data, monitoring the processes and formulate the various scenarios of land management is inevitable. So the first step was to decide the kind of information that would be incorporated and design the Database, that was linked with spatial data. Then spatial and non-spatial data were stored in the system and using the cartographic and tabular capabilities were analyzed and manipulated. For this study was used the Geographic Information System MGE-SX of Intergraph with RDBMS Oracle.

3. General Description of the Study Area

The study area is located in the western part of Central Greece, Ambrakikos gulf, has an acreage of 3600 has and belongs to 6 communities. It varies in altitude from 0 to 200m asl, with a topography level to sloping in the hilly area. The climate of the area is moist meso-mediterranean with dry and warm summer and moist winter. The mean annual temperature is 16^0C and annual rainfall 1035mm. From the annual rainfall only 4% is distributed during summer months, classified as semi-arid.

According to USDA classification the soil temperature regime is thermal and soil moisture regime is xeric except of the lower part of the floodplain, where mainly in the north part of coastal area ground water level is near the surface and it is marshy area if non-artificially drained.

Soils have been developed on Quartenary alluvial deposits with main soil forming process the periodical deposition of alluvial material. In the hilly area parent material is mainly flysch and partly calcite, due to topography and climatic conditions erosion is the main soil forming process.

The hydrology of the area can be described as open catchment. There are many small seasonal rivers that drain to Ambrakikos gulf. There are few wells and an increasing number of drillings, in the lowland, to provide water for irrigation.

The study area is mainly agricultural, the 90% of the population is occupied in agriculture with low income, eg extended sheep-husbandry, olive trees etc, mainly due to lack of water for irrigation. 68% of cultivated area are non-irrigated crops. Last years, the effort for agricultural development tends to increase environmental problems such as: very low quality of subsurface water, salt affected soils, pollution of surface water and sea etc. It has to be mentioned that the closed gulf of Ambrakikos has high interest in aquaculture (fish production).

4. Methodology

Before the fieldwork all the available data was gathered and studied to get more information about the area as topographic and geologic maps, air-photo, the designed drainage system, crop data and socio economic aspects.

During the fieldwork, a detailed soil survey was carried out and other relevant data was collected as water quality. In the whole area 30 profiles were described and samples from all horizons were analyzed. Also in 100 points were taken samples by augerhole in three depths (0-25cm, 25-75cm and 75-150cm).

The samples were analyzed for soil texture, pH, electrical conductivity, salt content, CEC, ESP, organic mater, calcium carbonate content, water content etc. Using photo-interpretation and the results of fieldwork and soil analyses 93 soil mapping units were delineated grouped to 25 soil series.

The topographic map, boundaries of soil mapping units and other relevant spatial data were digitized using the GIS established in our Institute (MGE-SX Intergraph). After the geographic corrections and checking of the mapping units boundaries each polygon was assigned by a centroid in order to link the spatial data with organized Database.

The Database was organized with the following data that were coded and stored in the system as: drainage, soil texture in three depths, slope, erosion, presence of calcium carbonate, presence of gravels, taxonomic unit up to great group level (USDA, Soil Taxonomy) and special properties as water infiltration, salt/alkali content and calcic horizon.

Using developed routines based on Boolean logic and the cartographic capabilities of the GIS spatial and non spatial data were incorporated in order to understand and present in map or tabular form the present situation and propose various scenarios of Land management.

5. Results

After analysis were produced a series of thematic maps presenting single or multifactor as: soil series, slope, drainage, soil type, salt affected soils, reaction (pH) map, irrigability present and potential etc. Routines were developed also to manipulate selected criteria for land suitablility maps.

In the study area were identified two landscapes, with distinct problems, that need different land management system. The plain area can be subdivided in the coastal area, the main plain and the river levees. Except of the lack of irrigation water the main problem of the plain, especially in the coastal area are drainage problems, soil affected soils. On the contrary was found that soils in plain have relatively low infiltration rate so low demand in irrigation water. So the proposed actions are to transport water from the mountainous area in order to extend the irrigated crops that has to be used with economy and make more workable and efficient the existing drainage system.

The landscape of hilly area, with slope from 6-25%, derived on flysch mainly and calcite and its main soil forming process is erosion. The main cultivation is olive trees and non-irrigated wheat. The irrigation system would be extended partly to less sloping area and protection of the hilly area from erosion hazard.

Soils of plain area were characterized as fertile. Proper investment and management would lead in agricultural development, increase of agricultural income with keeping in balance the environmental factors. Water for irrigation is insufficient and of very low quality.

The first priorities of the area are: water transportation from the mountainous area in order to increase the irrigated crops, establishment of a complete and more workable drainage system in the lowland and, where it is possible and cost effective. Protection from erosion in hilly area by better agricultural practices and construction of terraces where is cost effective. Very sloping area would be out of agricultural use.

Also to establish a system monitoring the surface runoff and the transportation of sediments to the sea, probably carrying fertilizers, in order to protect the gulf from pollution.

6. References

FAO, 1977, Guidelines for soil profile description

USDA, 1954 Diagnosis and improvements of saline and alkali soils, Richards LA, Handbook No60, Washington

USDA 1975, Soil Taxonomy, Soil Survey Staff, Agric. Handbook No436, Washington

USDA 1993, Soil Survey Manual, Soil Survey Division staff

Yassoglou N.I., G.Henrard and K.Apostolakis 1964. Second annual progress report of pedological studies in the Peloponnesus, NRC, Democritos, Athens