

Land suitability for the cultivation of corn (*Zea mays*) in the municipality of Bužim

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Abstract

Rational use of available land is of great importance for the economic development of every society, especially considering the fact that soil is the primary production resource, thereby placing an even greater importance on its protection and conservation, but also on the correct use of it. This paper focuses on the municipality of Bužim, located in the north/western part of Bosnia and Herzegovina, where the soil suitability for the purposes of corn cultivation were assessed and examined by using the FAO (1976) methodology of AEZ (agro-ecological zoning), which uses input data such as soil characteristics, climate change, relief patterns of the investigated area, and the requirements of the agricultural crops. Within the municipality of Bužim, 13,026.27 ha of the land is used for agricultural purposes. In regards with the corn, one distinguishes between two categories of soil suitability: the suitable classes (S1, S2, S3), which occupy more than 43.44% of the land surface, and the unsuitable class (the N class), which only occupies 0.94% of the land surface. Thus, it can be concluded that conditions necessary for corn do exist within the municipality of Bužim, in the form of land resources, and higher yields can be achieved by implementing landscaping measures and introducing new corn varieties in accordance with the latest scientific and expert achievements.

Key words: Agroecological zoning, Municipality of Bužim, soil suitability, corn.

Introduction

The Municipality of Bužim is located in the southern part of the northern temperate climate zone and is influenced by continental air currents. Administratively and geographically, it is a part of the Una-Sana Canton, i.e. Federation of Bosnia and Herzegovina, it covers the total area of 13.026,27 ha, which makes it the smallest municipality of the Una-Sana Canton. According to the 2013 Census, the population of the municipality was 20.298. In this municipality there are two repartitions of soil/ land with associated classes and types, namely automorphic/ terrestrial and hydromorphic soils. A total of eight types of soils have been identified, i.e., regosol, calcomelanosol, calcocambisol, terra rossa, eutriccambisol, districcambisol, luvisol, and fluvisol, and six land capability classes including two related land capability subclasses. Currently, the relationship between high-quality land and lower quality categories moved towards fewer quality categories.

The purpose of this research is to assess the suitability of soil in the Municipality of Bužim for cultivating corn, considering all the required data and analyzing them according to the Agro-ecological zoning method, and to develop a soil suitability map. The research resulted in three suitable soil classes S1 (9.41%), S2 (19.95%), S3 (14.96%), and N class of unsuitable soil with 1.43%.

Material and methods

The soil/ land as the subject of suitability assessment encompasses a wide array of different suitability factors required for the assessment of the intended use of space (FAO, 1976 and Vidaček et al., 1981). The applied model of agro-ecological zoning is a methodology used for assessing the suitability of soil for agricultural production. The AEZ system is used in order to determine the specific limitations for crop cultivation in certain climate, soil, and terrain conditions. A detailed description of the AEZ method used in this research can be found in the FAO Guidelines on Agro-ecological Zoning (FAO, 1996). The soil map of the Municipality of Bužim at the scale 1:25000 was used as the basis for the development of this research. The data on the boundaries of agrozones were obtained from The Federal Agropedological Institute, and the data on climate were obtained from the Federal Hydrometeorological Institute. Reconciliation of specific requirements of crops, defined by LUT, with the parameters of soil texture, reaction, contents of organic carbon, and soil depth, renders the degrees of soil suitability for cultivation of certain crops. The interaction of these parameters results in the final form for land utilization planning.

Tab. 1. Levels of suitability of soil/ land per parameters (Biancalani et al., 2004).

Suitability parameters	Classification	Limit values of parameters
Soil depth	S1	100-150 cm
	S2	70-100 cm
	S3	50-70 cm
	S4	30-50 cm
	N	<20 cm
Soil reaction	S1	6.5 - 7
	S2	5.5 – 6.5 7 – 7.2
	S3	5 – 5.5 7.2 – 7.5
	S4	7.5 – 7.9
	N	<5 >7.9
Soil texture	S1	I, PrI, PGI, PI, PrGI
	S2	PrG, GI
	S3	PG, PI
	S4	Pr, P
	N	G
Organic carbon	S1	20 - 50 g/kg
	S2	50 - 60 g/kg
	S3	10 - 20 g/kg
	S4	60 - 100 g/kg
	N	<10 g/kg >100 g/kg

Tab. 2. Soil/ land suitability classes (Biancalani et al., 2004).

Classification	Suitability class	% suitability
S1	Highly suitable	> 80
S2	Suitable	60-80
S3	Moderately suitable	40-60
S4	Limitedly suitable	20-40
N	Unsuitable	< 20

The Levels of Suitability of Specific Soil Parameters for Successful Cultivation of Corn (*Zea mays*).

Tab. 3. Degree of suitability of specific parameters for corn (Biancalani et al., 2004).

Parameters	S1	S2	S3	N
pH	6.5-7.2	5.5-6.5 7.2-7.5	4.5-5.5 7.5-8.0	<4.5; >8.0
Depth in cm	>100	50-100	20-50	<20
Texture	I, PrI, PGI, PI, PrGI	PrG, GI,	Pr, PG, PI	G
Total C	>20	20 – 10	<10	-

Results and discussion

The climate of the research area

Since there is no weather station in the municipality of Bužim and thus no official measuring data, the climate characteristics for the municipality of Bužim were described using the data of the nearest meteorological station in Bihac, situated at 246 m altitude. The presented data were based on the observation periods of 1961-1990 and 1999-2009, respectively. According to Šarić et. al. (2010), the length of vegetation period for the area of the Una-Sana Canton is 264 days for cryophile plants (+5°C), and 204 days for thermophile plants (+10°C).

Tab. 4. Mean monthly and annual air temperatures for the area of Bihac in 1961-1990 and 1999-2009 in °C (Federal Hydrometeorological Institute, 1961-1990; 1999-2009).

Period	Months												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1961-1990	0.3	2.3	6.1	10.7	15.1	18.3	20.1	19.3	15.9	11.3	6.3	1.7	10.6
1999-2009	1.4	3.1	7.3	11.5	16.7	20.0	21.5	20.9	15.6	12.4	7.5	2.9	11.7

Observing the data of mean monthly temperatures, it is evident that the values of mean temperatures were higher in the observation period for 1999-2009 in all months except September, when a minor drop of 0.3 °C in mean monthly air temperature was observed. As a result of rise in the sum of monthly temperatures, the mean annual temperature also rose. In the first period from 1961-1990, the mean annual air temperature was 10.6 °C, while in the second period from 1999-2009 the mean annual air temperature was 11.7 °C, which means that it increased by 1.1 °C. According to some estimates, warming in the moderate longitudes and latitudes of the northern hemisphere will increase, exceeding the global average, and ranging between 0.8 and 1.0 °C, for every 10 years (Komljenović et al., 2014. Zurovec et al., 2015).

Tab. 5. Mean monthly and annual precipitation for the area of Bihać in 1961-1990 and 1999-2009 in mm (Federal Hydrometeorological Institute, 1961-1990; 1999-2009).

Period	Months												Year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1961-1990	86	91	99	115	116	109	106	109	108	110	146	114	1.309
1999-2009	103	96	106	120	112	83	87	97	139	116	132	149	1.342

More than one third of annual precipitation falls in the autumn. What is characteristic for the period from 1961 to 1990 is that in the summer period the atmospheric fallout was higher than in the winter. The comparison of the total annual precipitation for the 1961-1990 period, which was 1,309 mm, with the precipitation for the 1999-2009 period, which was 1,342 mm, shows that the precipitation increased by 33 mm. Generally speaking, this increase can be seen as a good sign for agricultural production, however the rainfall distribution was not favourable, since the precipitation was lowest in the summer when water demands were the highest.

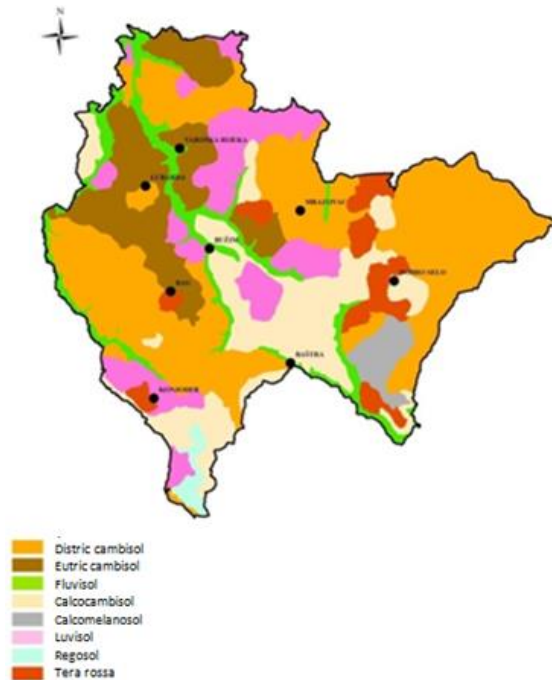


Fig. 1. Soil map of the Municipality of Bužim (Federal Institute for Agropedology, 2015).

Soil types

There are two soil orders in the Municipality of Bužim: automorphic/terrestrial and hydromorphic soils. Situated out of reach of flooding or underground

waters and characterized by water percolation through solum, automorphic soils are the dominant ones (Ičanović, 2016). Due to denser net, the quality of data presented and the comprehensiveness of the research probes and profiles, eight soil types were observed in the research area and the soil map was developed at the scale of 1:25 000.

Tab. 6. Soil types in the Municipality of Bužim.

Soil Type	Area (ha)	Percentage (%)
Regosol	128.01	0.99
Kalkomelanosol	331.60	2.54
Calcocambisol	2,272.20	17.45
Eutric cambisol	1,867.45	14.33
Distric cambisol	5,266.51	40.42
Rossa	709.16	5.44
Luvisol	1,550.98	11.91
Fluvisol	900.31	6.92
Total	13,026.27	100.00

Corn (*Zea mays*)

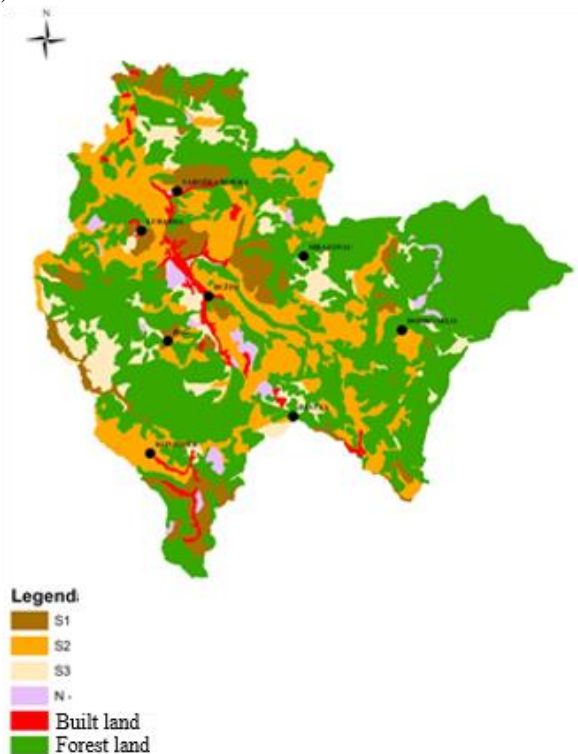


Fig. 2. Representation of the soil suitability for the purpose of corn within the municipality of Bužim (Federal Institute for Agropedology, 2015).

The total soil suitability for corn cultivation in the municipality of Bužim includes four suitability classes, namely the S1, S2, S3, and N class. The S1 class is present in the areas of local communities such as Konjodor, Zaradostovo, Jusufovići, Abdići, and the peripheral parts of the municipality towards Velika Kladuša. It is important to say that the suitability class S1 does not cover all of these areas, but it extends mainly to the flat terraces of these areas, which have slightly deeper soil. This suitability class on the territory of the municipality of Bužim occupies a total area of 375.64 ha or 2.89%.

The S2 class of soil suitability for corn cultivation in the municipality of Bužim continues from the S1 class and it occupies the central part of the municipality of Bužim, or the belt from the entrance to the municipality from the direction of Bosanska Otoka to the exit to Velika Kladuša. It also covers the wider area of Mrazovac, Mrazovo, Prokop, Bućevac, and Jusufović. It occupies 12% of the total area of the Municipality.

The S3 class is related to somewhat shallower lands prone to erosion, mostly acidic reactions, and these places are as follows: Elkasova Rijeka, Hrgar, Pala Gora, Karaula, and Sip. They occupy the largest area of the Municipality with 29.88%. The land unsuitable for growing corn (the N class) is located on the shallowest soil in Gornji and Donji Brigovi, the area from the cemetery in Kupusnici towards Nanića Dolina. It occupies 0.94% of the area of the Municipality.

Conclusion

Within the Municipality of Bužim there are eight soil types: regosol, calcic melanosol, calcic cambisol, eutriccambisol, districcambisol, red soil, luvisol, and fluvisol. In terms of the overall soil suitability, three soil classes were observed for corn cultivation, i.e., the S1, S2, S3, and N class, unfavourable soil. The soil for corn cultivation in the research area is divided into three classes of benefits, namely the S1, S2, and S3 class, and N class of unsuitable land for corn cultivation. The largest area is occupied by the S2 class with 24.69% of the Municipality. The areas with S1 and S2 classes are fairly even. The S1 class occupies an area of 9.96%, while the S3 class occupies 8.79% of the Municipality. The class N unsuitable land occupies only 2.26% of the Municipality area.

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Погодност земљишта општине Бужим за узгој кукуруза (*Zea mays*)

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Сажетак

Рационално кориштење расположивог земљишта од велике је важности за развој привреде сваког друштва, посебно ако се узме у обзир чињеница да је тло основни ресурс за сваку производњу, што даје још већи значај заштити и очувању, али и правилном кориштењу истог. У овом раду истраживано је подручје општине Бужим, која се налази на сјеверозападу Босне и Херцеговине, у којој смо помоћу ФАО методологије АЕЗ (агро-еколошко зонирање), (ФАО, 1976), извршили процјену погодности земљишта за узгој кукуруза. Наведена методологија као улазне податке користи карактеристике тла, климе и рељефа истраживаног подручја, те захтјеве пољопривредних култура. Укупна површинама пољопривредног земљишта општине Бужим износи 13.026,27 ха. У односу на укупна погодност земљишта за узгој кукуруза на подручју Општине издвојене су четири класе погодности: С1, С2, С3 и Н класа непогодног земљишта, од чега преко 43,44% површине земљишта се односи на прве три класе погодности, док Н класа непогодног заузима свега 0,94% површине. На основу изложеног може се закључити да на подручју општине Бужим постоје услови, у виду земљишних ресурса, за производњу кукуруза, уз провођење мјера уређења тла и увођење новог сортимената у складу с најновијим знанственим и стручним достигнућима, могу се постићи већи приноси.

Кључне ријечи: Агро-еколошко зонирање, општина Бужим, погодност земљишта, кукуруз.

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Received: Mart 02, 2022
Accepted: November 25, 2022