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LAND USE REGIMES OF AGRICULTURAL SOILS IN MOUNTAINOUS AREAS OF SOUTHWEST SERBIA

Abstract

In order to raise primary agricultural production to an economically viable level, the Republic of Serbia adopted the number of documents, strategies and laws regulating important issues related to agriculture and rural areas. This documentation would create conditions for achieving the economic, ecological and social goals of sustainable development adopted by the United Nations for the period 2015–2030. When it comes to the development of rural areas of Serbia, the main goals would be to: 1/ stop the migration of the rural population by creating the prerequisites for the modernization of primary agricultural production to increase the production of health-safe and functional food in areas where sustainable and organic agriculture can be organized 2/ production of health-safe and functional organic food. The holders of these projects, with the help of scientists from the Faculty of Agriculture in Zemun, increased the volume of primary plant and animal production on surfaces that were neglected for many years and covered with perennial weeds.

Key words: *lands, plant production, food products with geographical origin, rural tourism fairs*

INTRODUCTION

According to the Statistical Yearbook data, the total area of the Republic of Serbia is 7,747,400 hectares. From this area, 5,052,957 hectares are agricultural land. The forests are on 1,984,513 ha, while the unproductive land makes 709,930 ha. The largest

areas of agricultural land are plowed land – 3.398.700 hectares (66%). About 7% of the land annually remains uncultivated from this area and this trend is increasing, especially in the rural, mountains areas. Meadows and pastures occupy 1.455.589 ha (28%), but, larger areas under natural herbaceous vegetation are becoming less used as the livestock fund decreases in the areas where they are the most abundant. Orchards and vineyards are located on 298,667 ha, which makes up about 6% of the total agricultural land, and this area is increasing every year as a result of increasing consumption of fresh fruits and its products, with the tendency of increased exports (Matović et al., 2013). Nevertheless, according to estimates of experts in the field of agriculture, in Serbia every year, up to 350,000 ha of land remains unused, while unused grassland area is significantly higher, but there are no precise data about this, because high-quality system of land-management do not exist (Godjevac Obradović, 2018). The main reasons for the increase of area of uncultivated and unused agricultural land is less and less interest in this type of economic activity with which, in rural area, predominantly older persons are dealing. Applying the traditional way of agricultural production by using outdated agricultural machinery, they become non-competitive commodity producers.

In solving the issue of how to raise the primary agricultural production to an economically viable level, the Republic of Serbia adopted the number of documents, Official Gazette of the Republic of Serbia 2005; 2006; 2006a; 2009; 2010; 2011; 2011a; 2012; 2014;) strategies and laws regulating important issues related to agriculture and rural areas. By this documentation, the state seeks to define a clear platform and legal framework for decision-makers, businessmen, as well as all other stakeholders in further agrarian activities. As the main strategic aspirations, the need to reduce the backlog in technological development, more efficient land management better implementation of laws, institutional reforms and alignment with EU administrative requirements are recognized.

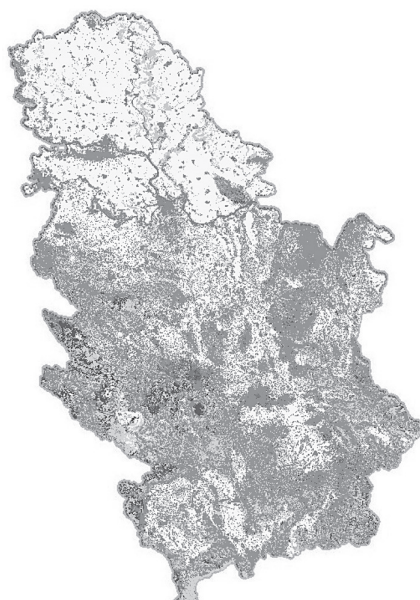
The said documentation would create conditions for achieving the economic, ecological and social goals of sustainable development adopted by the United Nations for the period 2015–2030 (Agenda for Sustainable Development 2015). When it comes to the development of rural areas of Serbia, the main goals would be to stop the migration of the rural population by creating the prerequisites for the modernization of primary agricultural production and to increase the production of health-safe and functional food in areas where sustainable and organic agriculture can be organized. By providing better living conditions for the rural population, by building family farms for processing agricultural products and by better linking with city centers and developing rural tourism, more and more young people would be interested in living in the countryside.

In the area of the southern highland-mountainous macro-region of Western Serbia, which was the subject of these surveys, with the help of state subsidies and extensive engagement of the local population, the level of agricultural production in the past decade are significantly risen – primary crop production and cattle breeding, as well as processing of plant and animal products, some of which received a certificates as organic health-safe and functional food and of geographical origin. The holders of these projects, with the help of scientists from the Faculty of Agriculture in Zemun,

increased the volume of primary plant and animal production on surfaces that were abandoned for many years and covered with perennial weeds. According to the orographic structure and climatic conditions in Serbia, two geographical units are distinguished: the plain area located north of the Sava and Danube rivers (the province of Vojvodina) and the central region of the Republic divided into western, central and eastern Serbia, Picture 1–4.

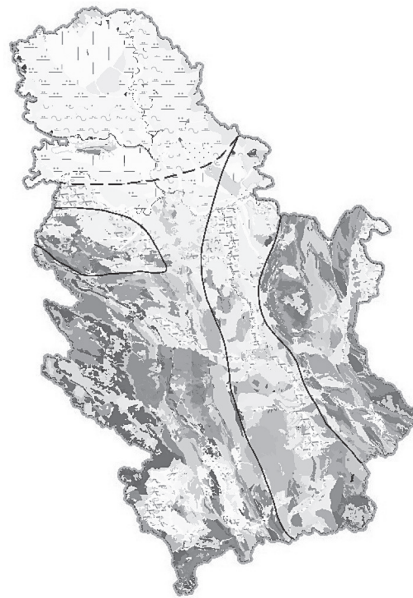


Picture 1. Nomenclature of Territorial Units for Statistics; Statistical regions level.
Source: <https://a3.geosrbija.rs/share/11663d12469b>



Picture 2. Land Cover of Republic of Serbia; State preview.
Source: <https://a3.geosrbija.rs/share/c4df06cc163c>

Western Serbia is a geographical area that extends north-south course, occupying the western parts from Sava in the north, to the Pestors Plateau in the south. In the west, it is bounded by the river of Drina and in the east by Šumadija and West Pomoravlje. The entire area is divided into three macro-regions. The subject of this work was the southern highland-mountainous macro-region. It extends from the Valjevska podgorina in the north to the southern borders of central Serbia. The area is dominated



Picture 3 – Geological Map of Republic of Serbia; State preview
Source: <https://a3.geosrbija.rs/share/1d848572e2ec>



Picture 4 – Elevations of Republic of Serbia; State preview in 30m GRID.
Source: <https://a3.geosrbija.rs/share/2c075cebe140>

by mountain relief with mountains of different geological origin and of pedological composition. Another feature of this area is a large number of mountain plateaus and surfaces that are dissected by cliffs and canyon valleys, between which the basins have been lowered. The largest plateau is Peštersko polje above sea level up to 1,150 m, which is built on the Dinaric surface (Pešterska zaravan). The second plateau is the Koštam Field at 950 m above sea level. In addition to the plateau in this area there are larger and smaller coves (Glamočlija et al., 2015).

Soil characteristics depend on the geological composition of the parent substrate. In the valleys and on the plateau they are more fertile, while, in the mountains, soil is shallow, poor in plant assimilates and acidic reactions (Živković et al., 2006). The share of agricultural land, predominantly grassland, and significantly less plow land, is larger in the southern regions, and of forests, in the north of the macro-region. Climatic conditions depend on the altitude, so the mountainous areas are under the influence of the subalpine climate, while the cold continental climate prevails on the plateaus and in the valleys. Winters are very cold with about three months under the snow. The average January temperature is -5°C . The mean annual temperature is below 10°C , and in higher mountains (Tara) it is 5.4°C . The annual rainfall is 700 mm in the south, up to 900 mm, in the north of the macro-region, and the area is rich in waters (Glamočlija et al. 2011). The temperature and water regime make the spring short and fresh, the summer is warm and damp, autumn is short and cold. Weather conditions are favorable for cultivating of grasses and plants of shorter vegetation period because most precipitation occurs during the summer period. In crop production, the most cultivated are oat and wheat, and of alternative – buckwheat (Glamočlija et al., 2010), potato, medicinal and fodder plants (Jevđović et al., 2011).

The paper is presented ways of using agricultural land of the mountain area of southwestern Serbia – an example of the of spelt and buckwheat production.

MATERIAL

During the past ten years, production experiments were performed on the representative landholdings of the private company Agrozlatar from Nova Varoš, as well as at some landholdings of farmers in the municipalities of Požega and Kosjerić. The company from Nova Varoš deals exclusively with plant production on its own land, as well as on leased areas. The main crops are buckwheat, wheat – spelt (German wheat), oats and potatoes. The paper is presented ways of using agricultural land of the mountain area of southwestern Serbia – an example of the of spelt and buckwheat production. The very favorable agro-ecological conditions of this region provide exceptional possibilities for this type of production, since they are far from large urban areas, industrial facilities and roads that excludes the possibility of contamination of crops by aerosols. At the same time, the specific climatic conditions with sharp winters and favorable heat and water regime during the vegetation season reduce the number of pests and pathogenic mushrooms, so indirect crop protection measures are very effective for obtaining healthy primary products suitable for processing into quality and health-safe food.

RESULTS AND DISCUSSION

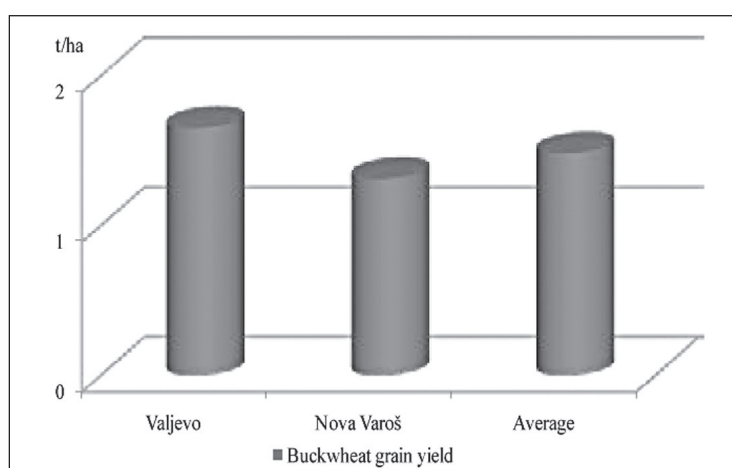
The main crops, during the past ten years, production experiments were performed on the representative landholdings of the private company Agrozlatar from Nova Varoš, as well as at some landholdings of farmers in the municipalities of Požega and Kosjeric, are buckwheat, wheat – spelt (German wheat), oats and potatoes. After the first experiences gained in the production of these crops and the upgrading of production technology through the supply of modern agricultural machinery, the employees in the company prepared the most suitable land area for organic plant production. Today, by obtaining the necessary certificates, on most agricultural areas, these listed crops are cultivated in the organic production system. The obtained products, in the first place, grain of buckwheat, spelt and oats are processed in their own factory and appear on the market as an organic product.

Grain yield of wheat – spelt. This type of old – new cereals in recent decades has become more and more interesting in human nutrition (Glamoclija, 2012). Spelta contains less gluten than common wheat and is suitable for eating people who are sensitive to this protein. Due to its nutritional, medical, and agronomic characteristics, the production and consumption of spelt in food industry grows steadily (Zielninski et al., 2008). In the diet, whole grain, groats and flour are used for the preparation of bread, pastry and biscuits. It is appreciated from the agronomic point of view because he is better adapted for growing on poor soil and in the cooler continental climate. The results of the research carried out on poor and degraded soil have shown that by correctly balanced nutrition of plants, with nitrogen, phosphorus and potassium, high grain yields of excellent quality can be achieved (Glamoclija et al., 2012). Experiments carried out on the Agrozlatar estate showed that this wheat can be successfully included in the organic production system because higher yields of grain are achieved than by production of common wheat, and the entire production, is processed of the production plant on the family farm into flour or, it is packed as whole grain, that are used for cooking. In addition to this estate, the spelt – wheat was also included in regular production by individual households in the wider area of mezzo-region, for example in the mountainous villages of the municipalities of Požega and Kosjerić (Ugrenović et al., 2012). Almost the entire organic production of this wheat takes place with the expert assistance of the scientists from the Faculty of Agriculture from Zemun and the PDS Institute Tamiš from Pančevo (Ugrenović et al., 2015; 2018).

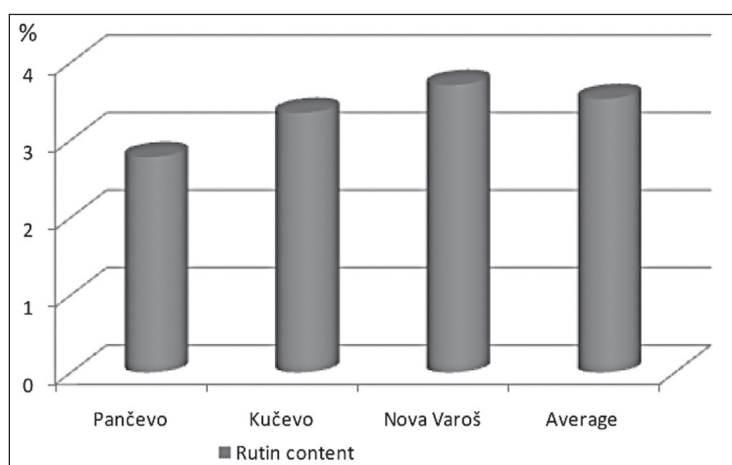
Buckwheat grain yield. The climatic soil conditions of the site have a significant impact on buckwheat grain yields, as confirmed by many years of research carried out at three sites. The first trier was in Srem on Chernozem soils, the second in the area of Valjevo (gray forest land) and third in the area of Nova Varoš (gray forest land). Significantly higher yield in perennial averages was achieved in Srem (1.65 t ha⁻¹) than in the mountainous area. However, the average yield of 1.31 t ha⁻¹ was 21% lower in Nova Varoš, which shows that buckwheat can be successfully cultivate (Ikanović et al., 2012) and in less favourable agro-ecological conditions at an altitude above 1,000 meters (chart 1a).

The content of rutin in buckwheat leaves. Rutin is an alkaloid used in the pharmaceutical and food industries. By examining of the content of rutin in the leaves by

liquid chromatography on the HPLC Hewlwt Pacard, the HP 1090 LC with the Dioden-Array Detector, it was concluded that the geographical origin of the raw material has a major influence on this property. The lowest content of rutin was found in leaves of buckwheat farmed in Vojvodina (Pančevo and Surduk), in the overall average of 2.78%, significantly more in Eastern Serbia (Kučevo) 3.35%, and the highest content from those, from experimental field in Nova Varoš, 3.71% . With using of NPK mineral nutrients, the rutin content of the leaves were declined, while water binding agents – hydrogel and zeolite significantly influence the synthesis of rutin (Lačnjevac et al., 2012). The content of rutin in these variants, compared to the variant with NPK mineral nutrients increased by about 10% (Graph. 1b).



a)



b)

Graph. 1. Grain yield, a, and rutin content, b, of buckwheat in Serbia

Organic production of buckwheat. In experiments based on the organic system of cultivating, for supplemental plant nutrition organic fertilizer Sifog, Fertor and poultry manure were used. The used plant nutrients significantly increased grain yield in relation to control. The smallest effect had the use of poultry manure (yield increase of 11.1%). Using Fertor, a higher grain yield was obtained by 19%, and using Sifoga, yield increase was 21.2% (Filipović et al., 2005). The results showed that buckwheat can be grown with use of the plant nutrition that is allowed for the organic production system. In addition to these nutrients, for increasing the natural fertility of the soil, systems of complex crop production are also advantageous, in which the grained legumes should be represented with greater participation, as main crops for grain production or as cover intercropping crops (Savić et al., 2009).

By studying the influence of weather conditions on the morphological and productive properties of buckwheat in the conventional and organic farming system, Popović et al. (2015) concluded that this plant species exhibits a great dependence on the distribution of heat and precipitation during the vegetation period. In favourable weather conditions there are no significant differences between these two systems of cultivation, while the unfavourable water regime as a whole, significantly reduces the yield of grain in the area of Vojvodina where the research was carried out. In the southwestern part of Serbia, the water regime is significantly more favourable and with less drought periods during the summer, so that the application of organic production system has a lot of economic justification (Popović et al., 2013).

Mezzo-region, which is the subject of study, is a suitable area for cultivation of most types of real and alternative cereals, in the system of sustainable agricultural production, thanks to favourable climatic and soil conditions. Most of these crop plants are cultivated in a semi-intensive way, which should be more used in the future, taking into account available mechanization and age structure of households. The produced grain of these cereals has a higher nutritional value compared to standard types and in industrial processing serves for the production of ready-made food products (Đurić et al., 2018) with increased nutritional value.

The results of the analysis of the land fund show that in the Republic of Serbia, from year to year, agricultural areas that are not used for plant production increase. The share of untreated area is significantly higher in hilly and mountainous regions due to the reduced interest of the younger rural population to remain on the ancestral homes and to engage in agricultural production.

In such conditions, the primary plant production remains the interest of the elderly population of the rural population that has obsolete agricultural machinery and does not have enough work force to process their agricultural land in the best possible way.

The consequence of such an approach to agricultural production, both herbal and livestock, is a smaller amount of food, produced on small rural households.

It is undeniable that there is an interest of the state to stop the trend of depopulation of rural areas. In order to improve rural life, it is necessary to make significant qualitative changes through joint efforts. The competent state authorities should offer programs that our scientific and research institutions will do by examining the natural resources of each individual area and suggesting what to produce and how to process

the obtained product that would, by its quality and health security, find its place on the domestic and foreign markets. At the same time, all rural areas need to have good road connection, be provided with quality water, electricity and modern Internet global communication.

The program, initiated by the scientists of the Faculty of Agriculture in Zemun and the Institute Tamiš from Pančevo, was very good accepted by agricultural producers in rural areas where production experiments were organized and lectures on sustainable and organic agricultural production were held, and also an introduction in the production cycle of new arable, forage and medicinal plants.

In the area of this mezzo-region, food fairs (days of buckwheat, days of cheese, days of honey, homemade crafts and similar) have been held for more than a decade. Every year, an increasing number of guests from the country and around visit them. These gatherings are organized by affirmed farmers with the help of local authorities and with the obligatory involvement of experts who pass on the latest knowledge in the expert field to interested parties. Guests who are attracted to clean nature, excellent food and accommodation often stay for several days in modern facilities for rest, which often are family houses built in traditional style.

The rural population, accepting this modern approach of agricultural production, which includes primary production, processing into food products in a traditional manner and recognizable geographical origin and quality and combined with rural tourism, remains on its landholdings by employing all members of the household, from the youngest to the oldest

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The next step that will lead to even greater improvement of agricultural production in rural areas will be the association of producers in specialized cooperatives that would define as producers of large quantities of certain food and medicinal products (dairy products, honey, flour, bread-bakery products, medicinal herbs, auxiliary medicinal products and the like) to which the market would be supplied throughout the year in the required quantities.

CONCLUSION

Agricultural producers, who have shown greater interest in improved plant production technology, with the expert assistance of scientific workers and with the appropriate incentive funds from the relevant ministry, have been producing higher yields for several years and they have started to develop rural tourism and that way, to do placement their food products on the domestic market.

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НАЧИНИ КОРИШЋЕЊА ПОЉОПРИВРЕДНОГ ЗЕМЉИШТА БРДСКО-ПЛАНИНСКОГ ПОДРУЧЈА ЈУГОЗАПАДНЕ СРБИЈЕ

Извод

Да би подигли примарну пољопривредну производњу на економски исплатив ниво у Републици Србији је усвојен значајан број докумената, стратегија и закона којима се регулишу значајна питања везана за пољопривреду и рурална подручја. Овом документацијом створили би се услови за остваривање економских, еколошких и социјалних циљева одрживог развоја усвојине од Уједињених нација за период 2015–2030. Када је у питању развијање руралних подручја у Србији, основни циљеви били би: како да се заустави миграција сеоског становништва стварањем предуслова да се осавремењавањем примарне пољопривредне производње, повећањем здравствено безбедне и функционалне хране у пределима где се може организовати одржива и органска пољопривреда, и производити органска здравствено безбедна храна. Носиоци ових пројеката, уз помоћ научних радника Пољопривредног факултета у Земуну, повећали су обим примарне биљне и сточарске производње на површинама које су биле дужи низ година запуштене и обрасле вишегодишњим коровима.

Кључне речи: *земљиште, биљна производња, производња хране са географским пореклом, сајмови хране и сеоски туризам*