

**MULTI-PURPOSE EVALUATION OF AGRICULTURAL LAND IN THE
FEDERATION OF BOSNIA AND HERZEGOVINA**

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ABSTRACT

Multi-purpose land evaluation is a method of assessing the quality and value of the land in the service planning and land management, and is the fundamental basis for the development and optimum use of land in general. The subject of the study was evaluation of multi-purpose suitability of land for agricultural use was made according to the Regulations on the uniform methodology for the classification of agricultural land in the class (Official Gazette of the Federation of B&H, No. 43/11), using FAO assessment methodology (FAO, 1976; Brinkman and Smyth, 1973). Based on the results of research was created a database and map of suitability of agricultural land for growing different plants in agriculture vegetable (gardening); arable farming (annual crops); fruits (fruits growing); wine-growing (viticulture) and grassland (pastures and meadows). It was determined the priority of agricultural use as well as dedicated map (1:200 000), which shows the distribution of 36 recommended agricultural and economic programs in the Federation of Bosnia and Herzegovina. It was found that the largest area of 429,685.4 ha or 40.45% of agricultural land in the Federation of Bosnia and Herzegovina is suitable for agricultural economic program of grassland. Follow the other agricultural economic programs: fruits-grassland 123,996.4 ha or 11.67%; then fruits-vegetable-annual crops with an area of 89,384.7 ha (8.41%) and grassland-fruits-vegetable occupying 66.562 ha or 6.26% and grassland-vegetable-annual crops with an area 62,136.3 ha (5.85%). Other agricultural economic programs individually occupy an area of less than 4% of land. We believe that the information obtained through this project contribute to the overall development of agriculture in the Federation of Bosnia and Herzegovina, especially in terms of creating a proper and balanced concept as part of sustainable land management and reasonable land use policy.

Keywords: *evaluation of land, land suitability, land use policy, agricultural economic programs*

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INTRODUCTION

Based on the Law of Agricultural Land (Official Gazette of the Federation of B&H, No. 52/09), multi-purpose land evaluation is obliged measure of the land policy of the Federation, cantons and municipalities which affects the functional and rational management of agricultural land as good of general interest.

Land evaluation for a multi-purpose use is process of assessing the quality and value of the land in the planning and land management adapted to agro ecological condition is the fundamental basis for the development and optimal multifunctional and environment-friendly use of land in general.

This paper presents results of the project entitled "Multi-purpose of land use in the Federation of Bosnia and Herzegovina". This project realized a team of experts of the Faculty of Agriculture and Food Technology, University of Mostar in co-operation with the Faculty of Agricultural and Food Sciences, University of Sarajevo in order to implement the regulations purchased by The Federal Ministry of Agriculture, Water and Forestry. Project is finalized in the form of study with maps in the scale 1:200 000 made in modern GIS technology serving as a professional scientific background of suitability of agricultural land for multipurpose use.

MATERIAL AND METHODS

The most update methods in the field of analysis and processing of soil data were used to prepare the project and this paper. The preparatory phase of the project was to collect the relevant information (in writing and cartographic digital form). The data are studied and analyzed, and additional identification, data processing (text and graphics), interpretation of data and preparation of studies and maps were made, following standard criteria of 1: 200 000 in GIS technology.

Basic characteristics of the agricultural soil and land of the Federation of Bosnia and Herzegovina and existing relevant agro-ecological characteristics are prepared based on the existing data and cartographic documents.

Climate features are presented based on data provided by the Federal hydro meteorological institute for the period of 1997th-2012th, from meteorological stations: Bihać, Bugojno, Gradačac, Ivan Sedlo, Jajce, Livno, Mostar, Sanski Most and Sarajevo.

Relief features present in this paper are based on data of altitude and slope angle, obtained by digital terrain model in the Federation of Bosnia and Herzegovina.

Land use was determined based on data from the Environment basis of Environment plan of the Federation of Bosnia and Herzegovina for the period of 2008th-2028th as well as data of the limits of agro-zone within the area of agricultural land (is the scope of the first, second and third agro-zone).

Soil Map of the Federation scales of 1:200 000 is the fundamental basis for the evaluation of a multi-purpose area, both for arable farming and for fruits and wine growing (viticulture), vegetable and grassland.

The map is obtained from the Federal Bureau of Agropedology and is made based on the data of The Basic Soil Map of Bosnia and Herzegovina in the scale of 1:50 000.

For each soil mapping unit are the data in the attribute base as following: number of mapping unit, dominant pedosystematic unit within mapping unit, parent material, participation of rocks on the soil/land surface (%), participation of stones on the soil/land surface (%), soil texture in surface horizon, permeability of soil, infiltration of water in the soil, slope of terrain and soil depth (cm) (FAO, 1976; Bogunović at al., 1988).

Preparing the soil map for the development of this project necessary further additions and corrections were made considering the geological maps, map of terrain slope, map of altitude of terrain and topographical map. Within the agricultural land of Federation of Bosnia and Herzegovina 22 soil types were identified along with a 91 lower pedosystematic units. The basic characteristics of particular types of soil are presented in detail in the existing literature (Resulović at al., 2008).

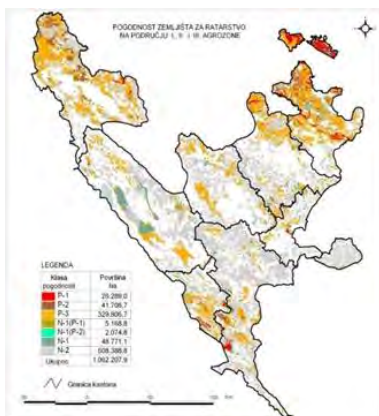
Assessment of suitability of land for multi-purpose agricultural use were made according to the Regulations on the uniform methodology for the classification of agricultural land in the class (P-1, P-2, P-3, N-1, N-2) (Official Gazette of the Federation of B&H, No. 43/11), based on the FAO assessment criteria (FAO, 1976; Brinkman and Smyth, 1973), considering requirements of agriculture crops including characteristics of the soil, the features of the relief, and climate characteristics.

P-1 suitability class include areas without significant limitations or with limitations that will not significantly affect the productivity. P-2 suitability class include areas with limitations that moderately affect the productivity, and P-3 suitability class cover areas with limitations that significantly compromise the productivity. Temporary unsuitable soils of the N-1 suitability class are areas with limitations that can be improved by certain agriculture engineering intervention. Permanently unsuitable soils of the N-2 suitability class cover areas with limitations that rule out any possibility of economically justified production.

Based on the assessment results, a database related to soil maps for specific agro-zone were made, on which the maps of benefits by individual industries are based, with the inventory area.

RESULTS AND DISCUSSION

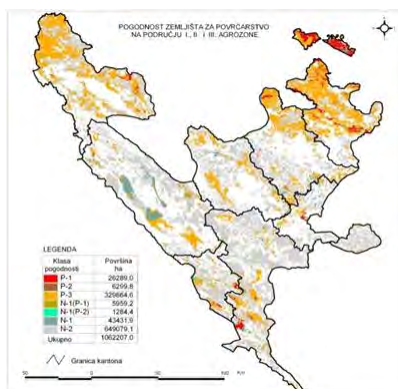
The suitability of agricultural land for arable farming (annual crops) in the Federation of BiH



The largest part of agricultural land in the Federation of Bosnia and Herzegovina is permanently unsuitable (N-2) for arable farming (57.28%), within that is the smallest part of P-1 class of suitability (2.47%). The area of temporarily unsuitable land is of great importance for farming (N-1), that, after the specific agricultural measures can significantly raise the level of suitability for intensive arable farming. The main limiting factors for arable farming are: slope, land rockiness and stoniness and soil depth.

Figure 1. Map of suitability of agricultural land for arable farming in the F BiH

The suitability of agricultural land for vegetable growing in the Federation of Bosnia and Herzegovina



Vegetable growing is the most challenging and demanding branch of the agriculture, because vegetable require the best soils, lowland flat, the optimal relative humidity, soil moisture, the good farmers knowledge and experience in order to have the successful gardening. The main limiting factors for vegetable are slope, soil depth, land rockiness, stoniness, and climate.

The largest part of agricultural land of Federation of Bosnia and Herzegovina is permanently unsuitable (N-2) for gardening (61.12%) within that is the smallest part of P-2 class of suitability (0.59%).

Figure 2. Map of suitability of agricultural land for gardening (vegetable growing) in the F BiH

The land resources of area with soils temporarily unsuitable for vegetable growing (N-1 class) must be considered, which, after conducting the

necessary agro- as well as hydro- technical regulation, can significantly raise the level of suitability for intensive gardening.

The suitability of agricultural land for fruits in the Federation of Bosnia and Herzegovina

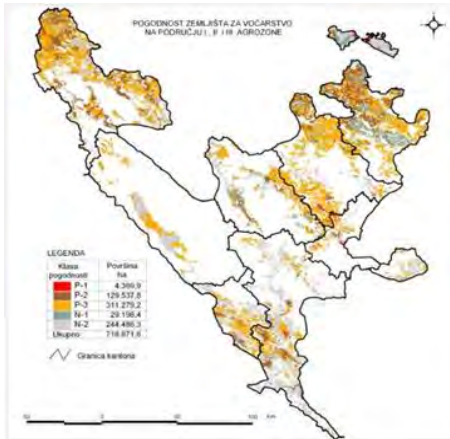


Figure 3. Map of suitability of agricultural land for fruit growing in the F BiH

The largest part of agricultural land in the Federation of Bosnia and Herzegovina (up to 800 m above sea level) is suitable for fruit production (61.93%), and within these areas is the largest part of the area P-3 (limited) class amenities (43.30%) and the lowest part of surface P-1 class amenities (0.61%).

The main limiting factors for fruits are climate, slope, soil depth and land rockiness.

The suitability of agricultural land for viticulture (wine-growing) in the Federation of Bosnia and Herzegovina

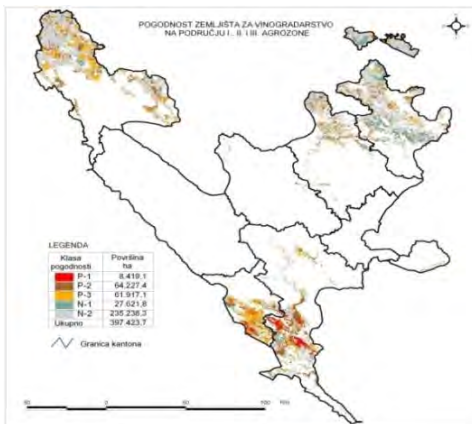


Figure 4. Map of suitability of agricultural land for viticulture in the F BiH

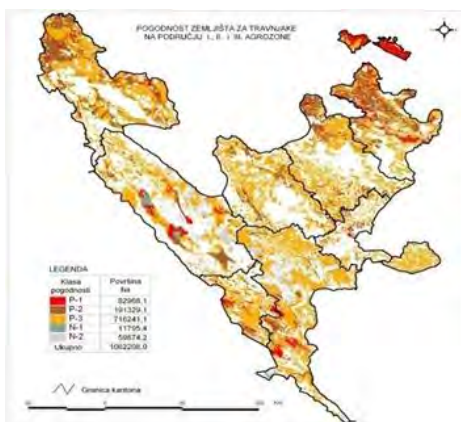
The viticulture - cultivation of vine and wine production in the Federation of Bosnia and Herzegovina is determined by the specific areas where is traditional occupation of farmers like in Neretva and tributaries river basins. Vine can grown in the Mediterranean area in all positions up to an altitude of 500-600 m, and in the continental part at specific southern, eastern and western expositions of 5 to 30%, at an altitude of 150 to 400 m above sea level. The main limiting factors for viticulture are climate, land rockiness, slope and soil depth.

Based on the assessments results of the agricultural land suitability for viticulture in the Federation of Bosnia and Herzegovina the largest part of agricultural land are permanently unsuitable (N-2) for viticulture (59,12%), with the smallest part of P-1 class amenities (2.19%), and the largest part of the area P-2 class amenities (16.16%).

Temporarily unsuitable land area for vineyards (N-1) is an important natural resource in the future, which after conducting the at first soil conservation follows by necessary agro- and hydro- technical measures, can be used in intensive viticulture.

The suitability of agricultural land for grassland production in the Federation of Bosnia and Herzegovina

Term grassland refers to the natural grass stands used as forage – pasture or meadows. Requirements of the grass roots are the smallest one. The main factor for the growth of grass is climate especially sufficient rainfall and temperatures fresher than for crops.



In the Federation of Bosnia and Herzegovina, as it was expected, the largest share of agricultural land is suitable for grassland (93.25%), and among them the largest part is of the area P-3 class amenities (67.43%) and the lowest part is P- 1 class amenities (7.81%) for grassland.

The part of area under temporarily unfavourable class (N-1) is 1.11%, and the remaining area are permanently unsuitable soils for grassland (5.64%).

Figure 5. Map of suitability of agricultural land for grassland in the F BiH

Priority of agricultural economic programs

Based on the results of research was created a database and map of suitability of agricultural land for growing different plants in agriculture vegetable (gardening); arable farming (annual crops); fruits (fruits growing); wine-growing (viticulture) and grassland (pastures and meadows). It was determined the priority of agricultural use as well as dedicated map (1: 200 000), including all three agrozone and all three altitudes in the Federation of Bosnia and Herzegovina. Based on data obtained it was determined of 36 recommended agricultural and economic programs.

The largest of agricultural land in the Federation of Bosnia and Herzegovina of 429,685.4 ha or 40.45% are suitably for agricultural economic programs of grassland. Follows the agricultural economic programs of fruits-grassland with 123,996.4 hectares or 11.67%; then fruits-vegetable-arable farming with an area of 89,384.7 ha (8.41%); programs and grassland-fruits-vegetable is occupying 66,562 ha or 6.26% and

grassland-vegetable-arable farming with an area 62,136.3 ha (5.85%). Other agricultural economic programs individually occupy an area of less than 4%.

Reviewing the areas and distributions of priority economic programs to altitude zone, which inhibits or prevents certain ways of the agricultural economy, the situation is quite different.

In the first altitude zone up to 400 m above the sea level, there is a complete wine-growing economic program. The total area of land under agricultural and economic programs under this altitude zone is 397,423.8 hectares or 37.41% of the agricultural land of the Federation of Bosnia and Herzegovina, and number of priority agricultural economic program was reduced from 36 to 29. It is obvious that within this area the largest part is occupied by agricultural economic program grassland- vegetable- wine-growing (51,503.5 ha or 12.95%), fruits-grassland (40,142.2 ha or 10.10%) and fruits-wine-growing-vegetable (37,643.4 ha or 9.47%).

In the second altitude zone of 400-800 m above the sea level number of priority agricultural economic programs has been reduced from 29 to 17, with a total of slightly smaller area of land designated for agricultural and economic programs, and it is 321,448 ha (30.26%) of total area Federation of Bosnia and Herzegovina. In the framework of this highland zone the largest part is occupied by agricultural economic programs grassland (104,532.3 hectares or 32.52%), fruits- grassland (83,854.2 ha or 26.08%) and fruits-vegetable-arable farming (58,857.3 ha or 18.31%).

Finally, the third altitude zone higher than 800 m above the sea is a zone of grassland and partly arable farming-vegetable. There is eight mapping units only with recommended agricultural and economic programs. The total area of land under these programs is 343,336 ha (32.32%). Agricultural economic programs grassland (288,327 ha or 83.98%) and grassland-vegetable-arable farming (31,813.7 ha or 9.26%) occupy the largest part within this altitude zone.

CONCLUSIONS

In the area of agricultural land of the Federation of Bosnia and Herzegovina there is minimum suitable land (soil suitability class of P-1 to P-3) for viticulture (134,563.6 ha), for vegetable production (362,453.4 ha), followed by arable farming (397,804.4ha) and for fruit production (445,186.9 ha). The largest area of agricultural land is suitable for grassland (990,538.3 ha).

The temporarily unsuitable land (N-1) should be reduced because removing their inherent limiting factors, providing the investments in amelioration of this land are economically viable. It is possible to increase the level of suitability and the fund of suitable land, especially for wine-growing (to 6.95%), then for arable farming (5.27%), vegetable growing (4.77%), fruits (4.06%) and grassland (1.11%).

We believe that the information obtained through this project contribute to the overall development of agriculture in the Federation of Bosnia and Herzegovina, especially in terms of creating a proper and clear concept as part of actual land policy.

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