

ARTICLES

CONTEMPORARY CHANGES IN CROPPING PATTERN OF CENTRAL BOSNIA CANTON

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ABSTRACT

Contemporary changes in cropping pattern of Central Bosnia Canton

In the last few decades, concepts such as concentration of crops, diversification of crops and crop combinations have attracted the attention of many agricultural geographers in the world, but not in Bosnia and Herzegovina. Therefore, this paper, on the example of the Central Bosnia Canton, analyzes in detail the above concepts of cropping pattern in the period 2004-2014. Cropping pattern was rated in order to better understand the proportion of different crops within the study area. Results of the paper will certainly help in understanding the unevenness of the spatial distribution of crops and the importance of certain crops in making appropriate strategies and defining the production of certain crops in the Central Bosnia Canton.

KEY WORDS

crop concentration, crop diversification, crop combination, agricultural geography

1. Introduction

Bosnia and Herzegovina is still a bigger consumer than a producer of food, which certainly affects negatively the adjustment of the food balance, particularly in regard to overall opportunities of Bosnia and Herzegovina in exports, so the orientation towards necessity of agricultural development in all settlements is even more understandable. Development of agribusiness in Bosnia and Herzegovina in period from 1995 to 2008 was ongoing under more favourable conditions than it was earlier. Basic conditions for considerably faster development of the agricultural production were created (Nurković, 2010).

The Central Bosnia Canton is located in the central part of Bosnia and Herzegovina, in the geographical coordinates of 43 ° 48 '30 " and 44 ° 26' 47" north latitude, and between 17° 10' 46" and 18° 12' 5" east longitude, which determine its astronomical and geographical position. Total area of Canton is 3,189 km² (6,2% of the Bosnia and Herzegovina). The geological composition is very complex and it is determined by belonging to the area of middle and outer parts of the Mesozoic carbonate platforms or Mesozoic limestone and dolomite with schistose mountains of Central Bosnia in the center, which belongs to the Paleozoic. Geomorphologically, this space belongs to the western Mediterranean zone of the Eurasian young chained highlands within which is the part of the Bosnian Dinarides. In terms of hypsometry, the Central Bosnia Canton is a hilly and mountainous area. The most important mountains are Vranica (2,112 m) in the area of the municipality of Gornji Vakuf and Fojnica in the south which represents the mountain system, and Vlašić (1,933 m) in the area of Travnik in the north, Komar (1,510 m) in the area of Donji Vakuf and Travnik in the middle part, and Kalin (1,531 m) in the area of Bugojno also in the middle part of the Canton. The largest valleys are the Uskopaljska valley in the west in the area of the municipalities of Bugojno, Donji Vakuf and Gornji Vakuf, and the Lašva valley in the area of Travnik, Vitez and Busovača in the east (World Atlas, 1998).

The Central Bosnia Canton is located in the southern part of the northern temperate climate zone but the most dominant is Cfb climate while in the higher elevations there is D climate. The average annual temperature in the basin areas, where intensive agricultural production takes place, varies from 8.8°C in Bugojno in the west to 9.8°C in Jajce in the northwest. Precipitation is evenly distributed over the year from 820 mm in Bugojno in the west to 1,500 mm in Fojnica in the southeast. (Meteorological Yearbook, 1961-1990). Hydrographic network is relatively well developed. The most important rivers are the Vrbas in the west, the Lašva in the east and the Fojnička River in the southeast of the Canton.

In the valley areas there are fertile alluvial soil suitable for intensive agricultural production which therefore have a great economic importance. The most widespread land in the Central Bosnia Canton are distric cambisols, rendzina and calcocambisol. Arable land covers 14.2% of the area of the Central Bosnia Canton (Spatial plan of Central Bosnia Canton, 2005).

In biogeographical terms, the Canton belongs to the Eurosiberian-Boreoamerican region, the Illyrian province, with the dominant biome of beech and beech-fir forests. Mountains Vranica and Vlašić are part of the Alpine-High Nordic region. About 61% of the Canton area is under forests (Spatial plan of Central Bosnia Canton, 2005). The Central Bosnia Canton is located within the entities of Federation of Bosnia and Herzegovina, which is part of the state of Bosnia and Herzegovina. The Central Bosnia Canton is administratively divided into 12 municipalities: Bugojno, Busovača, Dobretići, Donji Vakuf, Fojnica, Gornji Vakuf-Uskoplje, Jajce, Kiseljak, Kreševo, Novi Travnik, Travnik and Vitez. In the canton there are 252,573 inhabitants while the average population density is 79 inhabitants per km². Natural growth is negative and amounts to -0.45 per thousand. The largest urban centers are Bugojno (17,202 inhabitants) and Travnik (16,534 inhabitants). Geographical position is advantageous because important roads pass through it towards Banja Luka in the north, Mostar in the south, Split in the west and Sarajevo in the east. Only 40,750 inhabitants are employed, of which 3.3% in agricultural sector. Most of the population works in the tertiary sector 58.8% (Central Bosnia Canton in numbers, 2014).

Cropping pattern is the proportion of area under various crops at a point of as it changes over space and time. The concentration of crops, diversification of crops and crop combinations are three basic elements of agricultural geography as they help in the understanding of the spatial distribution of crops in a very detailed way, and understanding them can be very useful in planning the use of agricultural land. The concentration of crops is related to the spatial density of single crop or it can be said that it is a variation in the density of any crop in the area in a given time period. Delineation of areas of crop concentration helps determine areas where certain crops grow well even with the minimum of inputs and therefore have great importance for agricultural development and planning (Husain, 1996).

Diversification of crops refers to the cultivation of various crops in a given spatial unit such as a state, canton, municipality or farm. Crop diversification means the raising a variety of crops. The cultivation of crop depends on physical and socio-economic variables. The crops are the result of contemporary competition. Crops are diversified in the field due to erratic nature of rainfall and insufficient irrigation.

The greater number of crops lead to greater competition, the higher is the magnitude of diversification (Singh and Dhillon, 2004). Crop concentration and diversification do not only provide the idea of a region dominated by particular crop but also play a role of guide to strengthen agricultural economy and land use planning (Basu Roy and Barman, 2014).

The study of combinations of crops helps to understand spatial distribution and concentration of crops in a particular area as well as in the creation of the plan for inclusive production in agriculture. The concept of combination of crops is based on a survey of existing regional links between crops in association with other crops and on a survey on crops domination. In the last decade, this concept has received a lot of attention among geographers and agrarian planners. For proper execution of agricultural planning programmes, agricultural regionalization at micro level is indispensable. In this endeavour, identification and characterisation of crop combination plays a pivotal role. Agricultural development is a multidimensional concept which includes a variety of aspects such classification of land use, crop concentration and diversification, crop productivity, commercial attributes of agriculture, intensity of cropping, maintenance of ecological balance and so on. The study of crop combination is vital to understand cropping pattern and level of diversification (Hashmi and Gomatee, 2012).

The study of crop combination of any region has gained importance in geographical study. It gives us the relative position of crops on regional scale. Farmers grow crops in varied physical and cultural condition. The pattern of crop combination gives spatial predominance of certain crops or combination resulting the emergence of crop regions. Such analysis would ultimately minimize the chances of oversimplified generalization (Ali, 1978). Crop combination study in geography is fruitful in many ways, firstly it provides an adequate understanding of an individual crop. Secondly, combination is in itself an integrative reality and finally crop combination regions are essential for the construction of more complex structure of vivid agricultural regions (Weaver, 1954).

The crops are generally grown in combinations and it is rarely that a particular crop occupies a position of total isolation to other crops in a given area at a given time. The physical factors determine the shape of the areas of crops, while the socio-economic factors determine their extent. The government policies many often directly or indirectly influence decision to select the crops to grow. The development of better irrigation facilities, new varieties of crops could be introduced in the place of traditional and unprofitable agricultural system (Vyalij, 2009).

2. Literature review

First attempt for delineation of agricultural areas was made by Weaver in 1954. He studied crop combination for Middle west in United States. Later on, many more methods were introduced. Thomas in 1963 modified Weaver's formula by including all crops with zero percent theoretical values in each step of the method in the crop combination studies carried out in Wales but it did not yield different results than obtained by Weaver's method. Coppock (1964) also modified version of Weaver's method wherein he considered the rank in recognizing the leading crops. The Weaver's technique was subsequently modified by Doi in 1959 where he supplied one sheet of table required only the summing up of actual percentages under different crops instead of finding differences between actual percentage and theoretical distribution. Looking at this weakness, Rafiullah (1965) modified Weaver's method and introduced a new method known as "Maximum Positive Deviation Method" by applying same statistical procedure with altogether different format.

Many geographers and economists have applied diversification concept in different sense. Initially, diversification concept was applied in manufacturing field to obtain the degree of diversification by Florence and Baldamus (1948). Gibbs has applied diversification concept for computing measurement of diversification of employment in industry. Bhatia (1965) has computed crop diversification in India. The formula, later on, has been modified by Jasbir Singh (1976) and Ayyar (1969). According to Bhatia crop diversification means the land occupying for variety of crops, which occupy at least one percent to gross cropped area. The study of crop diversification is essential to understand the competition of crops in any region.

Many studies have been undertaken by geographers related to agricultural land use and cropping pattern. Chatterjee (1952) accomplished land utilization survey of Howrah district, West Bengal. Singh (1967) discussed various aspects of land use and cropping pattern and their ranking and analysed pattern of crop concentration in Uttar Pradesh. Das (1981) discussed salient feature of the land use pattern in Assam. Tripathi (1999) studied in detail various aspects of agricultural development and planning in Faizabad district. Rayamane and Nyo (2003) presented a spatio-temporal analysis of crop combination in Sedawgyi region of Myanmar.

Singh, Singh and Dwivedi (2010) have analyzed the different land use pattern, cropping pattern, intensity and coverage under vegetable crops in different farm size groups in eastern Uttar Pradesh. Barakade, Tonape and Lokhande (2011) analyzed the agricultural land use pattern at micro level in Satara district, Maharashtra. Hashmi and Gomatee (2012) worked out the chief characteristics of agricultural land use pattern in Bulandshahr district of upper

Ganga Yamuna doab, India. In order to calculate composite index Tiwari and Sharma (2012) have worked out an average of percentage of area under crops and percentage of production of crops. Gekić (2013) studied in detail influence of geographic factors and crop concentration in Bugojno Municipality, Bosnia and Herzegovina. To examine the crop combination pattern at taluka level in Karnataka, India, S.S. Motebennur (2014) used Rafiullah method. Also Ogale (2014) studied crop combination of Baramati tahsil in Pune District, India using Rafiullah method.

3. Methodology

The main objective of this paper is to rate the combination of crops, concentration of crops and crop diversification in the municipalities of Central Bosnia Canton. Municipalities have been considered as basic units for in depth study to highlight crop concentration, crop diversification and crop combination. The study was mainly based on secondary data and partially field research. Data on sown area were taken from the Institute for Statistics of Federation of Bosnia and Herzegovina and municipal services in charge of agriculture. ArcGIS 10.1 software was used to create thematic maps. In this paper, geographic analysis is performed for the periods 2004 and 2014.

In analysis of the crops concentration of the Central Bosnia Canton, there was used the method of location quotient that can clearly demonstrate and explore the regional character of the distribution of crops. To determine the concentration of crops, there was used the following modified method of location quotient (Bhatia, 1965; Singh and Dhilon, 2004; Saikia, 2012):

$$LQ = \frac{\frac{\text{Sown area of crops "a" in the municipality}}{\text{Sown area of all crops in the municipality}} \times 100}{\frac{\text{Sown area of crops in the Canton}}{\text{Sown area of all crops in the Canton}} \times 100}$$

It should be noted that the determination of concentration of crops in a particular area helps to determine areas where certain crops are grown well and with a minimum investment, and therefore has great importance for the development of agriculture and rural planning. The value of location quotient is determined by the crops concentration index. The analysis and measurement of the concentration of crops are made for 14 different crops of the Central Bosnia Canton in 2004 and 2014, with the help of location quotient method. These crops were selected because they take individually 1% or more of the sown area of the Central Bosnia Canton. After ascertaining the index values for the crops in the municipalities, they are arranged in an ascending or descending

order. The index scale is calculated by dividing the array into equal parts to distinguish the very high (above 2.00), high (1.51-2.00), medium (1.01-1.50), low (0.51-1.00) and very low concentration (0.00-0.50) (Singh and Dhillon, 2004).

For the detailed analysis of diversification of crops, there was used a modified method of diversification of crops by Jasbir Singh in which were considered the crops that have a share in the total sowing area in excess of 1% instead of greater than 5% as stated in Singh's method (Singh and Dhillon, 2004). This method of determining the spatial distribution of diversification of crops will best help in the analysis at the micro level. The method of calculating the index of diversification is as follows:

$$\text{Diversification index} = \frac{\text{Percent of total harvested area under the "n" crops}}{\text{Number of "n" crops}}$$

where "n" crops are occupying individually 1% or more of the total sown area.

When considering the importance of diversification of crops, many geographers have developed methods for measuring them. If the number of crops that are grown in one space was large, about 10, and each crop occupied about 10% of the total sown area, it would mean that diversification of crops is very high level. In contrast, if the crop takes up 100% of the total sown area, there is no diversification and it is not a case of high specialization of crops. The main value of the diversification of crops is that it detects a connection between relative spatial power of crops which are grown in a particular region.

The study of crop combination thus forms an integral part of agricultural geography and such study is greatly helpful for regional agricultural planning. A number of quantitative and qualitative methods have been used for computing of crop combination regions. In quantitative method, crops are arranged or ranked in hierarchical order and then crop combinations are determined. The ease of this method is the simplicity in calculation (Husain, 1996). In the analysis of combination of crops, there was used the method of maximum positive deviation developed by Rafiullah (1956) in his paper "A New Approach to the Functional Classification of Towns", and later applied by numerous agricultural geographers in their scientific works. The method of maximum positive deviation can be expressed as follows:

$$d = \sqrt{\frac{\sum Dp^2 - Dn^2}{N^2}}$$

where d is a deviation, D_p is the positive difference and D_n is the negative difference of the arithmetic mean of theoretical curves of combination value, and N is the number of functions (crops) in combination.

The method introduced by Rafiullah is more precise, more objective and more exact than others and therefore it is widespread to determine areas of combinations of crops. This method has also shown good results in highly diversified areas. According to this method, the shares held by individual crops of the total sowing area are sorted from the largest to the smallest. Crops that have a share of less than 1.0% of the total sowing area were excluded from the computations, and then it was continued with the calculation of maximum positive deviations of the variance. The arithmetic mean for monoculture was 50, for the combinations of two crops 25, for the combination of three crops 16.7, for the combination of four crops 12.5, and so on. After calculating the variance with the highest value of maximum positive deviation, there was determined the number of crops combined.

The most important indices of concentration of crops, crop diversification indices and areas of combinations of crop have been mapped in order to better present the characteristics of the spatial distribution of concentration, diversification and crop combinations.

4. Concentration of crops

There has been studied the link in general between density of individual crops and the corresponding density of the geographical area of the Central Bosnia Canton. The concentration of crops in a given area greatly depends on the characteristics of relief, air temperature, humidity and pedogeographical characteristics. Within a wider geographical area there is a tendency that some crops have a high concentration in certain parts where the geographical conditions are favorable, and the concentration decreases with deterioration of geographical conditions. If the index value is greater than unity, the component areal unit accounts for a share larger than it would have had if the distribution were uniform in the entire region, and, therefore, the component areal unit has a concentration of the agricultural distribution under study (Bhatia, 1965).

In 2004 in the Central Bosnia Canton, the total sowing area amounted to 17,234.3 hectares, and in 2014 it decreased by 4.5% to 16,442.9 hectares. In 2004, the largest share of the total sown area were 20.34% potatoes, 17.93% clover, 11.78% lucerne, 10.78% wheat and 8.84% grass-clover mixture. In 2014 the largest share of the total sown area were 18.98% potatoes, 11.08% clover, 10.73% grass-clover mixture, 10.71% wheat and 10.06% lucerne. (Plant production in Federation of Bosnia and Herzegovina, 2004-2014; Authors field research, 2014).

Table 1: Index of Crop Concentration in Central Bosnia Canton, 2004

Municipalities	Index of concentration (values of location quotient)													
	W	R	B	O	M	P	Bn	On	C	Cl	L	Fm	Fb	Gc
Bugojno	0,5	1,2	1,4	0,7	0,3	0,7	0,7	1,2	1,7	1,6	1,7	1,2	0,8	0,1
Busovača	1,3	0,8	0,4	3,7	3,9	0,9	2,2	0,4	0,3	0,5	0,1	0,5	0,8	0,6
Dobretići	0,3	8,9	0,6	11,6	0,5	1,2	0,6	1,2	0,5	0,2	0,0	2,2	0,0	0,4
Donji Vakuf	0,8	0,4	0,4	0,4	0,9	2,2	2,1	2,0	0,4	0,7	0,4	1,9	0,3	0,3
Fojnica	1,0	2,0	0,5	1,0	0,8	2,2	1,8	1,7	0,4	0,4	0,3	0,1	2,3	0,4
Gornji Vakuf	0,5	0,3	0,7	0,3	0,1	0,9	0,0	0,1	1,1	1,4	1,4	0,1	0,1	2,7
Jajce	0,2	0,0	0,7	0,2	1,2	1,8	3,7	1,6	1,1	0,6	0,3	0,1	2,0	0,9
Kiseljak	1,3	2,9	0,4	0,2	2,2	0,8	1,0	2,3	2,0	0,5	0,2	2,2	2,9	1,0
Kreševo	0,1	0,3	1,6	0,2	0,3	0,8	1,2	1,5	1,8	1,7	1,3	0,5	6,4	0,2
Novi Travnik	4,3	2,9	1,6	2,5	0,2	0,4	0,3	0,3	0,2	0,6	0,6	0,1	0,5	0,0
Travnik	2,4	0,6	1,3	0,4	0,6	0,8	0,7	1,7	1,1	0,6	0,9	4,3	0,0	0,3
Vitez	1,0	0,9	1,7	2,5	2,3	0,6	1,0	0,4	0,1	0,7	1,3	0,7	0,0	1,0
Total	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0

Table 2: Index of Crop Concentration in Central Bosnia Canton, 2014

Municipalities	Index of concentration (values of location quotient)													
	W	R	B	O	M	P	Bn	On	C	Cl	L	Fm	Fb	Gc
Bugojno	0,7	1,5	1,2	0,9	0,2	0,7	0,5	0,8	1,7	1,5	2,2	1,2	1,2	0,6
Busovača	1,2	0,8	0,4	1,9	3,7	1,0	2,5	0,6	0,4	0,7	0,0	0,2	0,8	0,4
Dobretići	2,6	0,0	0,2	0,4	0,7	2,3	1,1	2,1	0,2	0,1	0,0	1,5	0,0	0,0
Donji Vakuf	1,1	1,4	1,0	0,8	0,8	0,4	2,2	1,4	2,0	0,5	0,4	3,8	1,8	0,4
Fojnica	0,9	1,3	0,5	0,6	0,4	2,3	1,4	2,9	0,1	0,7	0,4	0,4	1,0	0,5
Gornji Vakuf	0,6	0,3	0,7	0,3	0,0	1,1	0,1	0,3	1,1	1,7	1,5	0,4	0,1	2,3
Jajce	0,2	0,0	0,6	0,4	2,6	1,8	4,1	1,7	1,5	0,3	0,3	0,5	1,2	0,1
Kiseljak	0,8	3,9	0,6	1,0	1,0	0,8	1,2	3,0	1,4	0,5	0,5	1,2	3,8	0,9
Kreševo	0,4	0,8	0,6	0,7	0,2	1,4	1,4	1,8	1,9	1,8	0,7	0,3	6,1	0,2
Novi Travnik	1,7	3,1	2,0	1,5	0,5	0,9	0,4	0,4	0,2	0,9	0,8	1,3	0,1	0,4
Travnik	2,4	0,4	2,2	0,7	0,7	0,8	0,7	1,0	1,2	0,5	0,5	1,8	0,3	0,4
Vitez	1,5	0,3	1,3	2,6	2,3	0,3	0,2	0,3	0,1	0,4	1,0	1,8	0,0	1,5
Total	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0

Legend: W- wheat, R - rye, B - barley, O- oats, M - maize, P - potato, Bn - Beans, On - Onions, C - Cabbage, Cl - clover, L - lucerne, Fm - Fodder maize, Fb - Fodder beet, Gc - Grass-clover mixtures

Source: Calculated by authors according Plant Production in Federation of Bosnia and Herzegovina, 2004-2014 and authors field research, 2015

Wheat

The concentration of wheat in 2004 was very high in Novi Travnik (4.26) and Travnik (2.41), moderate in Kiseljak (1.32), Busovača (1.30) and Fojnica (1.02), low in Vitez (0.97), Donji Vakuf (0.82) and Gornji Vakuf (0.52) and very low in Bugojno (0.46), Dobretići (0.34), Jajce (0.23) and Kreševo (0.10) (Table 1). In 2014 significant changes have occurred in the concentration of wheat so that the municipalities with very high concentration were Dobretići (2.55) and Travnik (2.41), with high Novi Travnik (1.70) and Vitez (1.53), with moderate Busovača (1.19) and Donji Vakuf (1.11), with low Fojnica

(0.94), Kiseljak (0.84), Bugojno (0.66) and Gornji Vakuf (0.60), with a very low Kreševo (0.41) and Jajce (0.19) (Table 2).

Rye

There was a very high concentration of rye in 2004 in the municipalities of Dobretići (8.92), Novi Travnik (2.89) and Kiseljak (2.86), high in Fojnica (1.99), moderate in Bugojno (1.19), low in Vitez (0.87), Busovača (0.76) and Travnik (0.59), and very low in Donji Vakuf (0.40), Gornji Vakuf (0.29), Kreševo (0.28) and Jajce (0.02). In 2014, a very high concentration of rye was in Kiseljak (3.88) and Novi Travnik (3.08), high in Bugojno (1.52), moderate in Donji Vakuf (1.35) and Fojnica (1.30), low in Kreševo (0.84) and Busovača (0.79), and very low in Travnik (0.37), Gornji Vakuf (0.32), Vitez (0.29), Jajce (0.01) and Dobretići (0.00).

Barley

In 2004, there were no municipalities with a very high concentration of barley. A high concentration of barley was in Vitez (1.70), Novi Travnik (1.65) and Kreševo (1.58), moderate in Bugojno (1.43) and Travnik (1.32), low in Gornji Vakuf (0.70), Jajce (0.69) and Dobretići (0.62) and very low in Fojnica (0.48), Busovača (0.42), Kiseljak (0.40) and Donji Vakuf (0.36). In 2014, a very high concentration of barley could have been found in the two municipalities of Travnik (2.22) and Novi Travnik (2.01), moderate concentration in Vitez (1.26), Bugojno (1.16) and Donji Vakuf (1.03), low in Gornji Vakuf (0.73), Jajce (0.62), Kreševo (0.62) and Kiseljak (0.59), and very low in Fojnica (0.49), Busovača (0.36) and Dobretići (0.17).

Oats

Very high concentrations of oats in 2004 was in Dobretići (11.63), Busovača (3.67), Novi Travnik (2.52) and Vitez (2.47). Moderate concentration of oats was in Fojnica (1.05), and low in Bugojno (0.69). The largest number of municipalities had a low concentration of oats, these were Donji Vakuf (0.43), Travnik (0.42), Gornji Vakuf (0.31), Jajce (0.25), Kiseljak (0.19) and Kreševo (0.17). In 2014 the situation in the concentration of oats changed in that the concentration of oats increased in the municipalities with the lowest value in 2004. A very high concentration of oats in 2014 had only Vitez (2.62), while a high concentration was in Busovača (1.93) and Novi Travnik (1.53). Moderate concentrations of oats was in Kiseljak (1.01), low in Bugojno (0.92), Donji Vakuf (0.78), Kreševo (0.73), Travnik (0.69) and Fojnica (0.62) and very low in Jajce (0.40), Dobretići (0.39) and Gornji Vakuf (0.29).

Maize

The concentration of maize in 2004 in the Central Bosnia Canton was very high in Busovača (3.95), Vitez (2.28) and Kiseljak (2.17), moderate in Jajce (1.19), low in Donji Vakuf (0.91), Fojnica (0.80), Travnik (0.57) and Dobretići (0.53), and very low in Bugojno (0.31), Kreševo (0.27), Novi Travnik (0.16) and Gornji Vakuf (0.07). In 2014 the concentration of maize slightly changed. Very high concentrations of maize had Busovača (3.67), Jajce (2.57) and Vitez (2.33), moderate Kiseljak (1.01), low Donji Vakuf (0.84), Dobretići (0.68) and Travnik (0.66), while the very low concentration of maize was in Novi Travnik (0.49), Fojnica (0.41), Bugojno (0.23), Kreševo (0.21) and Gornji Vakuf (0.03).

Potatoes

In 2004, a very high concentration of potatoes was in Fojnica (2.23) and Donji Vakuf (2.19), high in Jajce (1.81), moderate in Dobretići (1.16), very low in Novi Travnik (0.43), and low in other municipalities among which stood out Busovača (0.91) and Gornji Vakuf (0.86) (Figure 1). In 2014 there were significant changes in the concentration of potatoes in the Central Bosnia Canton. Municipalities with very high concentrations of potatoes were Dobretići (2.26) and Fojnica (2.25), with higher Jajce (1.82), moderate Kreševo (1.42), Gornji Vakuf (1.06) and Busovača (1.04), with low Novi Travnik (0.90), Kiseljak (0.79), Travnik (0.76) and Bugojno (0.66). The municipalities of Donji Vakuf (0.37) and Vitez (0.32) had a low concentration of potatoes (Figure 2).

Beans

A very high concentration of beans in 2004 was in Jajce (3.70), Busovača (2.19) and Donji Vakuf (2.12), high in Fojnica (1.78), moderate in Kreševo (1.25) and Kiseljak (1.04), and low in Vitez (0.97), Travnik (0.70), Bugojno (0.68) and Dobretići (0.59), a very low concentration in Novi Travnik (0.26) and Gornji Vakuf (0.03). In 2014, a very high concentration of beans was still in Jajce (4.12), Busovača (2.48) and Donji Vakuf (2.20), moderate concentration in Fojnica (1.39), Kreševo (1.37), Kiseljak (1.18) and Dobretići (1.11). A low concentrations of beans was in Travnik (0.73) and Bugojno (0.51), and a very low concentration in Novi Travnik (0.43), Vitez (0.24) and Gornji Vakuf (0.07).

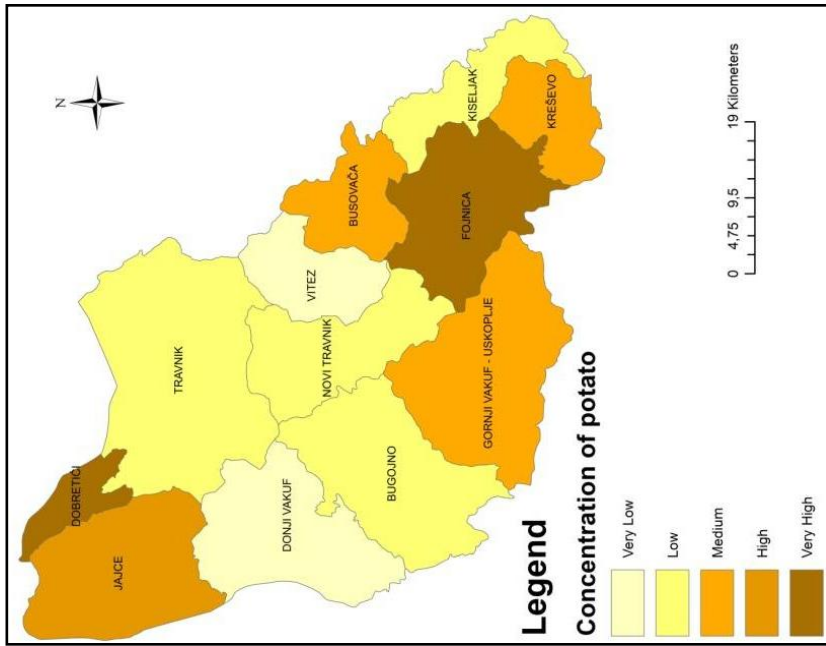


Figure 2: Concentration of potatoes, 2014

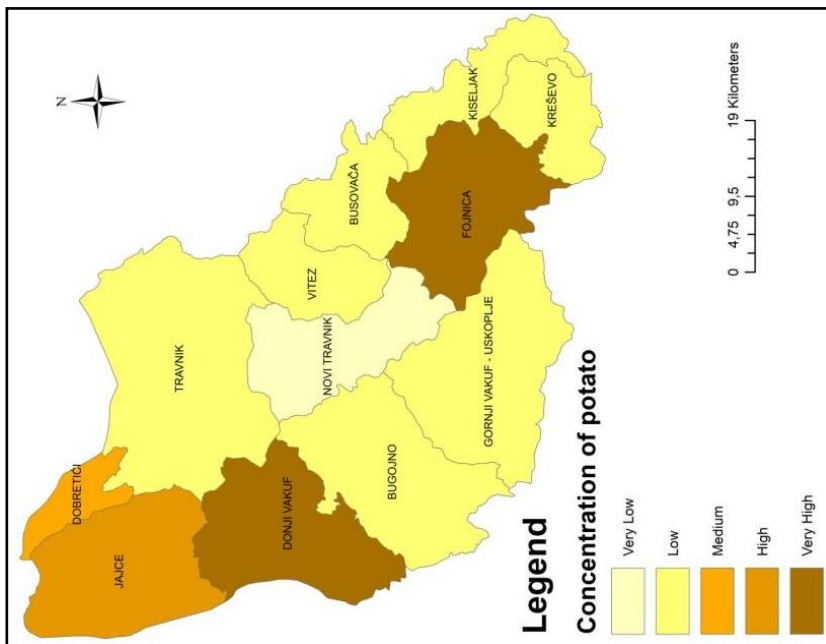


Figure 1: Concentration of potatoes, 2004

Onions

In 2004, a very high concentration of onions was in Kiseljak (2.28), high concentration in Donji Vakuf (1.99), Travnik (1.74), Fojnica (1.71) and Jajce (1.57), moderate concentration in Kreševo (1.49) , Bugojno (1.25) and Dobretići (1.16), a very low concentration in Vitez (0.38), Busovača (0.36), Novi Travnik (0.34) and Gornji Vakuf (0.08). In 2014 three municipalities of Kiseljak (2.95), Fojnica (2.85) and Dobretići (2.11) had a very high concentration of onion. A high concentration of onion was in Kreševo (1.78) and Jajce (1.67), moderate in Donji Vakuf (1.37) and Travnik (1.01), low in Bugojno (0.77) and Busovača (0.60), and a very low concentration of onion was in Novi Travnik (0.39), Vitez (0.30) and Gornji Vakuf (0.26).

Cabbage

A high concentration of cabbage in the Central Bosnia Canton in 2004 was in Kiseljak (1.97), Kreševo (1.81) and Bugojno (1.68). Moderate concentrations of cabbage were in Jajce (1.13), Travnik (1.08) and Gornji Vakuf (1.06). Very low concentrations were in Dobretići (0.50), Donji Vakuf (0.45), Fojnica (0.39), Busovača (0.26), Novi Travnik (0.22) and Vitez (0.15). In 2014, as in 2004, not a single municipality had a very high concentration of cabbage. A high concentration was in Donji Vakuf (1.98), Kreševo (1.86) and Bugojno (1.67). Moderate concentrations were in Jajce (1.46), Kiseljak (1.42), Travnik (1.17) and Gornji Vakuf (1.09). Very low concentrations were in Busovača (0.35), Dobretići (0.22), Novi Travnik (0.16), Vitez (0.13) and Fojnica (0.12).

Clover

Not one municipality in 2004 had a very high concentration of clover. A high concentration was in Kreševo (1.70) and Bugojno (1.61) and moderate in Gornji Vakuf (1.42). A low concentration was in Donji Vakuf (0.68), Vitez (0.67), Novi Travnik (0.64), Jajce (0.63), Travnik (0.61), Busovača (0.54) and Kiseljak (0.52). A very low concentration was in Fojnica (0.41) and Dobretići (0.20). In 2014 there was no municipality with a very high concentration of clover. A high concentration was in the municipalities of Kreševo (1.84) and Gornji Vakuf (1.68). Moderate concentrations were in Bugojno (1.46), while low concentrations were in Novi Travnik (0.93), Fojnica (0.71), Busavača (0.68), Kiseljak (0.54) and Donji Vakuf (0.52). Very low concentrations were found in Travnik (0.50), Vitez (0.41), Jajce (0.26) and Dobretići (0.11).

Lucerne

In 2004, a very high concentration of lucerne was not found in any municipality. A high concentration was only in the municipality of Bugojno (1.74). Moderate concentrations were in Gornji Vakuf (1.37), Vitez (1.31) and Kreševo (1.27), and low in Travnik (0.86) and Novi Travnik (0.57). Very low concentrations were in Donji Vakuf (0.38), Jajce (0.29), Fojnica (0.28), Kiseljak (0.24), Busovača (0.07) and Dobretići (0.00). In 2014, the

municipality of Bugojno (2.21) had a very high concentration of lucerne. Not one municipality had high concentrations. Moderate concentrations were in Gornji Vakuf (1.47), low in Vitez (0.95), Novi Travnik (0.75), and Kreševo (0.72). A very low concentration had Kiseljak (0.50), Travnik (0.48), Fojnica (0.38), Donji Vakuf (0.35), Jajce (0.26), Busovača (0.04) and Dobretići (0.00).

Fodder maize

A very high concentration of fodder maize in 2004 was found in Travnik (4.35), Dobretići (2.25) and Kiseljak (2.21). High concentrations were in Donji Vakuf (1.94) and moderate in Bugojno (1.21). Low concentrations were in Vitez (0.72), Busovača (0.53) and Kreševo (0.48). Very low concentrations were found in Novi Travnik (0.08), Gornji Vakuf (0.08), Jajce (0.07) and Fojnica (0.06). In 2014, only the municipality of Donji Vakuf (3.80) had a very high concentration of fodder maize. A high concentration was in Travnik (1.83) and Vitez (1.77). Moderate concentrations were in Dobretići (1.48), Novi Travnik (1.30), Kiseljak (1.24) and Bugojno (1.19). A low concentration was in Jajce (0.53), a very low concentration was in Gornji Vakuf (0.43), Fojnica (0.40), Kreševo (0.28) and Busovača (0.20).

Fodder beet

A very high concentration of fodder beet was found in 2004 in the Kreševo (6.37), Kiseljak (2.92), Fojnica (2.34) and Jajce (2.01). There were no municipalities with high and moderate concentrations. Low concentrations were found in Busovača (0.85), Bugojno (0.80) and Novi Travnik (0.55). A very low concentration was in Donji Vakuf (0.33), Gornji Vakuf (0.15), Travnik (0.01), Vitez (12:01) and Dobretići (0.00). In 2014, there were significant changes. Very high concentrations of fodder beet had municipalities of Kreševo (11.6) and Kiseljak (3.84). A high concentration was in Donji Vakuf (1.78) and moderate in Bugojno (1.20), Jajce (1.15) and Fojnica (1.03). A low concentration was in Busovača (0.82), and very low in Travnik (0.26), Gornji Vakuf (0.12), Novi Travnik (0.09), Vitez (0.00) and Dobretići (0.00).

Grass-clover mixtures

A very high concentration of grass-clover mixture in 2004 was found in Gornji Vakuf (2.68). Moderate concentrations were found in Kiseljak (1.05) and Vitez (1.05). Low concentrations were found in Jajce (0.89) and Busovača (0.57), and a very low concentration was in Dobretići (0.41), Fojnica (0.38), Travnik (0.35), Donji Vakuf (0.30), Kreševo (0.21), Bugojno (0.11) and Novi Travnik (0.05). Since 2014 there have been a very high concentration in Gornji Vakuf (2.30), while the moderate concentration was in Vitez (1.50). A low concentration was in Kiseljak (0.93) and Bugojno (0.55). Very low concentrations of grass-clover mixture was in Fojnica (0.47), Donji Vakuf (0.43), Travnik (0.42), Novi Travnik (0.42), Busovača (0.38), Kreševo (0.20), Jajce (0.09) and Dobretići (0.00).

5. Diversification of crops

The study of crop diversification as a measure of the intensity of crops in a particular area is considered one of the key steps in determining the character of distribution of crops in order to highlight the importance of one crop over another in the most obvious way. Diversification of crops is a concept that is contrary to the specialization of crops. For a better understanding of the cropping pattern, interpretation of their diversification is essential. Diversification of crops is now almost normal characteristic of a stable agriculture in most countries of the world. Farmers in developing countries are trying to cultivate a variety of crops on their farms in one year. The level of diversification to a large extent depends on the climatic characteristics of an area, socio-economic conditions in which farmers live and technological development of an area. Diversification of crops has become possible with modern techniques of irrigation, use of fertilizers, use of seeds with high returns and the development of mechanization. In addition to this, important factors affecting crop diversification are variations in weather affecting the farmers to grow different crops on their farms in order to get a return when weather is bad, rural lifestyle and traditional practices of subsistence agriculture that urge them to spend the most of their time on their farms in order to better face the demands of the internal market, some farmers cultivate different crops in order to earn as much as possible (Singh and Dhillon, 2004; Raju, 2012).

Table 3: Crops diversification in Central Bosnia Canton, 2004-2014.

Municipalities	2004		2014	
	Index of diversification	Degree of diversification	Index of diversification	Degree of diversification
1. Bugojno	7,99	High	6,97	High
2. Busovača	6,89	High	6,50	High
3. Dobretići	6,88	High	9,65	High
4. Donji Vakuf	8,66	High	5,48	High
5. Fojnica	7,52	High	7,41	High
6. Gornji Vakuf	13,77	Medium	11,96	Medium
7. Jajce	7,97	High	6,96	High
8. Kiseljak	7,51	High	6,91	High
9. Kreševo	8,70	High	6,51	High
10. Novi Travnik	11,88	Medium	8,76	High
11. Travnik	7,98	High	7,44	High
12. Vitez	8,78	High	8,03	High
Canton	6,98	High	6,94	High

Source: Calculated by authors according Plant Production in Federation of Bosnia and Herzegovina, 2004-2014 and authors field research, 2015

Analysis of crop diversification at the municipal level in the Central Bosnia Canton reveals that farmers of all municipalities grow several crops on their farms during the year. Basically, it is assumed that if the number of crops that are grown in a given geographical unit is large, for example about 10, and that each crop occupies about 10% of the total sown area, this means that diversification of crops is characterized by a very high degree. Conversely, if one crop takes up 100% of the total sown area, there is no diversification because that is the case the high degree of specialization.

The total value of the index of diversification of crops in the Central Bosnia Canton in 2004 was 6.98 so the degree of diversification of crops was designated as high (Table 3). According to the indices of diversification of crops for 2004 which are shown in the table, in the Central Bosnia Canton are only present two categories of areas of diversification of crops that are marked as "high" and "moderate" category or as areas with high and moderate degrees of diversification. Only two municipalities of Gornji Vakuf (13.77) and Novi Travnik (11.88) showed a moderate degree of diversification of crops (Figure 3).

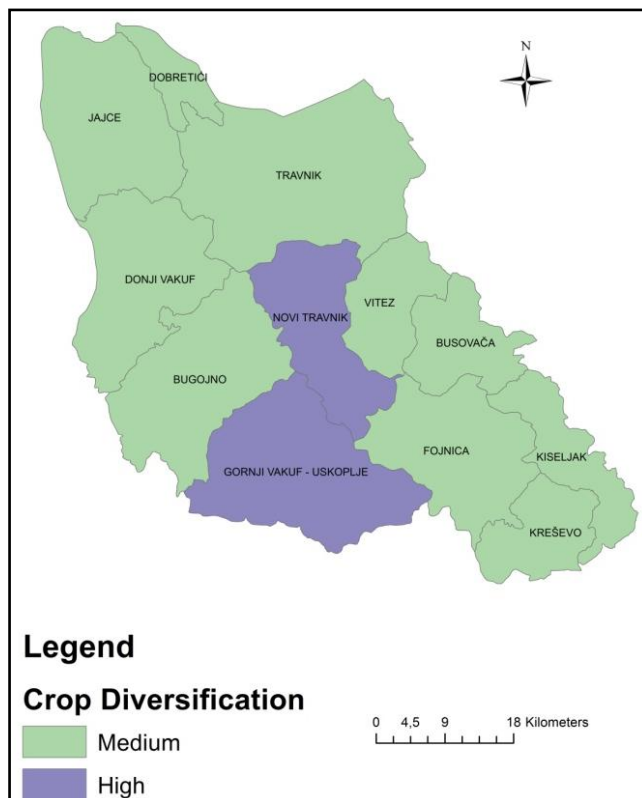


Figure 3: Crop diversification in Central Bosnia Canton, 2004

The other ten municipalities were characterized by a high degree of diversification of crops in Vitez (8.78), Kreševo (8.70), Donji Vakuf (8.66), Bugojno (7.99), Travnik (7.98), Jajce (7.97), Fojnica (7.52), Kiseljak (7.51), Busovača (6.89) and Dobretići (6.88). Generally, the Central Bosnia Canton in 2004 was characterized by a high degree of diversification of crops with the crop diversification index value of 6.98.

After 10 years, in 2014, there was a decline in the value of crop diversification index in the Central Bosnia Canton. Only the municipality of Gornji Vakuf (11.96) was characterized by moderate degree of crop diversification. All other municipalities were characterized by a high degree of crop diversification including: Dobretići (9.65), Novi Travnik (8.76), Vitez (8.03), Travnik (7.44), Fojnica (7.41), Bugojno (6.97), Jajce (6.96), Kiseljak (6.91), Kreševo (6.51), Busovača (6.50) and Donji Vakuf (5.48). The Central Bosnia Canton as a whole was characterized by high degree of crop diversification with the value of crop diversification index of 6.94 (Figure 4).

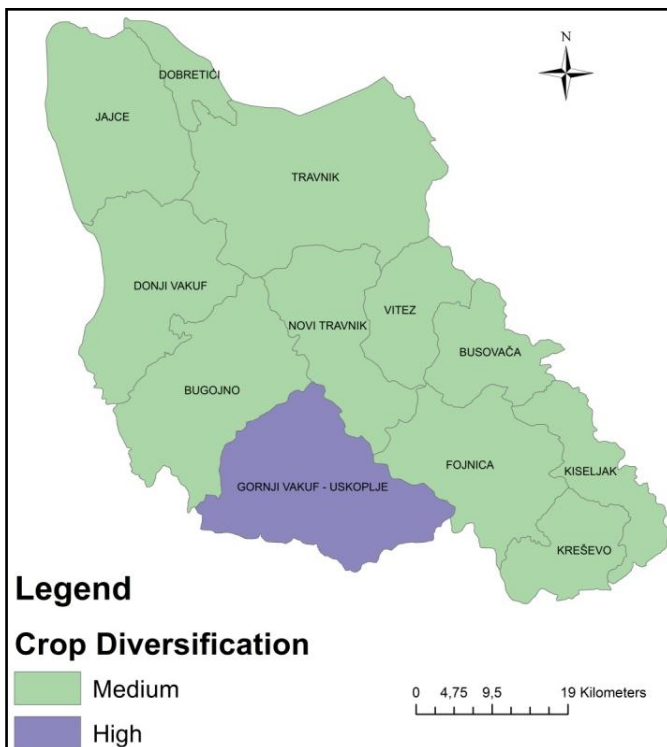


Figure 4: Crop diversification in Central Bosnia Canton, 2004

6. Combinations of crops

The study of crop combination is an important aspect of agricultural geography, as it provides a good basis for agrarian planning. Crops are generally grown in combinations and it is very rare that a particular crop has isolated position in relation to other crops in a particular area. In 2004, in the municipalities of the Central Bosnia Canton, there were present four categories of areas of crop combinations. In six municipalities was a combination of three crops (III): Dobretići (potatoes, oats, rye), Donji Vakuf (potatoes, lucerne, wheat), Fojnica (potatoes, wheat, clover), Jajce (potatoes, beans, clover), Kreševo (clover, potatoes, lucerne) and Novi Travnik (wheat, lucerne, barley) (Table 4).

Table 4: Crop Combination in Central Bosnia Canton, 2004

Municipalities	Number of crops in combination	Crops	Net sown area in hectares	Net sown area in % from Canton
1. Dobretići	III	P/O/R	4,356.9	25.28
2. Donji Vakuf	III	P/Cl/W		
3. Fojnica	III	P/W/C		
4. Jajce	III	P/Bn/Cl		
5. Kreševo	III	Cl/P/L		
6. Novi Travnik	III	W/C/B		
7. Bugojno	IV	Cl/L/P/B	9,313.2	54.04
8. Busovača	IV	M/P/W/Cl		
9. Gornji Vakuf	IV	Cl/Gc/P/L		
10. Travnik	IV	W/P/Cl/L		
11. Vitez	V	M/L/P/Cl/W		
12. Kiseljak	VI	P/M/W/Cl/Gc/C	1,401	8.13
Canton	V	P/Cl/L/W/Gc	17,234.3	100.00

Legend: W- wheat, R - rye, B - barley, O- oats, M - maize, P - potato, Bn - Beans, On - Onions, C - Cabbage, Cl - clover, L - lucerne, Fm - Fodder maize, Fb - Fodder beet, Gc - Grass-clover mixtures

Source: Calculated by authors

In five out of six municipalities with the III crop combination, potatoes were one of the leading crops. The total sown area amounted to 4,356.9 hectares which was 25.28% of total treated area of the Central Bosnia Canton. In the III crop combination, potatoes occupied 32.8% of the total sown area, and clover as the most common crop of second rank 13.4% of total sown area. In combined crops of the area there is mostly wheat with 13.29% of sown area.

Combinations of four crops (IV) had Bugojno (clover, lucerne, potatoes, barley), Busovača (maize, potatoes, wheat, clover), Gornji Vakuf (clover, grass-clover mixtures, potatoes, lucerne) and Travnik (wheat, potatoes, clover, lucerne). The area with a combination of four crops occupies 9,313.2 hectares or 54.04% of the total sown area of the Central Bosnia Canton. The most common crop combined is clover with 22.75% of the total sown area, while in the second place is lucerne with 11.80 of the total sown area (Figure 5).

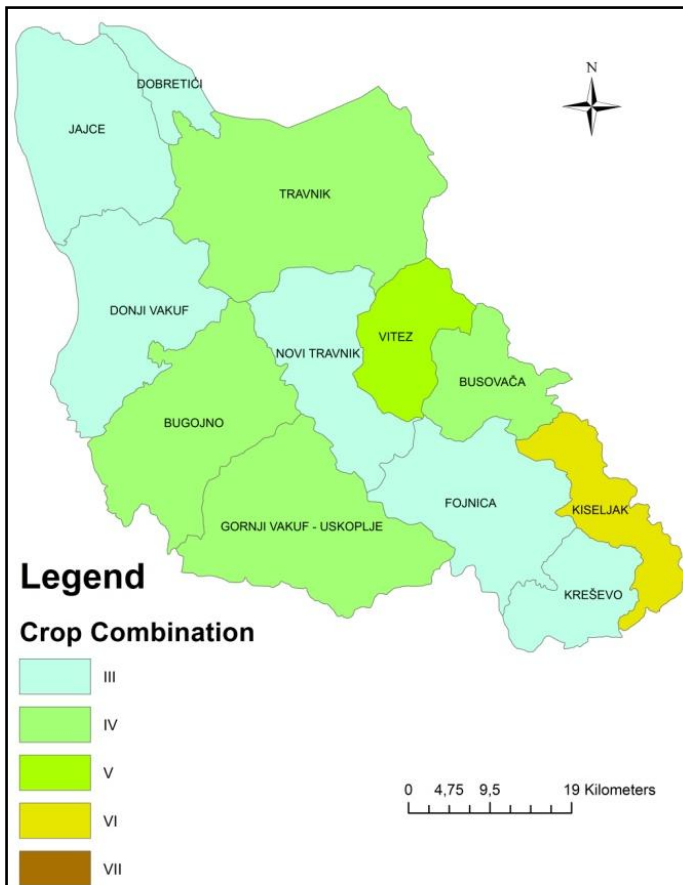


Figure 5: Crop Combination in Central Bosnia Canton, 2004

Combinations of five crops (V) was only in the municipality of Vitez, and there were combined maize, lucerne, potatoes, clover and wheat. This area covers 2,163.2 hectares of sown area which is 12.55% of the total sown area of the Central Bosnia Canton. Maize as a crop of the first rank is in the combination at 15.72%, and lucerne crop as the second rank crop at 15.49% of the total sown area. Combination of six crops (VI) was in the municipality of Kiseljak.

The combined crops were potatoes, maize, wheat, clover, grass-clover mixtures and cabbage. The area covers 1,401 hectare of the sown area or 8.13% of the total sown area of the Central Bosnia Canton. Potato is the crop of the first rank with 17.13% of sown area and maize as a crop of the second rank covers 15.00% of the sown area.

In 2014, it was continued with the diversification of crops that can be seen from the number of crops combined. Instead of the previous six, now only three municipalities have a combination of three crops, as follows: Dobretići (potatoes, wheat, fodder maize), Fojnica (potatoes, wheat, clover) and Jajce (potatoes, maize, beans).

The area of combination of three crops covers 2,475.9 hectares of the sown area that makes 15,06% of the total sown area of the Central Bosnia Canton. The crop of the first rank in the combination are potatoes which makes 38.53% of the total sown area, and wheat as the most common crop of the second rank makes 6.14% (Table 5). Combination of four crops (IV) have Busovača (maize, potatoes, wheat, beans), Gornji Vakuf (grass-clover mixtures, potatoes, clover, lucerne), Vitez (wheat, maize, lucerne, fodder maize) and Travnik (wheat, barley, potatoes, fodder maize) and they together make 51.27% of the total sown area of the Central Bosnia Canton or 8,430 hectares (Figure 6).

Table 5: Crop Combination in Central Bosnia Canton, 2014

Municipalities	Number of crops in combination	Crops	Net sown area in hectares	Net sown area in % from Canton
1. Dobretići	III	P, W, Fm	2,475.9	15.06
2. Fojnica	III	P, W, Cl		
3. Jajce	III	P, M, Bn		
4. Busovača	IV	M, P, W, Bn	8,430	51.27
5. Gornji Vakuf	IV	Gc, P, Cl, L		
6. Travnik	IV	W, B, P, Fm		
7. Vitez	IV	W, M, L, Fm		
8. Bugojno	V	L, Cl, P, B, W	4,110	25.00
9. Kreševo	V	P, Cl, Fb, L, C		
10. Novi Travnik	V	W, P, B, Cl, R		
11. Donji Vakuf	VI	Fm, W, Bn, B, P, C	430	2.61
12. Kiseljak	VII	P, R, Gc, W, M, Fm, Cl	997	6.06
Canton	V	P, Cl, Gc, W, L	16,442.9	100.00

Legend: W- wheat, R - rye, B - barley, O- oats, M - maize, P - potato, Bn - Beans, On - Onions, C - Cabbage, Cl - clover, L - lucerne, Fm - Fodder maize, Fb - Fodder beet, Gc - Grass-clover mixtures

Source: Calculated by authors

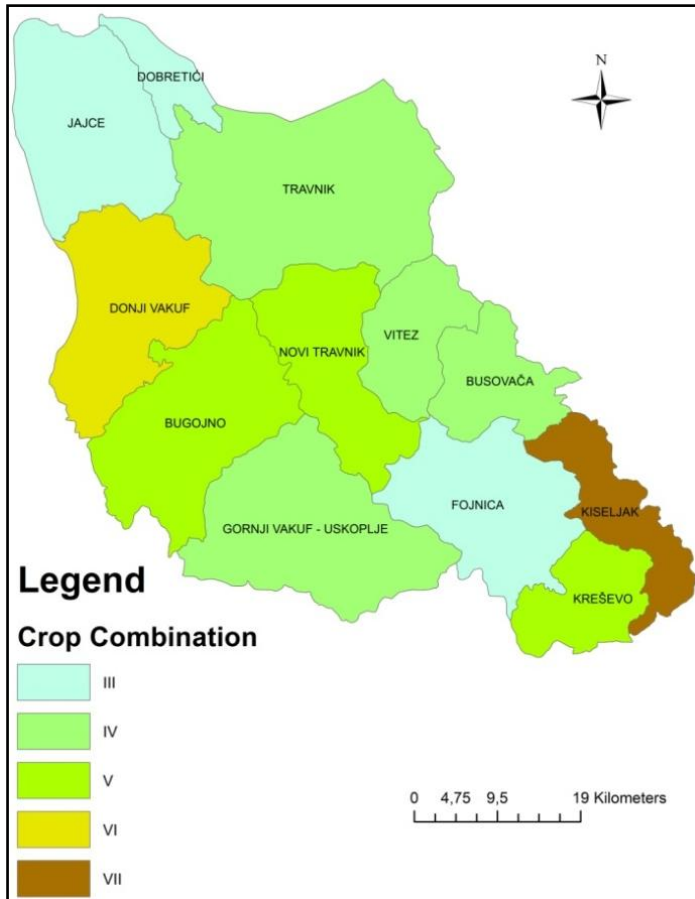


Figure 6: Crop Combination in Central Bosnia Canton, 2014

In this area potatoes are the most common in combinations in three out of four municipalities with 15.79% of the total sown area in the region while wheat makes 13.01% of the total sown area. The municipalities of Bugojno (lucerne, clover, potatoes, barley, wheat), Kreševo (potatoes, clover, fodder beet, lucerne, cabbage) and Novi Travnik (wheat, potatoes, barley, clover, rye) are characterized by a combination of five crops (V) and make 25.00% of the total sown area of the Central Bosnia Canton or 4,110 hectares. The most common crops in combinations are potatoes and clover. Potatoes make 15.96% of the total sown area, and clover 15.57% of the total sown area.

The municipality of Donji Vakuf (fodder maize, wheat, beans, barley, potatoes, cabbage) has a combination of six crops (VI) which makes 2.60% of the total sown area of the Central Bosnia Canton or 430 hectares. Fodder maize is the crop of the first rank with 20.00% of the total sown area, while wheat as crop

of the second rank has a share of 11.9% of the total sown area. Most crops combined are in the municipality of Kiseljak, a total of seven (VII), these are potatoes, rye, grass-clover mixtures, wheat, mize, fodder maize and clover. This area makes 6.06% of the total sown area of the Central Bosnia Canton or 997 hectares. Potatoes as crop of the first rank make 15.00% of the total sown area, while rye and grass-clover mixtures make 10.00% of the total sowing area in the areas with a combination of seven crops.

7. Discussion and Conclusion

The method for measuring the concentration of crops listed in this paper is a very useful tool in analyzing the distribution of crops in the municipalities of Central Bosnia Canton and has wider application in improving the characteristics of the distribution of crops. The method used to measure the concentration of crops has shown that very small municipalities, such as the municipality of Dobretići (59 km²), can quickly modify the spatial distribution of crops and thus directly affect the image of the degree of concentration of crops at the regional level, which means that the method used is not the most appropriate for very small areas. Applied methods of diversification and combination of crops in this study proved to be a very good for understanding the complexity of the distribution of crops.

Within the Central Bosnia Canton, there is a high concentration of individual crops in areas of the most favorable geographical conditions while concentration decreases as geographical conditions become less favorable. The biggest changes in the concentration of crops are on the area of the municipality Dobretići which is the smallest municipality according to total area and is located at the highest altitude (1,100-1,200 m on average). The most stable level of concentration of crops is in the municipality of Gornji Vakuf-Uskoplje and Jajce which is a characteristic of areas with significant specialization of crops.

Crop concentration analysis showed that the biggest change in the index of concentration were recorded in only a few municipalities: Dobretići (wheat, rye, oats, onion, fodder maize), Vitez (wheat, fodder maize), Donji Vakuf (rye, barley, potato, cabbage, fodder beet), Kreševo (barley), Fojnica (oats, fodder beet), Kiseljak (oats, maize, fodder maize), Jajce (maize, fodder beet), Novi Travnik (fodder maize), Bugojno (fodder beet). Other municipalities recorded significantly smaller changes in a way that they either increased or decreased the crop concentration index for only one degree.

The important factors that influenced the change in the degree of concentration of crop are higher education of farmers and greater investment in the development of animal husbandry, primarily through an increase in sown area

under fodder maize as one of the main crops for feeding livestock. Ultimately, farmers' transition to growing other crops for their own needs, either for livestock or own nutrition, especially after the economic crisis in 2008, has significantly contributed to changes in the level of crop concentration.

Analysis of the diversification of crops showed the presence of a slight decrease in the value of the index of diversification, while the degree of diversification remained much the same. The only exception is the municipality of Novi Travnik where the value of diversification index fell as much as 3.12, while the degree of concentration transferred from a medium to high level. Areas with a high degree of crop diversification in the Central Bosnia Canton are characterized by hilly - mountainous dissected relief, soil erosion, low level of irrigation of treated areas and poorer quality land as a whole. All of this with a less developed agricultural infrastructure, lesser use of modern agricultural practices and difficulties in finding a market for their products is forcing farmers to grow a greater number of crops, mostly for their own use. The only municipality which was characterized in 2014 by a moderate degree of crop diversification is Gornji Vakuf-Uskoplje where farmers prefer growing those crops that best suit hilly - mountainous relief, temperate climate, and foster development of animal husbandry such as clover, lucerne, grass-clover mixtures and potatoes.

The main factors that influenced the decrease in the value of the index of diversification in the municipalities of Central Bosnia Canton are irregular and insufficient financial incentives for agriculture by the authorities, weaker commercialization of agricultural production, and increased production for their own needs. Production of bread grains in particular is carried out mainly based on tradition, with a small proportion of the use of modern agricultural practices and with low competitiveness, relatively modest domestic support, so that farmers have increasingly been abandoning this production and are turning to the cultivation of vegetables. One important factor is the large number of elderly households in rural areas that produce for their own needs that together with the intensification of the process of depopulation affects the increasing concentration of vegetable crops and reduces the concentration of cereal crops. Production in areas above 800 meters above sea level where the natural conditions are generally difficult, is mainly extensive and abandoning such areas by farmers are constantly present regardless of their age.

Some of the factors that have significantly contributed to changes in the deployment of crops were: unfavorable economic situation at all levels, a very fragmented property with low intensity, difficult conditions in production, agriculture is often a supplementary occupation that slows down the modernization and market orientation, a slight increase in farmers' knowledge through various seminars, inadequate credit policy, lack of agricultural

extension services in the production practice, scientific studies are not sufficiently aligned with the developmental needs of agriculture, low level of application of mechanization, disorganization and lack of horizontal and vertical linking of production and processing.

The areas which have a high degree of diversification are generally the areas of high moisture conditions and/or erratic rainfall. In such areas agriculture is largely subsistent in character. The areas of high crop diversification of crops deserve special attention of planners for development of agriculture. The main advantage of a maps showing the level of diversification lies in the fact that they help in the future planning and development of agriculture. A comprehensive plan for each of the areas of high diversification may go a long way in enhancing their agricultural productivity and in reducing the regional inequalities in agricultural development. There is increasing awareness among experts of agriculture that crop diversification with suitable crop rotations is necessary for the maintenance of soil health and for making agriculture more productive and sustainable (Hussain, 1996).

Analysis of the crop combinations in municipalities of Central Bosnia Canton showed an increase in the number of crops in combination, which is the result of factors which also influenced the increase of diversification of the crops. A total of six municipalities have increased the number of crops combined, while six did not change. Analysis of the concentration of crops and crop combinations showed that there is no dominance of only one crop and that most municipalities are characterized by combinations of more crops. Potatoes are the crop that found themselves in the first place in combinations in most municipalities. Besides potatoes, the most common crops combined are clover, lucerne and wheat. More frequent crop combinations clearly show a trend of spatial crop distribution complexity in the Central Bosnia Canton.

There is not possible to find single crop occupying 100 percent of net sown area. Therefore, Rafiullah method for explaining changes in crop combination is realistic at its basic level where 50 percent of net sown might be occupied with one crop while remaining 50 percent might have been shared by other crops.

The increase in diversification of crops and the number of crops combined is also a result of a higher level of irrigation, use of fertilizers, seeds that give high yields and a slightly greater use of mechanization. In order to make as much profit from selling their products as possible on the local markets, farmers grow more crops on their farms. In all municipalities of the Canton, the diversification index is reduced.

In the period 2004-2014, there was continued with the fragmentation of holdings in the municipalities of Central Bosnia Canton as a result of inheritance. This adversely affected crop concentration because fertile land where individual crops were grown, especially crops for feeding cattle at higher altitudes, remained untreated because the new owners of previously elderly households did not continue with the agricultural production. The share of private sector ownership of arable land increased from 97.0% to 97.8%. The transition from state to private ownership was seen in the area with very favorable natural conditions in the valley areas of lower altitudes and soils of good production capabilities. In such areas it is generally begun to cultivate fodder maize, wheat and maize, which resulted in an increase in the concentration of these crops in certain municipalities (Bugojno, for example). Thus, there was a slightly increased diversification of crops and the number of crops combined.

Increasing marketability of agricultural production affected all three investigated phenomena. Along with this, the diversification of crops and the number of crops in combination were increased. The present differences in the investigated phenomena between the municipalities of Central Bosnia Canton are the result of complex effects of various natural and social factors where one factor may increase and the other reduce the value of the index of concentration, diversification or number of crops in combination. Of natural factors, relief affected the present variations most.

Relief has its greatest impact through the effect of altitude and slope that is also connected with air temperature and precipitation. Municipalities that have a significant proportion of the area above 800 m above sea level and with a pronounced slope angle of the total area are characterized by a higher concentration of fodder crops (lucerne, clover, etc.) and vegetables (potatoes, beans, etc.), and much lower concentration of grain (wheat, barley, rye, etc.) and vice versa (eg the municipality of Gornji Vakuf-Uskoplje on one side and the municipality of Kiseljak on the other side). Besides, these municipalities are characterized by lower index of diversification of crops, as well as a smaller number of crops combined dominated by previously mentioned crops, and vice versa.

The smaller index value of crop diversification in municipalities dominated by mountainous relief is the result of extensive and traditional ways of growing crops for the development of animal husbandry, and for nutrition needs of the population the main crops in combination are potatoes. The exception is the municipality of Dobretići which has the smallest total and sown area (59 km² and about 26 ha) and where minimal changes affect concentration, diversification and crop combination.

In the municipalities of the western part of the Canton, such as Bugojno, Jajce, Gornji Vakuf-Uskoplje and Donji Vakuf, land is more favorable for agricultural production in terms of their production value. In this part of the Canton there are more valley areas at altitudes up to 700 m, especially in Uskopaljska valley that includes the central parts of Bugojno and the northern parts of the municipality of Gornji Vakuf-Uskoplje and southern parts of the municipality of Donji Vakuf. In the northeast, in the municipality of Travnik 670 ha, in the east, in the municipality of Busovača 580 ha, and in the southeast, in the municipality of Kiseljak 1,300 ha are the areas of I-III quality classes of land. On the other hand, the most favorable areas for agricultural production of I-III category in the west in the municipality of Bugojno amount to 3,200 ha, or in the municipality of Gornji Vakuf-Uskoplje in the south about 3,400 ha. There was no relationship found between the amount of available arable land quality and crop combinations because municipalities with smaller and larger number of combinations of crops can occur regardless of whether they have more or less available land. Index of diversification of crops has proven to be somewhat higher in those municipalities where the prevailing mountainous land of weaker production values such as Gornji Vakuf-Uskoplje and Novi Travnik. Moreover, the number of crops combined was lower in municipalities in which mountainous land prevails. The relationship between the concentration of crops and soil in municipalities of Central Bosnia Canton is very clear. On the soil of more productive value are grown grains and vegetables, while on the soil of lower production values are usually grown fodder crops (lucerne, clover, etc.).

In municipalities with the traditional extensive mode of agricultural production of crops in a larger scale, there is less concentration, diversification index is higher, the number of crops combined is less. The degree of mechanization in the municipalities of Central Bosnia Canton cannot be associated with a number of crops combined, but more with the kind of crops combined, because for example in the municipality of Kreševo, where 14 ha of land is treated by 1 tractor has 5 crops combined which include mostly fodder crops and vegetables, while in the municipality of Novi Travnik where 6 ha are treated by 1 tractor has the same number of crops in combination as in 2014, and combined crops are cereals and vegetables. It is similar with crop diversification where Novi Travnik with a higher and Gornji Vakuf-Uskoplje with a lower degree of mechanization in the year 2004 had the same degree of diversification. The concentration of grain is higher in municipalities with a higher degree of mechanization, and the concentration of fodder crops for municipalities with a lower degree of mechanization. Generally speaking, the higher degree of use of agricultural technology in a certain area, the smaller degree of crop diversification.

When it comes to land as a natural resource in Central Bosnia Canton there are three key problems: first, extremely unfavorable ownership structure; second, the constant tendency of the increase of untreated surfaces (irrational use of resources) and, third, the issue of privatization. In the last ten years, the average farm size decreased from 3.0 to 2.6 hectares. It should be added that such a fragmented property consists on average of 5-10 parcels of low production potential. Reasons for the reduction in size of farms lie primarily in the depopulation of rural areas, particularly economically less developed and at higher altitudes; construction of transport infrastructure and the purchase of land by urban residents. All these problems related to land have a significant impact on the reduction of the index of diversification and increasing the number of crops combined.

Detailed research of crop diversification reveals that in the Central Bosnia Canton as a whole there is significant variations. It can be concluded that in 2004, the spatial distribution of crops was highly diversified but in the following 10 years it became more diversified indicating a poorer implementation and adoption of policies for the development of agriculture, a weaker development of agricultural infrastructure, introduction of seeds with high yields and the like, and not the commercialization of certain crops. After 10 years, the number of crops combined increased significantly in almost all municipalities, and the high degree of diversification of crops was even more pronounced.

Results of the crop diversification of the Central Bosnia Canton can be used in the analysis of its contribution to changes in income and in the study of long-term effects on resources, especially on land productivity, the use of other resources and so on. Research of crop concentration and crop diversification are also important in the optimal spatial planning and in the choice of crops to exploit resources in the best possible way. The results are of great help to planners to prepare the appropriate spatial-planning documents on land use in the Central Bosnia Canton.

Present study brings out clearly the relationship between the factors of physical and social environment and the spatial and temporal variations in the cropping pattern. As it is clear that agriculture has special significance for low income, poor and vulnerable sections of rural society. Because of these reasons agriculture is at core of socio-economic development of the society of the Canton and proper future policy for agricultural sector is crucial to improve living standards and to improve welfare of population. Coherence between policies and investments to increase productivity and economic efficiency is also needed. Incentive agricultural policy in the future needs to go in the direction of modernization, increasing productivity and encouraging commercial production.

8. References

- Ali, M. 1978: Studies in Agricultural Geography. Rajesh Publication, New Delhi.
- Ayyar, N.P., 1969: Crop Regions of Madhya Pradesh: A study in Methodology. Geographical Review of India, Calcutta, 31(1), 4-5.
- Barakade, A. J., Tonape, L.B. and Lokhande, T. N. 2011: Agricultural Land Use Pattern in Satara District of Maharashtra. International Reffered Research Journal, Vol. 2 (25), 54-57.
- Basu Roy, P., Barman U.K. 2014: Crop concentration and Diversification in Jalpaiguri District of West Bengal: A Case Study. International Journal of Food, Agriculture and Veterinary Sciences, Vol. 4 (3), 5-9.
- Bhatia, S. 1965: Patterns of Crop Concentration and Diversification in India. Economic Geography, Vol 41 (1), USA, 39-56.
- Central Bosnia Canton in numbers, 2014, Institute for Statistics of Federation of Bosnia and Herzegovina, Sarajevo
- Chatterjee, S.P. 1952: Land utilization survey of Howrah district. Geographical Review of India, Vol.14, 30-39.
- Coppock, J. T. 1964: Crop Livestock and Enterprise Combination in England and Wales. Economic Geography, Vol. 40 (1), 65-81.
- Das, M.M. 1981: Land Use Pattern in Assam. Geographical Review of India, Vol. 43, No.3, 43-44.
- Doi, K. 1959: The Industrial Structure of Japanese Prefecture. Proceedings of International Geographical Union, Regional Conference in Japan.
- Florence, P., Baldamus, W. 1948: Investment, location and size of plant: A realistic Inquiry Into the Structure of British and American Industries. Cambridge at the University Press, Cambridge.
- Gekić, H. 2013: Agricultural Geography of Bosnia and Herzegovina: A Case Study of Bugojno. Geo-Analyst Vol.3 (1), Geographical Society of West Bengal, Alipurduar, India, 22-34.
- Hashmi, N.I., Gomatee 2012: Pattern of Crop Concentration and Diversification in Upper-Ganga Yamuna doab, India. International Journal of Innovative Research and Development, Vol. 1 (5), 481-496.
- Husain, M., 1996: Systematic Agricultural Geography. Rawat publication, Jaipur and New Delhi.
- Meteorological Yearbook. 1961-1990: Institute for Hydrometeorology of Republic of Bosnia and Herzegovina, Sarajevo
- Nurković, R. 2010: Actual changes in economic structure of agricultural production in rural settlements of Bosnia and Herzegovina, in Europe, today. Proceedings of 5. konferenca DAES »Sodobni izzivi menedžmenta v agroživilstvu«. Pivola, 18.-19. mar. 2010, Slovenia, 207-213.
- Ogale, S. B. 2014: A study of crop combination region of Baramati tahsil in Pune District (Maharashtra State). International Journal of Innovation and Scientific Research, Vol.2 (2), Rabat, Morocco, 329-334.

- Plant production in Federation of Bosnia and Herzegovina, 2004-2014, Institute for Statistics of Federation of Bosnia and Herzegovina, Sarajevo
- Rafiullah S.M. 1956: A New Approach to Functional Classification of Town. *Geographer* 12, 40-53.
- Raju 2012: Patterns of Crop Concentration and Diversification in Vizianagaram District of Andhra Pradesh. *Transaction of Institute of the Indian Geographers* 34 (2), 189-197.
- Rayamane, A. S. and Nyo, N. 2003: A Spatio-temporal Analysis of Crop Combination in Sedawgyi Region, Myanmar. *The Deccan Geographer*, Vol. 41 (1) 55-63.
- S.S. Motebennur 2014: Crop Combination Regions in Karnataka With Special Reference to Major Edible Oilseeds. *Indian Journal of Applied Research*, Vol. 4 (11), Ahmedabad, India, 248-252.
- Saikia, D. 2012: Agricultural Development in Nagaon District, Assam: A Geographical Analysis. Unpublished PhD thesis, Gauhati University, Assam, India, 204-224.
- Singh, B. 1967: Landuse and Cropping Pattern and their Ranking, *National Geographic Journal of India*, Vol. 13 (2), Varanasi, India.
- Singh, J. 1976: An Agricultural Geography of Haryana. Kurukshetra. Vishal Publications, University Campus, 313-320.
- Singh, J., Dhillon, S.S., 2004: *Agricultural Geography*. Tata-Mcgraw-Hill, Publishing Company Limited, New Delhi.
- Singh, S.P., Singh, A.K. and Dwivedi, S. 2010: Land Use and Cropping Pattern Followed by Vegetable Growers in Eastern Uttar Pradesh. *Research Journal of Agricultural Sciences*, Vol. 1(4), 448-450.
- Spatial Plan of Central Bosnia Canton 2005-2025. Institute for architecture, urbanism and spatial planning, Sarajevo, 2005.
- Tiwari A.K., Sharma V.N. 2013: A study of Crop Combination Regions in Eastern Uttar Pradesh. In: Eds. Sharma, P.R., Yadava, R.S. and Sharma, V.N. "Interdisciplinary advances in Geography". RK Books, New Delhi, 261-272.
- Tripathi, D.K. 1999: Agricultural development and planning in Faizabad district. Unpublished Ph.D thesis, Department of Geography, BHU.
- Vyalij, P. Y. 2009: A Spatio-Temporal Analysis of crop Combination in Nashik District Maharashtra. *Shodh Samiksha aur Mulyankan International Journal*, Vol. 2 (6), 775-777.
- Weaver, J. C. 1954: Crop Combination Regions in the Middle West. *The Geographical Review*, Vol. 44 (2), 176-181.
- World Atlas. 1998. Sejtarija, Sarajevo

