USE OF THE GEOGRAPHIC INFORMATION SYSTEMS FOR ASSESSING THE AGROECOLOGICAL RESOURCES IN THE YAKOROUDA MUNICIPALITY, BLAGOEVGRAD

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ABSTRACT - *Agroecology examine ecological processes in an agrophytocenoses and its task is to elucidate the forms, the dynamics and functioning of these relationships. Knowledge of these interactions in agroecosystems enables it to regulate and manage human for optimal performance and low environmental risk to the environment. Weaker interference by human environmental regulation makes the system more sustainable and environmentally plastic. At this stage, many scientists in the field of agroecology regard agroecological systems as a kind of ecological systems in which systematize and analyze the processes of biotic and abiotic interactions.*
The agroecosystem is any stretches of ground in which anybody conducts an agricultural activity, in which is created a complex of plant and animal organisms in the environment with specific soil, climatic and anthropogenic conditions.
The purpose of this paper is to undertake a comprehensive assessment of agroecological resources in the Yakorouda municipality in terms of the opportunities for maintaining and improving soil fertility and productivity of agricultural lands.

Keywords: *agricultural lands productivity, agroecosystems, agroecological resources, biotic and abiotic interactions, soil fertility.*

INTRODUCTION

The greater part of the surface of the continents is covered with soil. It provides terms and minerals for plant growth, without which it is impossible for the survival of animals and humans. The soil consists of solid particles (organic and rock), water, air, and other living organisms. The soils have a different thickness - from a few tens of centimeters to several meters. Agricultural land is an important component of agroecosystems. They are also the subject of studying agroecology. Agroecology study tolerant attitude to the ongoing human agriculture to the environment. This means that as a general and a leading trend should not be placed on agroecosystem productivity and sustainability of their productivity during the time. In a narrower sense Agroecology is the science that studies the environmental phenomenon in agroecosystems. Agroecology examine ecological processes in an agrophytocenoses and its task is to elucidate the forms, the dynamics and functioning of these relationships. Knowledge of these interactions in agroecosystems enables it to regulate and manage human for optimal performance and low environmental risk to the environment. Weaker interference by human environmental regulation makes the system more sustainable and environmentally plastic. At this stage, many scientists in the field of Agroecology considered agroecosystems as a kind of ecological system in which systematize and analyze the processes of biotic and abiotic interactions. Agroecology concept was introduced in the 70s of the twentieth century, but the elements of scientific and practical knowledge in agroenvironment field date back to ancient times.
Resources in agroecosystems are: Natural; Human; Capital; Productive.
Natural resources: land, water, climate and natural vegetation that are used by farmers to produce agricultural products. Agroecological resources are location, relief, climate, agro-climatic and soil resources.
Agricultural land - This is a broader concept of „soil". Defined as the specific surface area of the Earth's surface that is relatively stable under cyclic predictable properties and behavior. Includes vertically above and below him biosphere attributes like atmosphere , soil, geology lining materials

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topography, hydrology, plant and animal populations as a result of past and present human activity greatly subjected to be influenced by current anthropogenic activity. The land is characterized by its productivity. Unlike fertility, productivity is measured in a quantitative yield (weight output of one or more crop per unit area). Land use - Land use is any permanent or cyclic human intervention to meet the complex human needs, natural resources or created together called the "agricultural land." It is through the application of human control over the natural ecosystems in a relatively systematic way to take advantage of them. The man can be seen as an integral part of the ecosystem, while manipulating them. This can be done as extensively and intensively. Summarize land use is relatively stable process associated with a particular area at a certain time, a certain targeted by environmental conditions and necessarily human activity.

The aim of this article is to undertake a comprehensive assessment of land resources in the Yakorouda municipality in terms of the opportunities for maintaining and improving soil fertility and productivity of agricultural land.

To achieve the intended objective GIS of Soil Resources (GISoSR) are developed (GISoSR) for the studied object. The following methods are used:

• A critical analysis of the existing literature data;
• SWOT-analysis in sector economic development - agriculture in Yakorouda municipality;
• Remote Sensing;
• The literature data and internet sources.

2. OBJECT AND METHODS

2.1. GEOGRAPHY AND TOPOGRAPHY

Yakorouda municipality is located in northeastern part of Blagoevgrad district with an area of 339.3 km^2. It borders the municipalities of Samokov and Sofia Kostenec area, Belica, Belovo, Velingrad and Pazardzhik municipalities. The municipality is composed of eight settlements - municipal center Yakorouda and seven villages, which are located in the southeastern part of the municipality.

Relief - Fig. 1 is mountainous and hilly, covers parts of Western Rila and Rodopi mountains and narrow valley in the upper reaches of the Mesta. The average altitude is 1603 m and average slope is 11.1 %, which adversely affects the overall economic and infrastructural development of the municipality, as well as the development of the settlement network.

Fig. 1. General view of the relief.

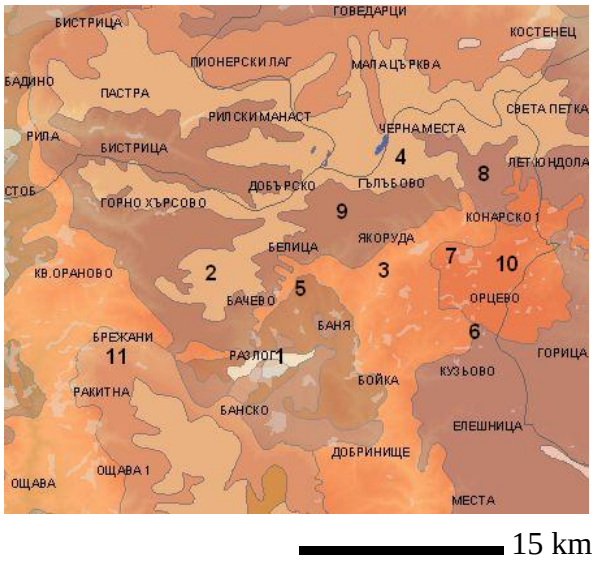
The climate is temperate with a touch of Mediterranean influence, mainly through the valley of the Mesta, the average annual temperature is 8°C. Winters are cold with an average January temperature is - 2°C snow cover lasts about 150 days a year. Summers are short and cool with an average temperature in July 18°C. The most common are Brown and Cinnamonic Forest Soils (*Cambisols)*, and in areas with more than 1600 meters above sea level - dark colored mountain forest soils (*Cambisols*). Along the rivers are mountain meadow and alluvial-meadow soils (*Humo Fluvisols*) suitable for growing vegetables and fruit trees, and in the high mountain – Mountain Meadow Soils and Undeveloped Skeletal Soils - Gurov G. & Artinova N. [1]. Soils and climatic conditions and the strong vertical segmentation of the landscape have led to the development of a very strong degree of erosion, especially in deforested areas. Soil erosion has an extremely negative impact on the development of agriculture.

2.2. SOIL RESOURCES – THE GENERAL CONCEPTS

Main object of study in this work are the soil and especially the productivity of soil resources in the Yakorouda municipality. Soil formation is the result of weathering of rocks and activity of organisms. In weathering (mechanical, chemical and biological - under the influence of some microorganisms) rocks were crushed to loose layer called weathering crust. The soil type of depends on the soil formation rocks as they have a similar chemical composition. The same type of rock, however, can form different soil types because of the different places weathering occurs in different conditions - climate (especially temperature and humidity), relief, vegetation cover and exposure to animals and humans. Soils are renewable natural resources. However, they can be easily contaminated by human activity with poisonous substances or exhausted when exploited and unreasonable with faster than the natural rate of recovery. If vegetation is destroyed, the humus horizon concerns of surface runoff and soil becomes barren.

2.3. SOIL RESOURCES IN THE OBJECT OF STUDY

According to the soil geographical country zoning, Yakorouda municipality falls in the Balkan - Apennines soil sub region, Rila - Pirin province - Kolev B. & Kastreva P. & Miteva N. & Samuilova S. [4]. It is characterized by the dominance of acidic brown mountain-forest soils and dark colored mountain-forest soils as a significant small areas rankers and litho sols - Fig. 2. The province is forested with high-bonitet coniferous forests. It is potentially threatened by erosion. The region offers excellent conditions for recreation and tourism.



Legend:

1. Alluvial and alluvial -meadow , acidic, sandy and sandy loam;
2. Eroded leached cinnamoning soils;
3. Humus- calcareous, sandy clay soils;
4. Deluvial and deluvial meadow, mostly acidic, sandy and sandy loam soils;
5. Shallow dark brown and dark colored forest soils;
6. Shallow leached cinnamonic forest soils;
7. Shallow mountain meadow soils and rendzinas;
8. Shallow brown forest, neutral and acidic soils;
9. Shallow brown forest, mainly acidic soils;
10. Cinnamonic forest soils, heavy sand loam;
11. Shallow mountain meadow soils and alfehumus soils;

Fig. 2. Soil resources of Yakorouda municipality.

2.4. AGROCLIMATIC RESOURCES.

Following the principles of agroclimate zoning according to Hershkovich E. [7], the object falls within sub-belts of slightly thermophilic crops, moderately warm their sub zone. Its northern part is less arid sub zone and the south - in arid sub zone. The most important feature of the climate in the two agroclimatic regions and especially those related to agricultural production are:

2.4.1. MODERATELY WARM, SLIGHTLY ARID AGROCLIMATIC REGION.

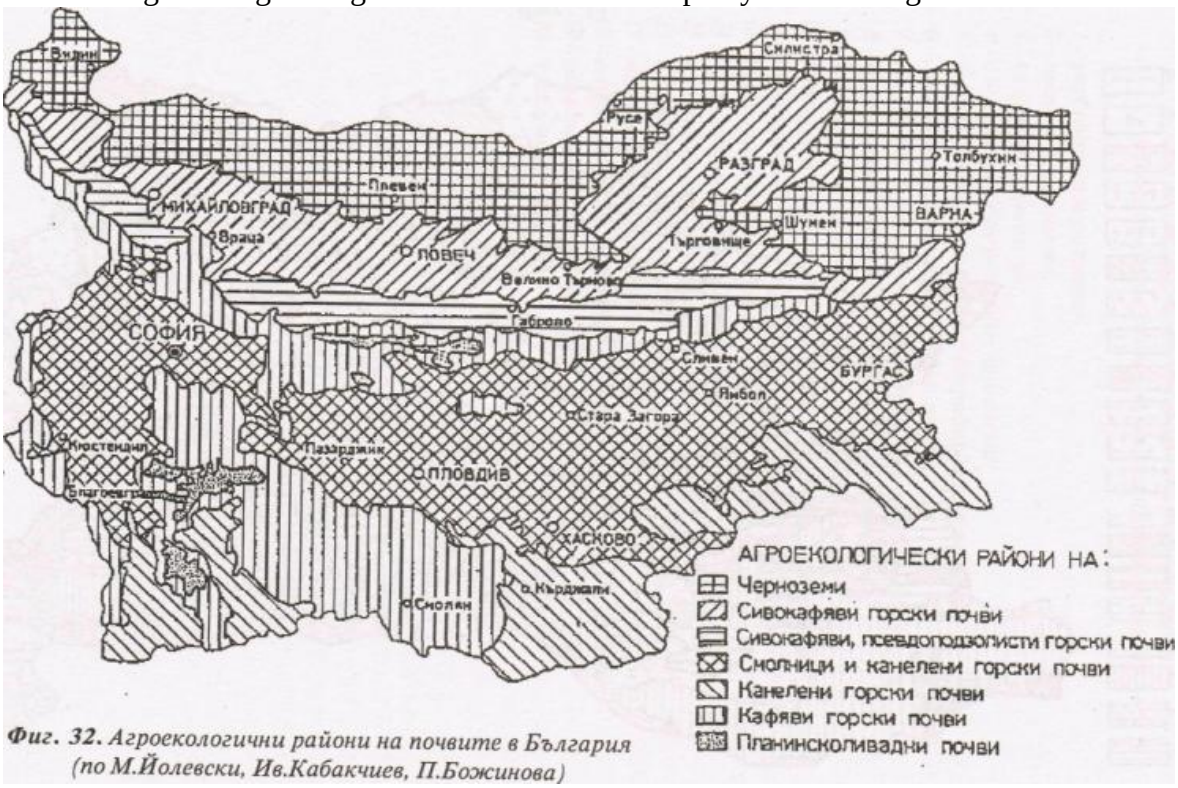
Average daily temperatures above 10 °C here is to establish 17 to 24 April and remain until October 19 to 13. The average length with out of frizzing period is about 180-165 days. Temperature sum of the period with an air temperature above 10 °C is 3100 to 2700 °C, for a period until the date after harvesting lasting down 10 °C in the autumn is 1800 to 1400 °C. The average of the annual minimal temperatures is lower than -18 °C, -20 °C.
In this area there are many favorable conditions for growing medium thermophilic crops (beet, tobacco - up to 700 m a.s.l.) and slightly thermophilic crops (oats, flax, potatoes).
Humidity conditions are relatively good. The balance of the humidity in the summer months is slightly negative to positive. Years deficient humidity > 100 mm, by sprinkling as needed to 2-3 are 10, but in places with very shallow and are more permeable soils due to the lower spring- water supply in the soil.

2.4.2. MODERATELY WARM, ARID AGROCLIMATIC REGION.

Temperature conditions are analogous to the preceding agroclilmatic region. Due to the low rainfall in the summer months and bad water retention properties of soils the humidity conditions are worse. The deficit of the humidity balance is from 100 to 150 mm.

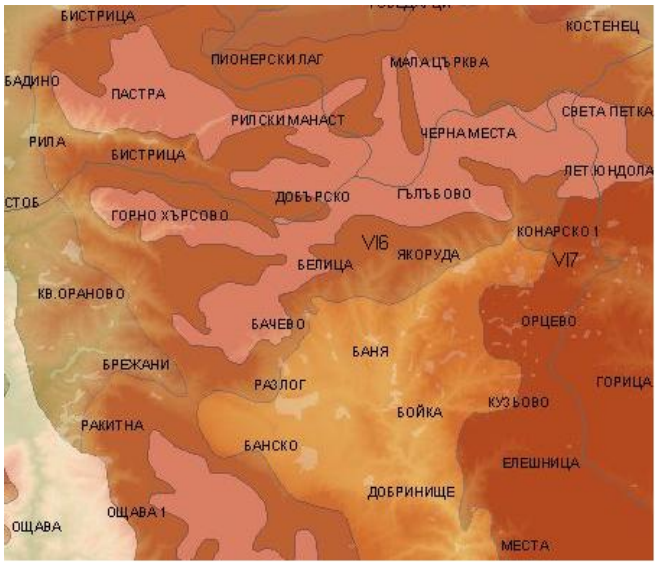
2.5. AGROECOLOGICAL REGIONS

The agroecological regions of the Bulgarian soils - Gurov G. & Artinova N. [1], are presented in Fig. 3 and the agroecological regions in which the municipality falls - in Фиг. 4.



Фиг. 32. Агроекологични райони на почвите в България (по М.Йолевски, Ив.Кабакчиев, П.Божинова)

Fig. 3. Agroecological regions of the Bulgarian soils.



Legend:
1. (VI6) - Rila-Pirin region
2. (VI7) - Rhodope region

15 km

Fig. 4. Agroecological regions in the municipality territory.

(VI6) Rila- Pirin region occupies areas with an altitude of 800 to 2000 m. It has alpine character. Soil forming materials are granites, gneisses, schists, limestones and their weathering products. The biggest is the participation of the brown mountain forest soils, which are similar to their peers' case treated areas but the humus horizon, is more powerful (20-60 cm) and darker colored. The annual rainfall is about 840 mm, such as about 440 mm falling during the growing season. The average annual temperature is around 5°C with temperature sum of the growing season around 2000°C. Agricultural land in this area is characterized by medium (agronomic) bonitet ball 52, i.e. bonitet group "middle lands", but it refers to the lower areas with an altitude of 700-800 to 900-1000 m, where climatic conditions still allow their growing (and here they favor the and of a strong Mediterranean influence). Outside the forest zone lands are unsuitable for normal land use, except for potatoes, pastures and meadows. The lower parts are suitable for potatoes and wheat productivity class 71 and 60 ball (i.e. the group "good lands". Less is the suitability of environmental conditions for grasslands, oriental tobacco, sugar beets, grapes, apples (credit rating ranging from 52 to 41 ball, i.e. the group "middle lands" for maize, sunflower and alfalfa productivity class in the group of „bad lands" and for soybeans - "unfit lands." Like other areas assessments land for different crops vary considerably, which is associated with altitude, the nature of the soil that is affected in varying degrees of erosion.

Table 1. Bonitet (suitability) of soils in VI6 Rila-Pirin AER.

Crops	Bonitet (Suitability) (0-100)	
	<=1000 meters a.s.l.	>1000 meters a.s.l.
Wheat	60	0
Maize	39	0
Soybeans	5	0
Sunflower	35	0
Beet	47	0
Oriental tobacco	46	0
Potatoes	71	71
Alfalfa	30	0
Grasslands	52	52
Apple	41	0
Vineyards	48	0

(VI7) Rhodope region includes areas of Western and Central Rhodope. Soil forming materials are rhyolites, granites, crystalline schists and their weathering products. The soils are almost exclusively brown mountain forest. In their features they are too similar to its peer's Central forest mountain - Samokov region, but are slightly clayey (20-30 % physical clay). In terms of climate, the region is not uniform. In the lower parts of the valleys of the rivers, the average annual temperature is around 8- 9°C, and higher in around 5°C. Temperature sum of the growing period is from 2800 to 3000°C with a low around 2000°C and for the higher elevations. Better warmth of this region allows the cultivation of tobacco, flax, potatoes and more to higher altitudes. Precipitations are from 700 to 1000 mm and humidity conditions are good. Total productive capacity of the land is characterized by medium (agronomic) bonitet score 48, which they attributed to bonitet group " middle lands", but for most crops credit rating refers to the lower areas. They may be graded as follows: most are suitable for potatoes (79 ball - group "good lands." Second are the grasslands and wheat (credit rating in the range of 57-55 ball, i.e. "medium lands"). Less is suitability for growing grapes, apples, sugar beets, corn, sunflower, oriental tobacco (credit rating ranging from 40 to 29 ball, i.e. to bonitet group "bad lands "and for alfalfa and soybeans – "unfit lands". Total productive capacity of the land group agro-ecological regions of the mountain brown forest soils are low. The mean average (agronomic) ball for the whole area is very low (18 ball) and it belongs to the group bonitet "unsuitable lands." As seen, the main difference in this soil group areas are mountainous brown forest soil, occupying areas with an altitude of 800 to 1500 m, where climatic conditions are favorable for agricultural production. In the lower parts of the area with an altitude up to 1000 m (which is no more than 20 % of the total area) can still grow a number of field crops, although with sufficiently satisfactory results (i.e. land are relatively low bonitet ball), while the higher areas the environmental conditions are suitable only for potatoes, pastures and meadows, raspberries, which respectively bonitet ball is higher.

Table 2. Bonitet (suitability) of soils in VI7 Rhodope AER.

Crops	Suitability (0-100)	
	<=1000 meters a.s.l.	>1000 meters a.s.l.
Wheat	55	0
Maize	32	0
Soybeans	22	0
Sunflower	32	0
Beet	39	0
Oriental tobacco	29	0
Potatoes	79	79
Alfalfa	18	0
Grasslands	57	57
Apple	40	0
Vineyards	40	0

2.6. METHODS

The study used the tools of ArcGIS 9.3 - ArcMap for the objects, Visual Basic and Access for analysis of water-physical and hydrological properties of the different soils, remote sensing - Kolev

B. & Rousseva S. & Dimitrov D. [9] and SWOT - analysis in the economic development sector - agriculture.

3. RESULTS AND DISCUSSION

3.1. SOIL RESOURCES IN YAKOROUDA MUNICIPALITY

Data that are discussed below were made soil mapping (1:25000). The overall appearance of the object by means of ArcGIS 9.3 - ArcMap is presented in Fig.5. Dominated by the brown forest soils (1-7 KG) - Fig. 5 and found more brown, shallow, medium eroded (KGE) and brown, shallow, heavily eroded (KGC). They are the most widespread soils in mountain areas and occupy the area of 17 million hectares or 15%. These soils are rich in humus, but the average stock of available nitrogen and phosphorus absorbed. They need to be combined fertilization. In the higher parts of the mountains brown forest soils in passing dark colored forest and mountain meadow.

On the riverbanks it meet alluvial (AP - alluvial, medium power) and on the slopes - delluvial (DL - (delluvial, less powerful) and talus (DR - delluvial, medium power) soils. Higher in parts of the municipality is dominated by mountain meadow, shallow, low and medium eroded (PL). Cinnamoning soils are presented by cinnamoning and cinnamoning immature, shallow and heavily eroded and rocks (NKK). Represent the most common soil type in the country. Occupy 25 % of the total soil area of Bulgaria, mostly in the Central Forest Mountain and Southern Bulgaria. These soils are medium humus in humus like gray forest soils, poorly maintained to absorb nitrogen and phosphorus. Improving soil fertility is recommended fertilization and irrigation.

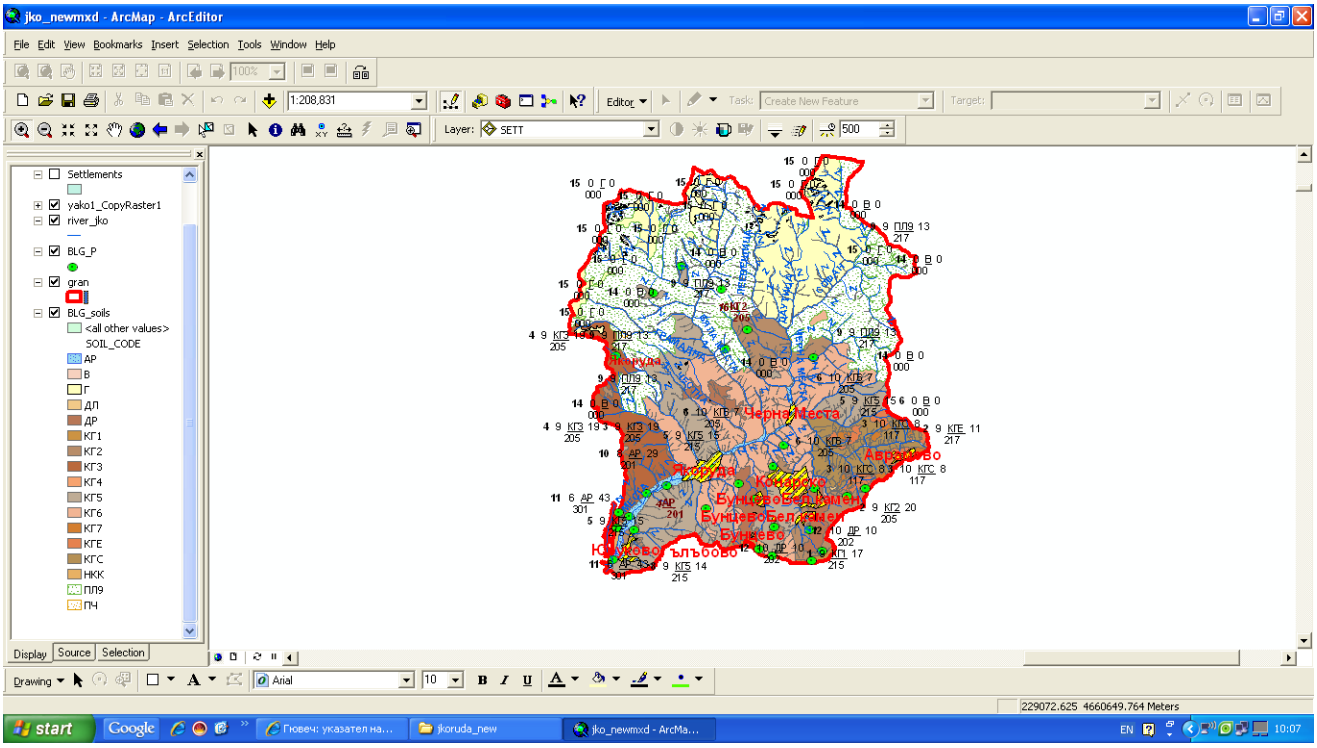


Fig. 5. General view of the object.

Rocks (R), sands and gravels (S&G) and gullies and ravines gullies (r&g) complete soil resources of the municipality.

Determination of water- physical and hydrological properties of the studied soils (on the example of cinnamoning forest soil) is shown in Fig. 6 (general data). The next figure illustrates recalculated particle size distribution structure after the reallocation of losses from treatment with HCl in fractions – Kolev B. [3] - Fig. 7.

Classification of soil texture and determination of some water-physical and hydrological properties, according to Kolev B. & Rousseva S. & Dimitrov D. [9], are shown in Fig. 8.

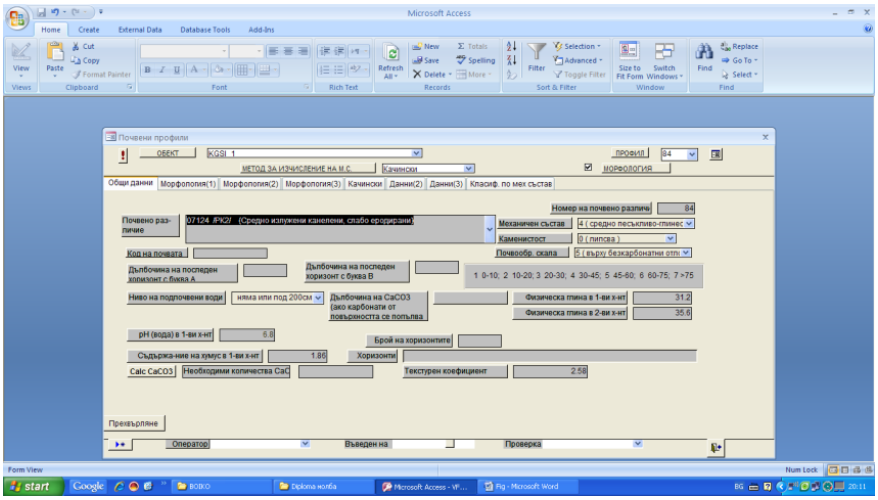


Fig. 6. General data.

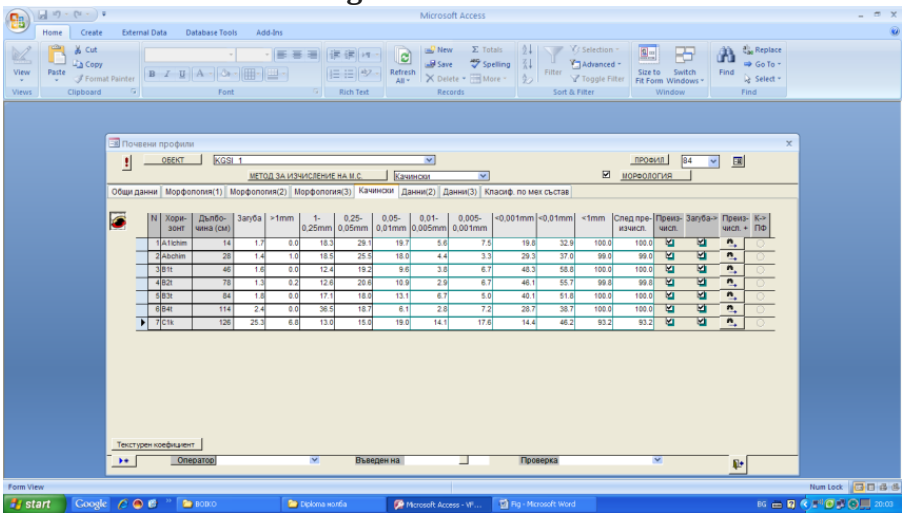


Fig. 7. Particle size distribution structure after the reallocation of losses from treatment with HCl in different fractions.

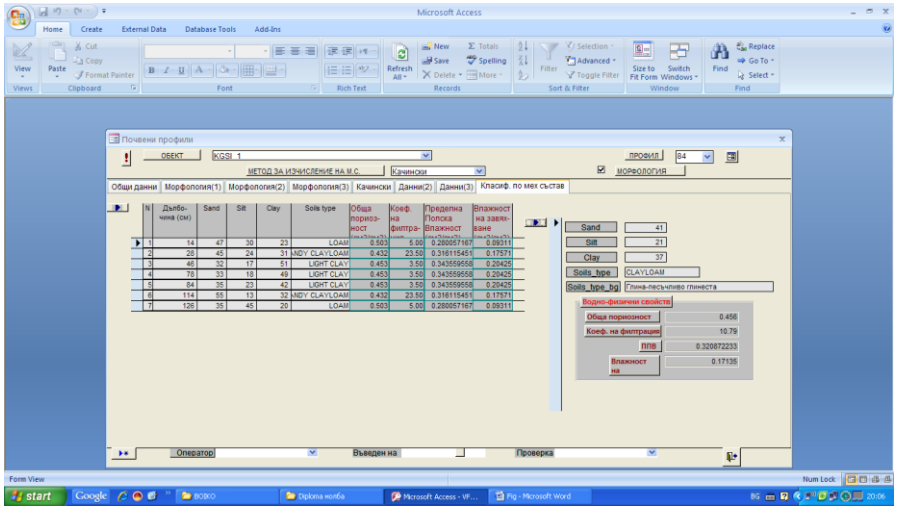


Fig.8. Classification of soil texture and determination of some water-physical and hydrological properties.

The three factions of the mechanical composition in USDA classification Sand (sand fraction), Silt (silt fraction) and Clay (clay fraction) are calculated, and some water and physical and hydrophysical properties - total porosity, filtration coefficient, field water capacity and wilting point in soil horizons and for the entire soil profile - Kolev B. & Michalev D. & Zhivkov D. & Miteva N. [8]. Soil horizons varies from loam true silty clay loam to light clay, an average the soil profile is defined as clay loam - clay, sandy loam , with an average content of Sand (sand) - 41 %, Silt (silt) – 21 % and clay (clay) – 37 %. Total porosity varies horizons from 43.2 to 50.3 % on average 45.6 %. Filtration coefficient is 5 cm/24 h in plugging horizon to 23.5 cm/24 h in the under plugging horizons, with average value of 10.79 cm/24 h. Field capacity (PPW) varies between 28% in plugging horizon to 34.36% in the under plugging horizons, with average value of 32.10 %. Wilting point (WZ) follows the PPW - from 9.3% in plugging horizon to 20.42 % in the under plugging horizons, with an average value of 17.14 %.

3.2. Balance of the agricultural lands by category in Ykoruda municipality

Table 3. Land categories.

N^0	Land category	Land properties (numb.)	Size (daa)	Size (%))
1.	VI	1	17.928	0.01
2.	VIII	3308	4807.307	1.46
3.	IX	3997	77389.102	23.56
4.	X	6923	35884.876	10.93
5.	Without category	1841	210343 .381	64.04
	Total	16070	328442.594	100.00

The land category in the municipality varies from VI th to X th it does not mean that the lands are not fertile. In Rila- Pirin AER environmental conditions are suitable for potatoes and wheat productivity ball varies between 71 and 60 ball - Table. 1, and in the Rhodope AER environmental conditions are suitable only for potatoes, pastures and meadows, raspberries, for which respectively bonitet score is higher - Table. 2.

3.3. Analysis of the strengths, weaknesses, opportunities and threats (SWOT - analysis).

Agricultural land fund is 11305.7 hectares, of which arable land is 54,174 hectares or 15.97 % of the territory of municipality. Irrigated area wills no functioning irrigation system. Form of ownership, 24 % of agricultural land is privately owned, 9 % municipal, 46 % of the state, while 22 % residual municipal fund. The share of municipal land is low and limited opportunities to promote agricultural development by providing land to tenants for creating large farms and farms. Reserves are lands that are expected to be registered as municipal property after the expiration of the limitation period for the recovery of property. The main problems facing agriculture are:

- Family farms are closed; the land is cultivated almost without the use of equipment not carried out agricultural activities, leading to lower yields.
- The marketing of agricultural produce is very difficult, and the proposed prices are below the cost of production. An exception is the implementation of the tobacco, where despite the possibility of delayed payments to producers purchasing campaign is at a satisfactory level.
- There is no modern agricultural technology and modern buildings, and financial resources for technological innovation farm. Lack knowledge of proper implementation of agro technical measures, incorporation of fertilizers and pesticides is done randomly.
- Family farms are not market-oriented, market appear surplus households. The production quality is low due to lack of knowledge among farmers about feeding and housing of animals.
- The above problems provoke negative trend of decreasing arable land, degradation of technical support agriculture and reduce yields. In animal husbandry, tends to reduce the numbers of animals

continued deterioration breed and yields. Yakorouda municipality is included in the project "Sustainable Rural Development ", funded by UNDP and the Ministry of Agriculture and Food, in which it appears expert and financial support to farmers. Prospects for the development of agriculture in the municipality Yakorouda associated with introducing alternative crops such as herbs, raspberries and blueberries. Important for the development of agriculture is the development of related industries, especially the food industry and rural tourism. Opportunities for economic development are related to:

- Lack of significant pollution of the environment and the ability to produce ecologically clean agricultural products , subject to the technological requirements;
- The development of short-term programs for rural and eco tourism based on the resources of the Rila National Park and Resort „Treshtenik"
- Active marketing investment to attract private investment in agriculture and industry with significant growth potential;
- Opportunities for mining of wild mushrooms and herbs, as well as cultivation of medicinal plants as an alternative form of employment and reduction of unemployment for unemployed and for a significant proportion of growers.

Table 4. Analysis of the strengths, weaknesses, opportunities and threats.

STRENGTHS	**WEAKNESSES**
➢ Absence of industrial pollution, ecologically pure area; ➢ Developed wood processing industry; ➢ Water resources and power generation; ➢ Availability of significant woodland and forest resources; ➢ Traditional experience in agriculture.	➢ Monostructural economy dominated by the timber industry; ➢ Fragmentation of agricultural land and insufficient opportunities for their consolidation; ➢ Availability of large areas affected to varying degrees by erosion; ➢ Remoteness of the municipality of economic and administrative centers.
OPPORTUNITIES	THREATS
➢ Ability to develop alternative forms of agriculture, rural and ecological tourism; ➢ Opportunities to attract inward investments and the activation of economic links with the business in Greece.	➢ Total economic decline; ➢ Quality deterioration of the technical infrastructure.

CONCLUSION

It must be emphasized that the primary activities in National Agroecological Program (NAEP) are associated with preservation of agricultural lands with high natural value and conservation and restoration of biodiversity in them; maintaining the traditional features of the landscape and low-intensity farming practices of local varieties of fruit orchards; reducing water pollution by nitrates from agricultural sources by introducing appropriate sustainable crop rotations; prevention of soil erosion in the river watershed; protection of endangered local breeds and development of organic production.

Better land management and environmental objectives implementation of the approved NAEP and has international commitments such as the Kyoto Protocol and the Conventions on Biodiversity, the fight against desertification and climate change.

From an agroecological assessment of soil resources can be concluded that despite the acquisition of contemporary and modern look of the Municipality Yakorouda, the environmental effects are

insignificant. Category of land in the municipality Yakorouda ranged from VI th to X th. This does not mean that the lands are not fertile. In Rila - Pirin AER environmental conditions are suitable for potatoes and wheat productivity class 71 and 60 balls. In the Rhodope AER environmental conditions are suitable respectively for potatoes, pastures and meadows, raspberries that bonitet score is higher.

Recommendations are made to minimize negative impacts on the environmental components. Of the sites as potential contaminants are not expected to significantly impact on a territorial scale.

It is envisaged that the introduction of a system of self-monitoring for enhanced effective control and management of air, water and soil.

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