MAN-INDUCED TRANSFORMATION AND LANDUSE/LANDCOVER MONITORING USING GIS

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Introduction

The Boliarino village is situated in a rural area thirty kilometers from Plovdv, the second biggest town in Bulgaria. It is situated in the Upper Trakian Lowland, in South Bulgaria. The study area is 2669.7 hectares; the elevation of the north part is 160–180 meters above sea level and reaches up to 209 meters in the south. The southern hills are limestone. The soil has up to 2 percent humus. The climate type is transitional continental. The area is characterized by the fluctuation of shallow underground water. There are no rivers in the area, which is why many channels and reservoirs have been constructed for water storage and irrigation. Conditions are most suitable for agriculture, which is the main livelihood of the local population. There are three small limestone pits in the hills near the village.

Goal and objectives

The goal of this project was to monitor and evaluate the landuse/landcover and the man-induced transformation of the study area.

To achieve the goal, the following tasks were set:

1. To develop and apply a suitable methodology for monitoring the landuse/landcover and the man-induced transformation of the study area using GIS and remote sensing.
2. To monitor the environmental state of the study area, using aerial photography and field checks.
3. To create a GIS project for the study area with information about landuse/landcover, man-induced transformation, soil, and geohazard dynamics over time (1978 and 1995).
4. To evaluate the landuse/landcover structure and the level of man-induced transformation of the study area.
5. To evaluate if the area was exploited sustainably, and if not, to suggest a future strategy for sustainable development.

Methodology

The Iliev–Ilieva methodology developed for Bulgaria and described here could be used for any study area in the world (with minor modifications) to achieve goals similar to those stated on the previous page.

1. Choosing the study area and defining its borders.
2. Developing the GIS project structure.
3. Developing a thematic data bank of reference information about the state's current and historical conditions, including topographic and thematic maps, aerial and satellite images, weather data, pollution data, and so on.
4. Choosing sampling methods and points based on the gathered information.
5. Designing a GIS database and importing all needed data (figure 1).
6. Processing and analyzing data using GIS and aerial photography.
7. Evaluating man-induced transformation over time.
8. Creating new maps, tables, charts, and reports.
9. Evaluating the study area dynamic over time.
10. Making decisions about how to develop the area sustainably.

STRUCTURAL SCHEME OF BOLIARINO GIS PROJECT

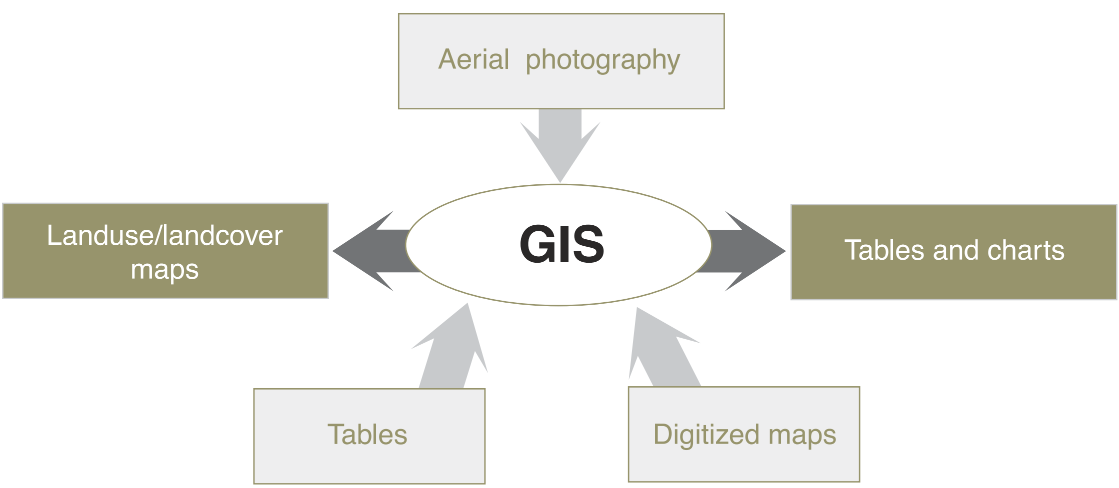

Figure 1: Structural scheme of Boliarino GIS Project.

To evaluate the man-induced transformation, the following method was applied:

1 Landuse/landcover definition of each polygon.
2 Distribution of the landuse/landcover types in categories and ranks (r)—see the table below.
3 Calculation of the total area in %, taken by certain landuse/landcover type.
4 Calculation of the index of man-induced transformation (Umit) for each landuse/landcover type by:

$$\text{Umit} = r \times \%\ \text{area}$$

5 Fill in the table:

Category landuse/landcover	Rank (r)	% Area	Umit = r × % area
Protected land	1		
Forests	2		
Meadows	3		
Pastures and graze land	4		
Permanant crops	5		
Arable land	6		
Water area	7		
Area for transport and infrastructure	8		
Urban and industry development and construction land	9		
Disturbed land from mining, excavations, dump sites, etc.	10		

6 Comparison of the calculated values for each studied year.
7 Evaluation of the man-induced transformation dynamic over time.

Results and discussion

After detailed analysis of the database (which contained thousands of entries, grouped in twenty-one tables and themes and seven electronic maps) the following results were obtained:

1 The total index of man-induced transformation for the study area has decreased from 538.40 in 1978 to 537.06 in 1995. It shows an improvement in the environmental conditions during the study period (figure 2).

2 For the study period (1978–1995) the population has decreased from 665 in 1978 to 564 in 1995. This phenomenon corresponds to the overall negative birthrate in Bulgaria.

3 The amount of arable land per person has increased from 2.50 ha/person in 1978 to 2.88 ha/person. The same is the situation with pastures and graze land: from 0.31 to 0.37 ha/person (figure 2). The reason is the population decrease.

4 The type of agriculture (the main means of livelihood in the area) being practiced in the area hasn't changed a lot in the course of the study period. The area planted with alfalfa has decreased. The area with vegetables has increased for the study period. A new culture was introduced into the study area during the last years. Permanent crops (vine grape) increased from 0 ha in 1978 to 11.8 ha in 1995. This new category of landuse/landcover bears a better rank of man-induced transformation (5) than the one for arable land (6), which vine grape has replaced (figure 2).

5 The meadows consist mainly of xerothermal vegetation and thus have a very low productivity. The total area of pastures, grazing land, and meadows is about 21 percent (figure 2). For this reason the area is not suitable for cattle breeding.

6 There is no change in the level of industrialization.

7 The limestone pits, which are the only disturbed areas, account for only 2.32 ha. They provide occupation for the local people and don't cause a lot of environmental damage. They occupy a small rocky area on the hills and don't destroy native plant or animal habitats.

8 The level of environmental contamination is low. This rural area has no major polluters in it, and it is not affected by transborder pollution.

9 The use of fertilizers has decreased from 1978 to 1995. This is related to the overall increase in the poverty of the country. This is unfavorable for the people, but it has a positive impact on the environment.

10 There has been a water supply problem in the area in the last years. Large parts of the reservoirs have dried out and the new land has been taken over by meadows. The water shortage problem is consistent throughout the entire country.

11 The area taken up by forests hasn't changed over time. The forests are used for breeding pheasants. Powerline clear-cuts are planted with corn and fodder plants, which the pheasants feed on. This is a very good example of optimal land use.

12 The arable land is very fragmented and difficult to till mechanically.

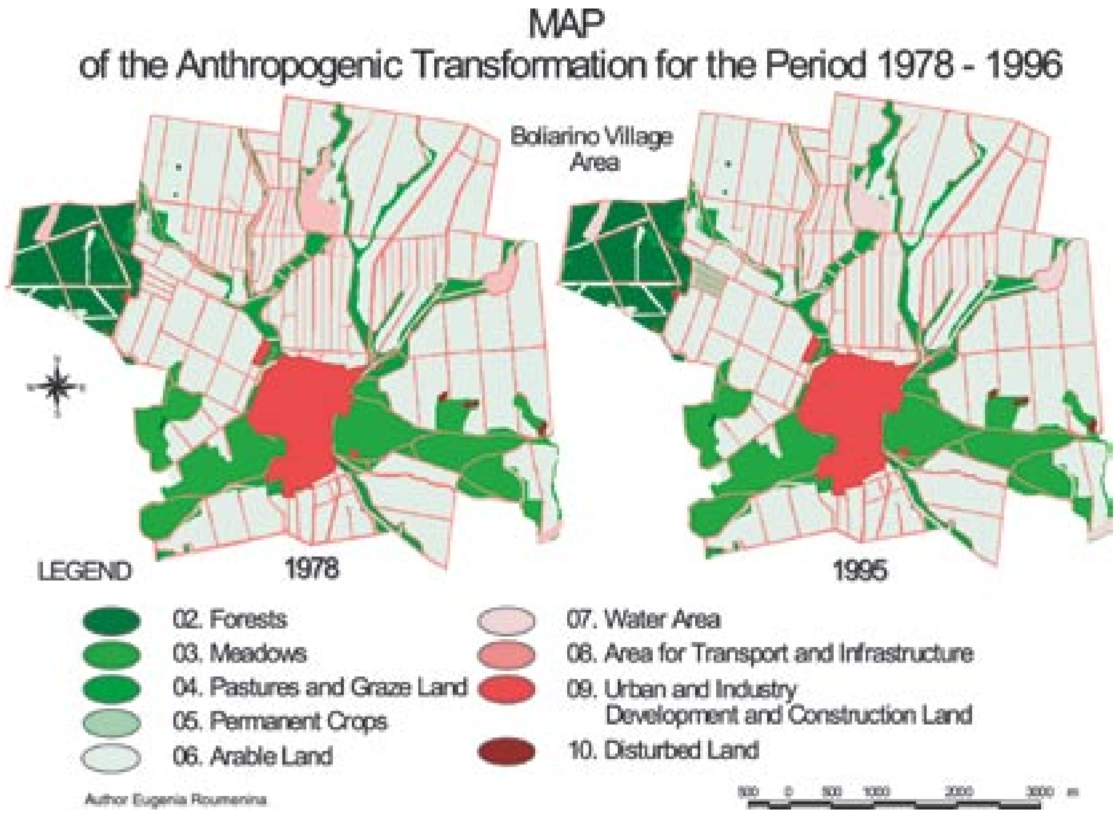

Figure 2: Map of the anthropogenic transformation for the period 1978–1995. The colors show landuse/landcover types, ranged from green to red according to their rank of anthropogenic transformation, green being the least disturbed. The different patterns indicate soil types.

Conclusions

The study area hasn't changed a lot in the seventeen years from 1978 to 1995. Its development may be classified as sustainable and the state of the environment is getting better. The type of livelihood of the people is very suitable for this type of land (figure 3). The soil is productive and may be used for sustainable agriculture without the use of large amounts of fertilizers. Even organic farming is possible, as the highest quality crops can thrive in this type of soil. The problem is land fragmentation, which causes difficulties in the mechanization of plant cultivation. The use of machines for planting and cultivating is necessary in this case because of the population decrease and aging of the people. Planting grapevines is a good way of introducing sustainable culture. Growing other permanent crops will be beneficial for the local people.

The prognosis for the future sustainable development of this area is good. If a proper management plan is developed and applied by the local authorities in this region, it will steadily improve and become a wonderful example of sustainable agriculture.

Acknowledgments

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