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SPATIAL AND TEMPORAL ANALYSIS OF THE LANDUSE ON TWO TERRITORIES IN RAKOVSKI DISTRICT

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Abstract

The paper is dedicated to landuse monitoring on the territory of Belosem and Shishmantsi villages, Rakovski district. To accomplish the set objectives and tasks, concepts and methodologies from Remote Sensing, GIS and landscape science are applied. The following tasks were set: development of GIS database, containing data of the landuse dynamics, soil differences, geology and topography; monitoring of the landuse, using multichannel images and the developed GIS database; composition of maps, presenting the landuse structure and determination and analysis of the spatial landuse dynamics for 1995 vs. 1978.

Environmental conditions and the prospects for their reclamation provide good preconditions for agricultural use of the land. Enforcement of the Law on Ownership and Use of Agricultural Land and Land Allocation to its Owners or Their Heirs may result in a change in landuse structure and environmental status. This called for monitoring of the territory, using the GIS database developed in this study.

Key words: remote sensing, GIS, landuse

An issue of present interest for modern society is ensuring and supporting a sustainable landuse, consistent with the environmental and socio-economic characteristics of the respective regions.

This called for periodical assessment of the utilization and use of territory in close relation with the processes of its transformation, applying modern technologies for rapid acquisition of accurate spatial information. The necessary data can be obtained by development of regional and local Geography Information Systems (GIS), which use multichannel images as information input.

The main **objective** of the current study is monitoring of landuse on the territory of Belosem and Shishmantsi villages. Here, the following **tasks** have to be resolved: 1. Development of a GIS database (GIS-DB),

containing information for landuse dynamics, soil differences, geology and topography; 2. Monitoring of landuse, using multichannel images and the developed GIS-DB; 3. Composition of maps, presenting landuse structure; and 4. Determination and analysis of spatial landuse dynamics for 1995 vs. 1978.

The **object** of the present research are different landuse types on the territory of Belosem and Shishmantsi villages, Rakovski District. They are situated in the North part of the Upper Thracean Flat, north-east of Plovdiv town. They occupy area of 4,171.4 ha (Belosem) and 1,980.3 ha (Shishmantsi).

Materials and methods

To accomplish the set objectives and tasks, concepts and methodologies from Remote Sensing (RS) [Velikov V., 1995], GIS [Mitchell A., 1999] and landscape science [Petrov P, 1990; Popov A.,1989] are applied. The development of the digital models is performed in Arc View 3.2.a environment. The structural diagram of the study is presented in Fig. 1. It shows the relationship between different types of input data and their processing and transformation into GIS-DB; the generation of new thematic layers using the database and the thematic maps, composed using the obtained results i.

The information sources used in the process of development of the GIS-DB and the methods of composition of digital maps are presented on Table 1.

Table 1. Information sources and methods used for composition of digital maps

DIGITAL MAPS	INFORMATION SOURCES	USED METHODS
Basic Map	Topography Maps, scale 1:25000, Publisher: MTS; Data from Local Agronomists and Field Checks;	12 Themes are Digitized
Geology Map	Geology Map, scale 1:100000, Map Sheets Plovdiv and Chirpan; Publisher: IG-BAS and GSGMC; 3 Themes from the GIS-DB are integrated	2 Themes are Digitized
Geo-hazard Map	Geo-hazard Map in Bulgaria, scale 1:500000, Publisher. BAS, GMRA; 2 Themes from the GIS-DB are integrated	3 Themes are Digitized
Soil Map	Composed by scientists from SRA, MAF, scale 1:10000; 5 Themes from the GIS-DB are Integrated	1 Theme is Digitized
Landuse Map for 1978	Aerial Photos, Taken on 09.08.1978: Panchromatic: - Camera MRB, f-152 mm, scale 1:72000; Multichannel Camera MKF-6 MC, f – 125 mm, scale 1:32000, Spectral Ranges: 0,46-0,50 μm, 0,52-0,60 μm,0,58-0,62 μm, 0,64-0,68 μm, 0.70-0,74 μm, 0,79 – 0,89 μm; Data from Local Agronomists and Field Checks; 8 Themes from the GIS-DB are integrated.	Computer Aid Visual Interpretation of Panchromatic and Multichannel Images
Landuse Map for 1995	Panchromatic Aerial Photos, Taken on 30.06. and 6.07. 1995 , scale 1:21000; Satellite Image from Landsat TM, taken on 19.08.1992, Pixel Size for Channels 1-5 and 7 – 30x30 m, for 6th – 120 m; Spectral Ranges: 1. 0,45-0,52 μm 2. 0,52-0,60μm 3. 0.63-0,69 μm, 4. 0,76-0,90 μm 5.1,55-1,75 μm, 6. 10.40-12,50 μm, 7. 2,08-2,35 μm; Data from Local Agronomists and Field Checks; 8 Themes from the GIS-DB are integrated.	Computer Aid Visual Interpretation of Panchromatic and Multichannel Images
Change Detection Map for Landuse in 1995 vs. 1978	Information from the GIS-DB is uses - Landuse Maps for 1995 and 1978	Arc View GIS
Change Detection Map of the Soil and Landuse Categories for 1995 vs. 1978	Information from the GIS-DB is uses - Landuse Maps for 1995 and 1978 and Soil Map	Arc View GIS

Results and Comments

The analysis of the monitoring results and composed digital maps provides to identify the following main trends in landuse dynamics in Shishmantsi and Belosem villages.

The landuse structure established on the territory of the two villages is of agricultural type. The relative part of arable land (fields, permanent crops, pastures and meadows), compared to the total area of Shishmantsi is 80.7 % for 1978 r., displaying a slight trend for decrease in 1995 - 78.6 % (Fig 2). For the territory of Belosem this indicator remains unchanged. (80.1 % for 1978 and 79.7 % for 1995). Second comes build-up area, which shows some increase from 5.6 % (1978) to 7.1% (1995) for Shishmantsi and no change for Belosem with 8.7 % for both years. Third ranks infrastructure, which increases from 4.2 % (1978) to 4.8 % for (1995) for Shishmantsi and from 4.7 % (1978) to 5.3 % (1995) for Belosem. The other types of landuse for the territory of Shishmantsi are forests and water catchments - 4.7 % and 3.5 % accordingly, which have experienced no change during the study period.

For Belosem, the forth place is occupied by water catchments with 5.4 %, followed by forests with 0.9 % (1978) and 0.3 % (1995). The area occupied by industrial and mining waste and limestone-pits amounts to 1.3% of the territory of Shishmantsi and only 0.04 % of Belosem.

The most significant change is observed for the permanent crops category on the territory of Shishmantsi (Fig. 2.). In 1978, vineyards occupied 73.4 ha and decreased to 6.7 ha in 1995 (Table 2.). The industrial zones increased their area from 0.6 % in 1978 to 2.1 % in 1995. The reason is building of a (Table 2.) steelworks in the foot of the limestone hills, which are situated eastward of the village.

For the territory of Belosem (Fig. 3.), the greatest change is also observed in the permanent crops category. In 1978, the vineyards occupied 50.4 ha and in 1995 they were completely cleared off (Table 3.). The same trend is observed for rice crops. In 1978 they occupied 31.9 % of the total area and in 1995 they were grown no longer (Fig. 3., Table.3.).

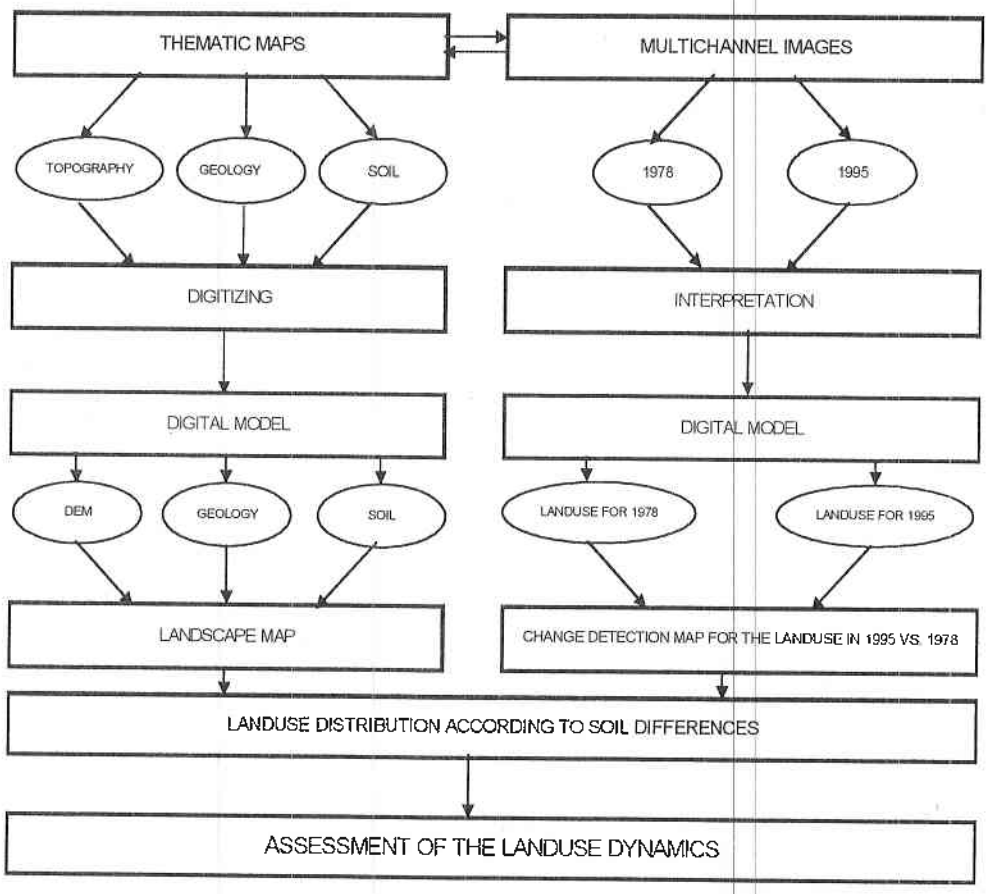

Fig. 1. Flowchart of the study

Belosem is the biggest village in Rakovski District. The provision of the local population with fields increased from 0.3 (1978) to 0.6 (1995) ha per person. This can be explained with increase of the fields in 1995, which comes from an area, occupied by rice and permanent crops in 1978.

The provision of the inhabitants of Shishmantsi with fields increased from 0.9 to 1.0 ha per person for the two years. The reason is again the replacement of permanent crops for fields.

The number of people in the two villages remains practically unchanged [National Statistics]. The provision-with-fields indicator for the studied villages differs essentially from the overall trends for Bulgaria as

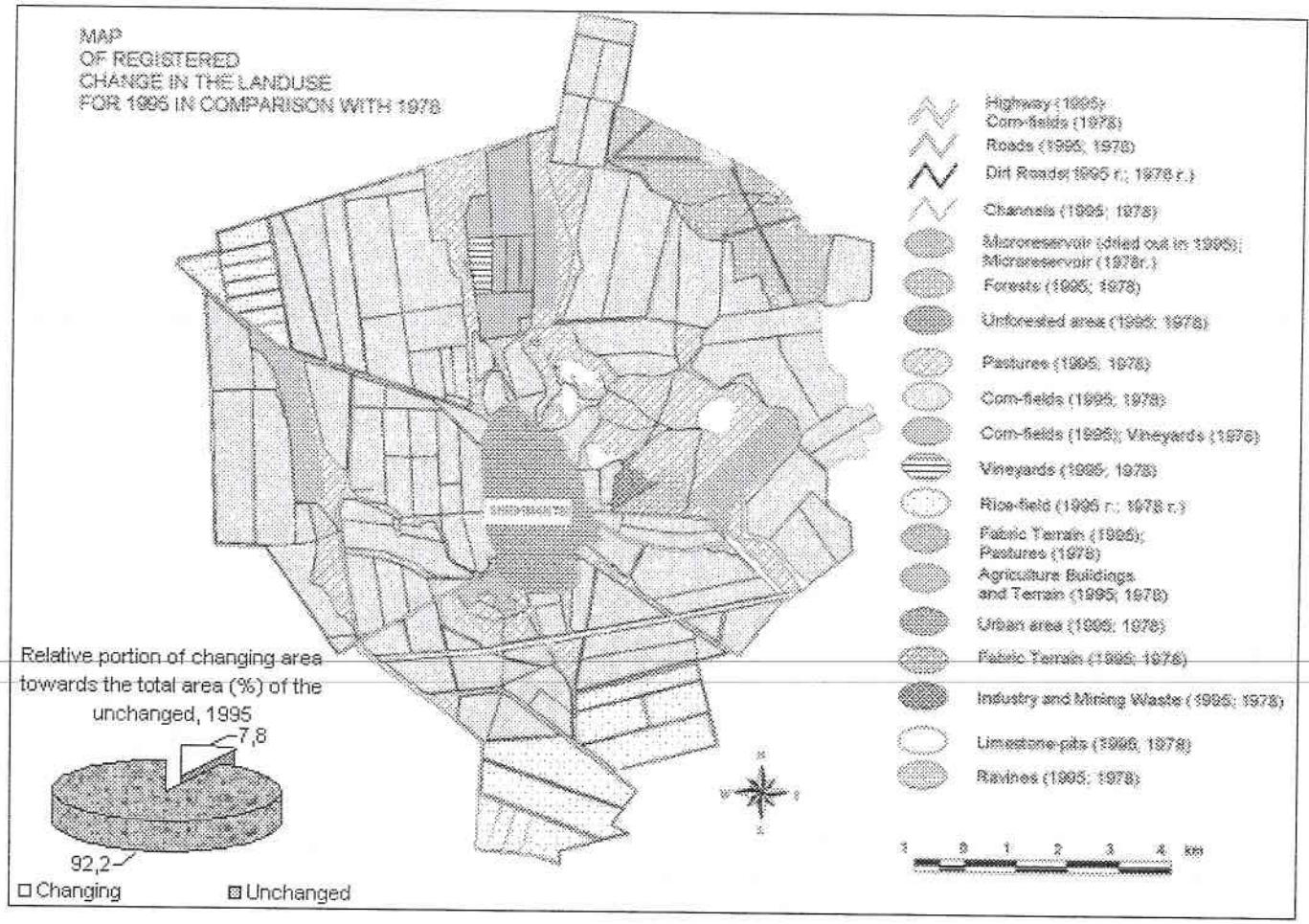
MAP
OF REGISTERED
CHANGE IN THE LANDUSE
FOR 1995 IN COMPARISON WITH 1978
Highway (1995); Corn-fields (1978)
Roads (1995; 1978)
Dirt Roads (1995 r.; 1978 r.)
Channels (1995; 1978)
Microreservoir (dried out in 1995); Microreservoir (1978r.)
Forests (1995; 1978)
Unforested area (1995; 1978)
Pastures (1995; 1978)
Corn-fields (1995; 1978)
Corn-fields (1995); Vineyards (1978)
Vineyards (1995; 1978)
Rice-field (1995 r.; 1978 r.)
Pebble Terrain (1995); Pastures (1978)
Agriculture Buildings and Terrain (1995; 1978)
Urban area (1995; 1978)
Pebble Terrain (1995; 1978)
Industry and Mining Waste (1995; 1978)
Limestone-pits (1995; 1978)
Ravines (1995; 1978)
Relative portion of changing area towards the total area (%) of the unchanged, 1995
7,8
92,2
Changing
Unchanged
0 0,5 1 2 3 4 km

Fig. 2.

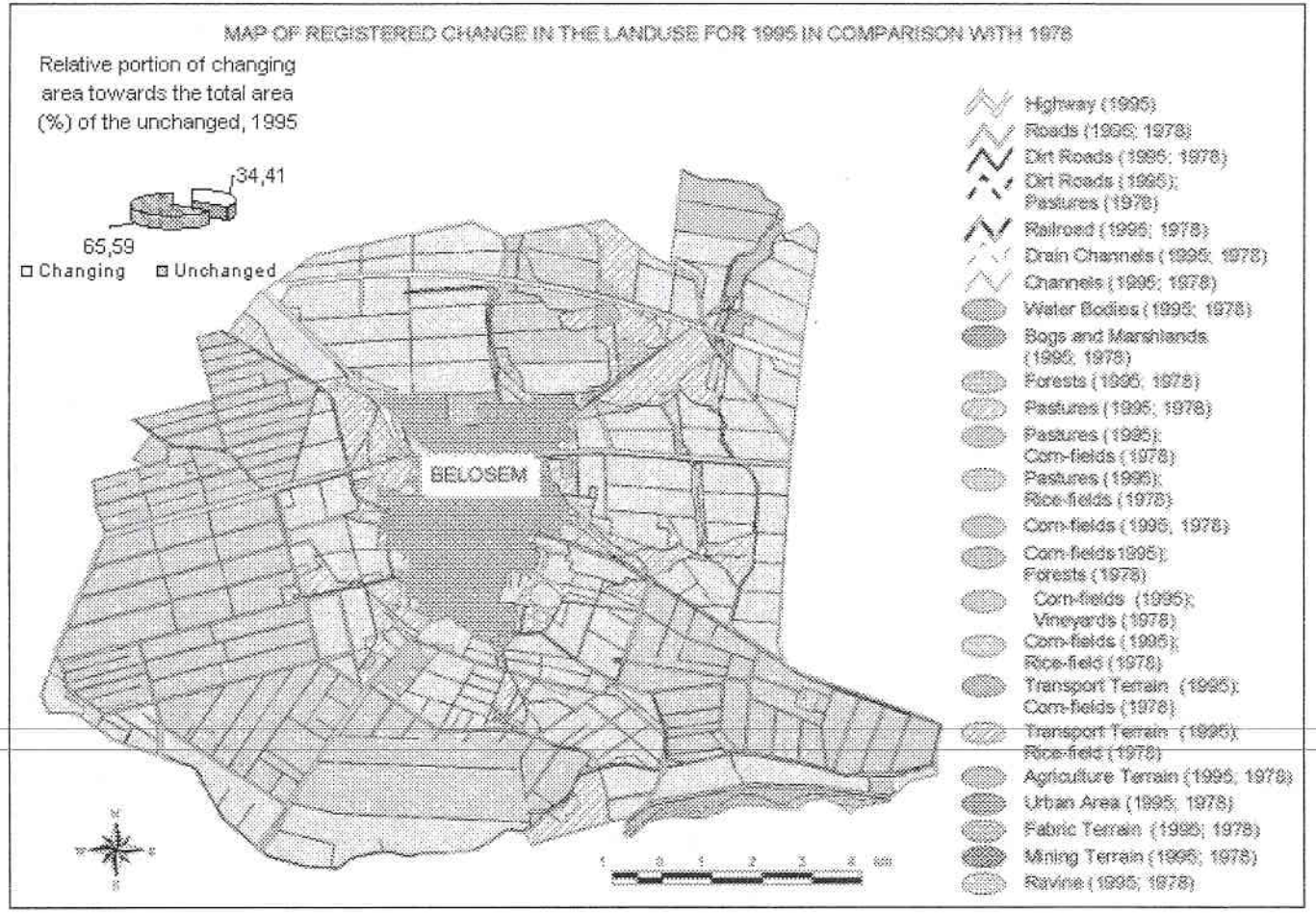
MAP OF REGISTERED CHANGE IN THE LANDUSE FOR 1995 IN COMPARISON WITH 1978
Relative portion of changing area towards the total area (%) of the unchanged, 1995
34,41
65,59
Changing
Unchanged
BELOSEM
Highway (1995)
Roads (1995; 1978)
Dirt Roads (1995; 1978)
Dirt Roads (1995); Pastures (1978)
Railroad (1995; 1978)
Drain Channels (1995; 1978)
Channels (1995; 1978)
Water Bodies (1995; 1978)
Bogs and Marshlands (1995; 1978)
Forests (1995; 1978)
Pastures (1995; 1978)
Pastures (1995); Corn-fields (1978)
Pastures (1995); Rice-fields (1978)
Corn-fields (1995; 1978)
Corn-fields 1995); Forests (1978)
Corn-fields (1995); Vineyards (1978)
Corn-fields (1995); Rice-field (1978)
Transport Terrain (1995); Corn-fields (1978)
Transport Terrain (1995); Rice-field (1978)
Agriculture Terrain (1995; 1978)
Urban Area (1995; 1978)
Fabric Terrain (1995; 1978)
Mining Terrain (1995; 1978)
Ravine (1995; 1978)

Fig. 3.

Table 2. Area (ha) changes of land-cover categories for Shishmantsi Villag

1978 / 1995	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total 1995
1	84.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84.8
2	0	8.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.8
3	0	0	8.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.6
4	0	0	0	273.1	0	0	0	0	0	0	0	0	0	0	0	0	0	273.1
5	0	0	0	0	6.7	0	0	0	0	0	0	0	0	0	0	0	0	6.7
6	0	0	0	0	66.7	1033.0	0	0	0	0	0	0	0	0	0	0	0	1099.6
7	0	0	0	0	0	0	168.3	0	0	0	0	0	0	0	0	0	0	168.3
8	0	0	0	0	0	0	0	25.4	0	0	0	0	0	0	0	0	0	25.4
9	0	0	0	0	0	0	0	0	43.5	0	0	0	0	0	0	0	0	43.5
10	0	0	0	0	0	12.7	0	0	0	0	0	0	0	0	0	0	0	12.7
11	0	0	0	0	0	0	0	0	0	0	3.3	0	0	0	0	0	0	3.3
12	0	0	0	0	0	0	0	0	0	0	0	79.8	0	0	0	0	0	79.8
13	0	0	0	0	0	0	0	0	0	0	0	0	7.4	0	0	0	0	7.4
14	0	0	0	0	0	0	0	0	0	0	0	0	0	93.2	0	0	0	93.2
15	0	0	0	28.6	0	0	0	0	0	0	0	0	0	0	11.7	0	0	40.3
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.2	0	7.2
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17.8	17.8
Total 1978	84.8	8.8	8.6	301.7	73.4	1045.7	168.3	25.4	43.5	0	3.3	79.8	7.4	93.2	11.7	7.2	17.8	1980.3

1. Forests, **2.** Unforested Area, **3.** Ravine, **4.** Pastures, **5.** Vineyards, **6.** Corn-fields, **7.** Rice fields, **8.** Microreservoir, **9.** Channels, **10.** Highway, **11.** Roads, **12.** Dirt Roads, **13.** Agricultural Buildings and Terrain, **14.** Urban Area, **15.** Plants, **16.** Industry and Mining Waist, **17.** Limestone-pits

well as for Plovdiv region. The value of this indicator for Rakovski district is 0,5 ha per person for 1990 [M. Ilieva at al, 1997].

The diagram for Shishmantsi, (Fig. 4) showing the relative portion of soil types towards the total area of the fields, reveals that the most widely distributed soils are Calcixerollic Xerochrepts - 32.2 % and Typic Haploxeralfs - 21.5 %. They are suitable for growing grain and fodder crops, vineyards and orchards.

Second rank Fluventic Xerochrepts - 19.6 %. They are suitable for vegetables, permanent crops and meadows. Pastures grow mainly on Entic Haploxerolls. These soils feature with small depth, rocky composition, and great active carbonates content. They are of poor economic importance.

Table 3. Area changes of land-cover categories (ha)for BelosemVillag

1978 / 1995	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total 1995
1	15.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.8
2	0	2.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.7
3	0	0	2.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.9
4	0	0	0	387.4	0	2.6	3.2	0	0	0	0	0	0	0	0	0	0	0	0	393.2
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	20.3	0	0	0	50.4	1543.6	1318.3	0	0	0	0	0	0	0	0	0	0	0	0	2932.6
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	64.6	0	0	0	0	0	0	0	0	0	0	0	64.6
9	0	0	0	0	0	0	0	0	97.0	0	0	0	0	0	0	0	0	0	0	97.0
10	0	0	0	0	0	0	0	0	0	62.0	0	0	0	0	0	0	0	0	0	62.0
11	0	0	0	0	0	0	0	0	0	0	22.0	0	0	0	0	0	0	0	0	22.0
12	0	0.1	0	2.9	0	21.8	4.2	0	0.1	0.1	0	0	0.4	0	0	0	0	0	0	29.6
13	0	0	0	0	0	0	0	0	0	0	0	0	17.5	0	0	0	0	0	0	17.5
14	0	0	0	0	0	0	0	0	0	0	0	0	0	155.1	0	0	0	0	0	155.1
15	0	0	0	0	0	4.6	6.7	0	0	0	0	0	0	0	0	0	0	0	0	11.3
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.5	0	0	0	21.5
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	328.4	0	0	328.4
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13.2	0	13.2
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.0	2.0
Total 1978	36.1	2.9	2.9	390.3	50.4	1572.6	1332.4	64.6	97.1	62.1	22.0	0	17.9	155.1	0	21.5	328.4	13.2	2.0	4171.4

1. Forests, 2. Bogs and Marshlands, 3. Ravine, 4. Pastures, 5. Vineyards, 6. Corn-fields, 7. Rice-fields, 8. Water catchments, 9. Drain Channels, 10. Channels, 11. Railroad, 12. Highway, 13. Roads, 14. Dirt Roads, 15. Transport Terrain, 16. Agricultural Buildings and Terrain, 17. Urban Area, 18. Plants Terrain, 19. Industry and Mining Terrain

Conclusions

As a result of anthropogenic activities, nowadays the landuse structure of the studied areas is highly disturbed and the anthropogenic influence increases over time.

Rice and permanent crops cultivation exhibit a clear trend of area decrease in 1995.

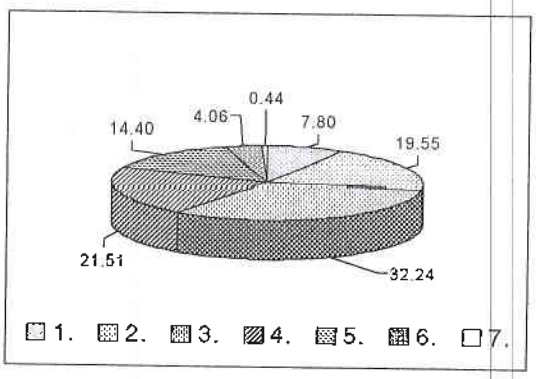

Fig. 4. Relative portion of soil types towards the total area (%) of the fields, 1995 г. 1. Typic Xerofluvents, 2. Fluventic Xerochrepts, 3. Calcixerollic Xerochrepts, 4. Typic Haploxeralfs, 5. Entic Haploxerets, 6. Typic Haploxerets, 7. Entic Haploxerolls.

The high provision of the population with arable land and the lack of working force will influence significantly plant-growing structure. It is necessary to grow less labor-consuming cultures with higher mechanization potential.

The environmental conditions and the opportunity for their reclamation provide good preconditions for agricultural use of the land. Enforcement of the Law on Ownership and Use of Agricultural Land and Land Allocation to its Owners or Their Heirs may lead to a change in the landuse structure and environmental status. This calls for monitoring of the territory, using the GIS database developed in the present study.

The GIS database provides the opportunity for rapid extraction of unbiased thematic information from multichannel images for the purpose of regular landuse monitoring of the studied areas.

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ПРОСТРАНСТВЕН И ВРЕМЕВИ АНАЛИЗ НА ЗЕМЕПОЛЗВАНЕТО В ДВЕ ОБЛАСТИ НА РАЙОН "РАКОВСКИ"

Евгения Руменина

Резюме

Статията е посветена на мониторинга на земеползването на територията на селата Белозем и Шишманци -- община Раковски. При реализацията на поставените задачи и цели са използвани концепции и методики от дистанционните изследвания, ГИС и ландшафтознанието. Поставени са за решаване следните задачи: създаване на ГИС база данни за динамиката на земеползването, почвените различия, геологията и топографията с помощта на многоканални изображения и създадената база данни; съставяне на карти, изобразяващи структурата на земеползването и определяне и анализ на пространствената динамика на земеползването за 1995 година сравнена с 1978 година.

Екологичните условия и възможностите за тяхното възобновяване създават добри предпоставки за използване на земята за целите на земеделието. Прилагането на закона за собствеността и използването на земеделската земя и връщането на земята на нейните собственици и техните наследници може да доведе до промяна в структурата на земеползването и екологичния статус. Това поражда необходимостта от наблюдение на територията с помощта на базата данни, разработен в изследването.