THE CHANGES IN THE USAGE OF AGRICULTURAL LAND IN EASTERN REGION OF REPUBLIC OF MACEDONIA BETWEEN 1991 AND 2030

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Summary

This paper will present the analysis of the degree of changes in the usage of agricultural land in Eastern region of Republic of Macedonia. The basis for this analysis is statistical data for previous 23 years (1991 - 2013). The forecast presented here will encompass period of following 17 years, i. e by the year 2030. The method used in this process is trend extrapolation.

Our calculations predict relatively large positive or negative changes in the future use of land. Different degree of changes can be seen among different arable crops. The usage of agricultural land shows negative changes in every category on regional level.

Key words: *Eastern region, agricultural land, trend analysis.*

JEL: *Q01, Q15*

Introduction

Total surface area of Republic of Macedonia is 25,713 km^2. Out of that, 1.9% is water and the rest is land. Its land area has most diverse geomorphologic terrain structure. According to Markovski (2004), lowland area takes 20.3% (5,064.7 km^2), highland area 30.5% (7,598.6 km^2) while the remaining 49.2% are mountains. This categorizes Republic of Macedonia as mountainous country.

In December 2007, Government of the Republic of Macedonia adopted the Nomenclature of Territorial Units for Statistics - NTES ("Official Gazette of the Republic of Macedonia" No. 158/2007). NTES consists of 5 levels: NTES level 1 and NTES level 2 represent the whole territory of the Republic of Macedonia as an administrative unit, NTES level 3 consists of 8 non-administrative units – statistical

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regions (Map 1) that are formed by grouping the municipalities as administrative units of lower level, NTES level 4 consists of 80 municipalities as administrative units, and NTES level 5 consists of 1,767 settlements.

Eastern region encompasses 11 municipalities: Berovo, Vinitsa, Delchevo, Zrnovtsi, Karbintsi, Kochani, Makedonska Kamenitsa, Pehchevo, Probishtip, Cheshinovo-Obleshevo and Shtip with 217 inhabited places. According to estimation from SSORM (2015c), on 30.06.2014 this area had 177,700 inhabitants, or 8.6% out of country's total population (2,067,471 inhabitants). Average population density in Macedonia is 83.0 inhabitants per km^2, the lowest is in Pelagonia region (49.1 inhabitants /km^2) and the highest in Skopje region (339.7 citizens/km^2). In Eastern region population density is 50.2 inhabitants/km^2.

Map 1. Regions in the Republic of Macedonia
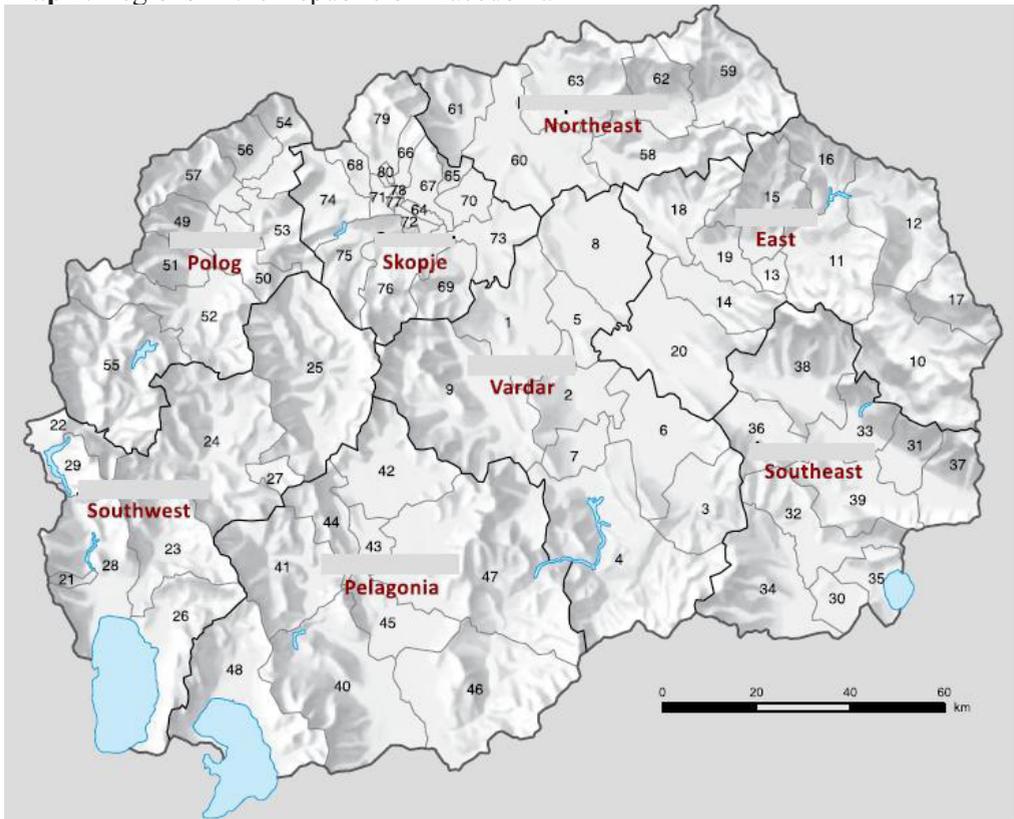
Sources: SSORM (2015a)

According to the data from SSORM (2014b) for added gross value in agriculture on country's level for 5 years (2009-2013), the South-East region had the biggest share of 30.3%, followed by the Pelagonia region with 20.0%, while the South-West region had the smallest share - 3.8%. Eastern region had 8.0% share. The South-East region had dominant share in total value of crop output in the Republic of Macedonia with 34.9%, while Eastern region had 8.6%. While the Pelagonia region was the largest contributor

to the total value of animal output with 20.3%, Eastern region contributed with 11.6%. When it comes to vegetable output, the largest value (above 50%) was produced in vegetables, then fruits (14.6%), crops (12.4%) and the last are vineyards (through wine production) with only 4.9% share in total value (average: 862.9 mil. EUR).

During previous years (2009 - 2012) there was an increase of total investments in basic funds. They grew from 1,331.2 mil. EUR in 2009 to 1,714.5 mil. EUR in 2012, i.e. 28.8% (SSORM, 2015c). The most resources (60.5%) from these funds (average of 91,243 million MKD) were invested in Skopje region, while Eastern region got only 6%. Relatively small investments were made into agriculture, forestry and fishery - only 3% of total investments (average of 2,465 million MKD). Unlike the increase of investments in total, here we can see the decline of investments, from 3,123 million MKD in 2009 to 2,221 million MKD in 2012. On the other side, the most resources from these funds were invested in Pelagonia region, while Eastern region got 9% of total investments. Although investments are small, agriculture nevertheless has relatively high share in country's GDP. For last 13 years (2000 - 2012) its share was 10.1% on average, varying between 8.9% in 2007 and 11.6% in 2004 (SSORM, 2015a).

In the Republic of Macedonia, agriculture has significant role which is supported by the fact that in 2014, over 49% (1,263,155 ha) out of total surface area was used for agriculture production (SSORM, 2015a).

The highest percentage (20.8%) of agricultural land is in Pelagonia region and the lowest in Skopje region - 6.3% out of total agricultural land. Eastern region had 14% share in total agricultural land area. The initial analysis of usage of agricultural land showed that this share is decreasing each year. The reasons for this are residential development, infrastructure facilities etc. but also emigration from rural areas.

The goal of this paper is to determine the degree of changes in usage of agricultural land in Eastern region for previous years (1991 - 2013). After that, we will present the prediction for development in agricultural land for following period (by 2030) on the basis of these changes.

Materials and Methods

To realize established goal, we used secondary data published by State Statistical Office of the Republic of Macedonia (SSORM) in Statistical review: Field crops, orchards and vineyards. Starting year is 1991 - that is the year when Republic of Macedonia gained independency and left former Yugoslavic Republic - and the final year is 2013. We believe that this period of 23 years is good enough base to predict future trends for agricultural land development. Trend analysis is a mathematical technique often used to predict future events. This analysis helps to determine if the values generally increase or decrease (getting "better" or "worse"). In statistical terms this is a determination of whether the probability distribution from which they arise has changed over time. Trend analysis is a special case of regression analysis where the dependent variable is the variable to be forecasted and the independent variable is time.

Equation for a trend line, F = a + bt

Where: F – forecast, t – time value, a – y intercept, b – slope of the line

$b = (n\Sigma XY - \Sigma X\Sigma Y) / [n\Sigma X^2 - (\Sigma X)^2]$

This equation describes a straight line, Y represents area and X represents time. Linear regression is slow to recognize turning points and step function shifts in land use. Linear regression fits a straight line to the data, even when the data is seasonal or better described by a curve. Forecast specifications: n equals the periods of history of land use that will be used in calculating the values for a and b.

During this research, we used several statistical methods, common for these king of research. The information was analyzed with the help of MS-Excel (2013).

Results and discussion

The usage of agricultural land from 1991 to 2013

The terrain in Eastern region (3,566.7 km²) varies from lowland (26,9%) to highland area with hills 200-500 AMSL. According to Markovski (2004), out of total area, 2.300,12 km² is lowland terrain (500-1000 AMSL) and 233,07 km² is low mountain area (1000-2000 AMSL).

The terrain, according to Panov (1998), is vertically placed between 225 AMSL and 1.130 AMSL. The lowest point is cadastral municipality Cheshinovo (municipality Cheshinovo-Obleshevo). Agricultural land in cadastral municipality Zelengrad (municipality Probishtip) is on the highest point and also the area where the Eastern mountain region is. However, the Eastern region area has relatively large natural resources for agricultural production. Namely, over 51% of area is agricultural land and over 50% of that land is cultivated (Table 1). Unfortunately, distribution of land for pasturage is almost the same as for cultivation. If you add the meadow area into this correlation, then the production of crops (hay) grows to 54.5% of agricultural land. This presents good basis for livestock farming, especially for cattle, sheep and goat farming. The analysis of this category of land per municipality showed that the highest prospects for developing milk production by increasing the number of dairy animals (cows, sheep and goats) have Berovo, Shtip and Kochani municipality and the lowest Zrnovtsi municipality.

Table 1. Agricultural area by category of usage, 1991-2013 by municipalities

Muncipalities	Agricultural land	Cultivated land					Pastures
		Total	Arable lend and gardens	Orchards	Vineyards	Meadows	
Berovo	37204	14619	9249	1173	0	4197	22583
Vinitsa	15416	8322	7118	273	286	645	7093
Delchevo	22679	12534	10199	801	9	1526	9708
Zrnovtsi	1585	1514	1441	35	29	8	70
Karbintsi	7860	7161	6549	159	342	111	700
Kochani	25293	9968	9239	204	280	245	15327
Makedonska Kamenitsa	4752	3542	3162	118	0	261	1210
Pehchevo	8060	5047	3094	512	0	1441	3013
Probishtip	18483	9379	8436	128	263	552	9100
Cheshinovo-Obleshevo	7434	6468	6145	87	154	82	960
Shtip	34762	13842	12740	201	732	212	20903
Total ER*	**183528**	**92396**	**77372**	**3691**	**2095**	**9280**	**90667**
Total RM*	**1234160**	**585999**	**485649**	**16756**	**26806**	**56788**	**648161**
Participation ER in RM (%)	**14,9**	**15,8**	**15,9**	**23,6**	**7,8**	**16,3**	**14,0**

*Eastern Region

** Republic of Macedonia

Sources: SSORM (2014a)

The analysis of usage of agricultural land for previous years (1991 – 2013) showed that it has relatively large oscillations from year to year. These yearly oscillations in usage of agricultural land are the most evident for pasture land, while other categories are more stable. The intensity of yearly oscillations in usage per municipalities is different. The Chart 1 shows example for Berovo municipality, the largest one in Eastern region, and its volume of agricultural land. During researched period (1991 – 2013), the agricultural land in Berovo municipality varied between 25,784 ha (2007) and 44,713 ha (1993), or the interval of 18,529 ha and Cv=16.8%. The meadow area had relatively stable movement (Cv=13.6%). On the other side, big oscillations from average value can be seen for orchards (Stdev=502 ha; Cv=42.8%). Here, maximum was 2,132 ha (1991), and minimum was in 2006 (583 ha), after which the area grew again to 1,216 ha in 2013.

Chart 1. The dynamics of usage of agricultural land in Berovo municipality
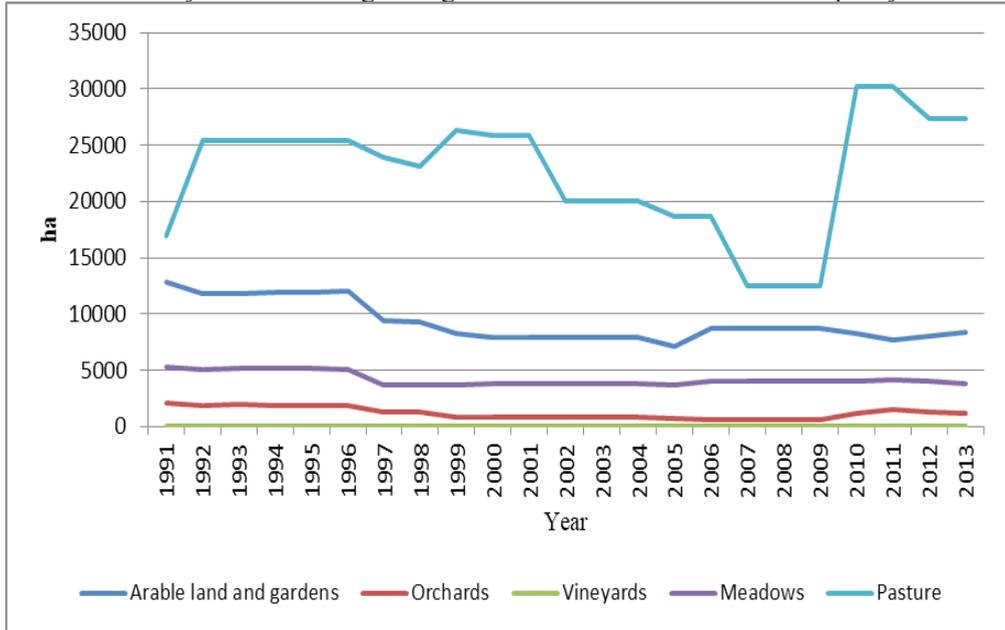
Sources: SSORM (1992-2014) and personal calculations

The arable land and gardens can be seen mostly in Sthip, Delchevo, Berovo and Ko-chani area and rarely in Zrnovtsi municipality. This means that the first four munici-palities have the best prepositions for development of vegetable, industrial and pastur-age (annual and perennial) arable crops, unlike the last municipality.

Changes in usage of land for agricultural production

The agricultural production mainly takes place in gardens, arable land, meadows and pastures. But in practice there are cases where perennial crops are uprooted. This hap-pens when the plantation is amortised. For a year or two after, instead of new planta-tion, annual or bi-annual agricultural crops are planted. There are also situations when orchards and vineyards are cultivated on arable land, gardens, meadows or pasturage areas.

In any case, Eastern region has plenty annual crops. However, State Statistical Office doesn't evident every crop area but only those areas larger than 0.1 ha. Because of that, the statistical evaluation is missing 28,516 ha, that is – data encompasses only 145,803 ha out of 174,319 ha in total (Table 1). This is the reason why our research encompassed only 28 crops.

Table 2. The changes in crop areas (ha)

Plants	Berovo	Vinitsa	Delchevo	Zrnovtsi	Karbintsi	Kochani	M. Kamenitsa	Pehchevo	Probishtip	Cheshinovo-Obleshevo	Shtip	Total	Change (2030 to 1991-2013), %
Wheat	0	0	799	288	0	0	3	414	0	727	0	2231	-82,5
Rye	135	0	0	3	0	0	3	77	0	0	0	218	-91,8
Barley	0	0	1048	448	1749	0	326	128	427	972	630	5728	-42,3
Oats	0	0	142	0	0	0	0	107	0	0	0	249	-87,7
Maize	72	352	561	426	314	0	16	76	107	1270	0	3194	-14,7
Rice	0	0	0	0	285	0	0	0	0	3211	0	3496	-13,8
Sunflower	0	0	0	0	0	0	0	0	0	0	0	0	-100,0
Tobacco	63	0	0	274	449	149	13	0	0	0	0	948	-2,3
Poppey	0	80	0	8	99	0	0	0	0	0	0	187	70,0
Potatoes	1509	0	177	178	0	365	39	430	33	233	0	2964	-6,7
Onions	23	0	0	8	0	15	0	21	0	134	95	296	-24,1
Garlic	5	0	2	6	0	57	0	7	0	12	0	89	-50,6
Beans	80	0	127	68	0	82	16	67	0	170	0	610	-54,2
Peas	0	6	0	40	0	0	0	0	0	67	0	113	28,4
Lentil	0	2	0	0	0	0	0	0	0	0	0	2	-97,0
Cabbage	32	0	32	11	0	20	0	6	0	95	0	196	-27,1
Tomatoes	28	0	20	18	0	96	2	20	5	105	0	294	-54,8
Peppers	10	0	41	70	0	174	2	15	0	402	0	714	16,3
Cucumbers	0	4	0	0	0	41	0	0	0	0	12	57	14,0
Melons and watermelons	0	0	0	12	0	0	0	0	76	20	140	248	-55,2
Clover	0	0	0	0	0	0	0	0	0	0	13	13	-93,4
Alfalfa	101	21	192	99	369	0	57	172	92	562	304	1969	-9,0
Vetches	0	0	46	1	1	0	0	53	0	161	0	262	-67,8
Fodder peas	0	17	2	0	0	0	0	0	0	0	0	19	-54,8
Fodder maize	0	0	0	0	133	0	0	0	0	0	0	133	43,0
Fodder beet	0	0	3	0	0	0	0	13	0	0	0	16	-68,6
Meadows	5028	629	831	12	0	124	293	2463	466	124	0	9970	-5,3
Pastures	20718	9938	8796	0	0	9244	1304	15586	0	0	6786	72372	-17,4
Total	**27804**	**11049**	**12819**	**1970**	**3399**	**10367**	**2074**	**19655**	**1206**	**8265**	**7980**	**106588**	**-26,9**

Sources: Personal calculations

The analysis of data for last 23 years showed that every crop area has relatively high oscillations in volume of land used for its cultivation respectively. The intensity of oscillations has positive or negative impact on trend for following period by 2030. Unfortunately, for large number of arable cultures, negative impact is more expressed than positive one (Table 2). By 2030, in Eastern region the area that had been used for crops production (1991 – 2013) will decrease for 39,215 ha, or 26.9%. The results from the trend analysis showed that by 2030, there will be no sunflower production. There will be almost no rye, lentil or alfalfa. The smallest decrease is expected for tobacco (only -2.3%). On the other hand, 70%

increase can be expected for poppy, 43% for feed grain etc.

In the next part of this paper we will give an example of changes in area for potato production. In Eastern region during the previous period, potato production used average land area of 2,988 ha, or 22.2% of total land area in the country. The largest area (28.7%) was in Berovo municipality and the smallest (2.6%) in Probishtip municipality.

During previous years there was an increase in land area for potato production that happened almost each year in Berovo municipality. Out of 700 ha in 1991, the total area increased to 1250 ha in 2013, while deviations from average value (859 ha) were 22%. As a result of constant increase during researched period, the trend of positive changes will continue by year 2030 (Chart 2).

Chart 2. The projection for land area for potatoes production in Berovo municipality
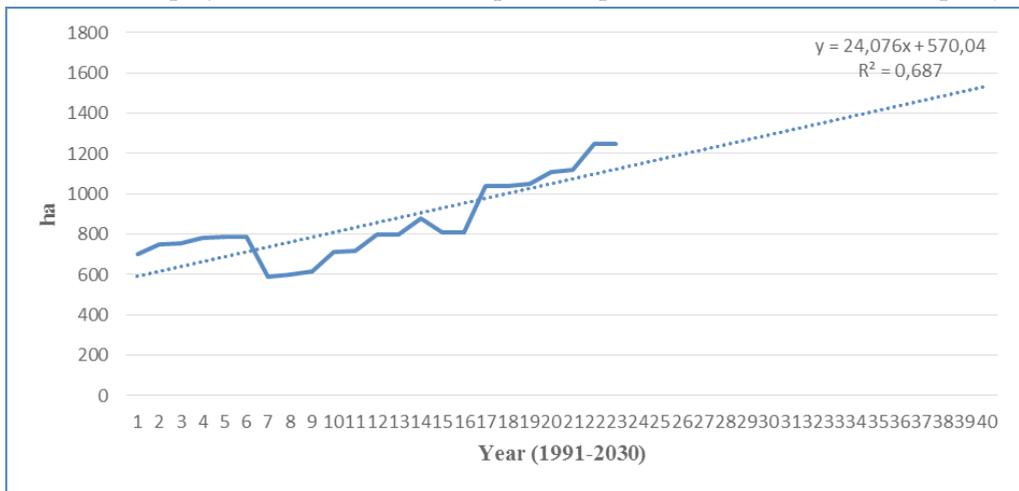
The land area for potato production in Berovo municipality grows every year for 24 ha. As a result, the total land area in 2020 will be 1,268 ha and by 2030 it will be 1,509 ha.

The changes in usage of land for orchards and vineyards

During the researched period (1991 - 2013) in Eastern region orchards were cultivated on 3,691 ha (Table 1) on average, or 22% of total area in the Republic of Macedonia (SSORM, 2015a). But, according to information from statistical reviews (SSORM, 2014a), there is only 972.7 ha, or less than 19.5% orchards out of total land area. The difference of 718.3 ha is the result of the fact that SSO doesn't review orchards smaller than 0.1 ha.

However, during previous time period there can be seen positive tendency in changes for large number of fruit varieties. Consequently, the same varieties will continue this growing trend for the following period until 2030 on regional level (Table 3). Other fruits on municipal level will disappear. The largest negative changes on regional level will happen for pears, and the least for plums. On the other hand, the largest positive changes will happen for cherries and the least for sour cherries.

Table 3. The changes for orchards and vineyards areas (ha)

Type of orchards and vineyards	Berovo	Vinitsa	Delchevo	Zrnovtsi	Karbintsi	Kochani	M. Kamenitsa	Pehchevo	Probishtip	Cheshinovo-Obleshevo	Shtip	Total	Change (2030 to 1991-2013), %
Cherries	0,0	7,9	12,2	5,4	0,2	0,0	9,5	20,2	2,3	143,1	38,5	239,3	173,17
Sour cherries	0,0	0,0	58,7	2,0	532,1	70,9	1,4	0,0	0,2	113,2	35,2	813,7	9,05
Quinces	0,2	1,9	2,6	0,2	0,0	0,6	0,6	0,0	0,2	1,3	0,1	7,7	-16,30
Apricots	0,0	4,2	4,0	2,0	8,9	0,0	0,7	0,0	4,0	5,0	9,3	38,1	32,29
Apples	25,1	9,6	0,0	0,0	1,4	18,3	8,1	32,5	5,5	6,7	2,5	109,7	-47,98
Pears	0,0	0,0	22,5	6,7	7,9	0,0	17,3	9,7	15,2	6,5	0,0	85,8	-66,38
Plums	411,8	90,5	366,2	15,9	35,0	88,9	93,9	43,1	41,8	43,1	41,9	1272,1	-4,13
Peaches	0,0	2,3	3,6	3,2	20,6	0,0	1,3	0,0	1,5	0,0	5,1	37,6	-15,88
Walnuts	0,0	41,4	95,9	0,0	27,8	33,9	40,2	50,1	86,6	16,3	29,8	422,0	60,33
Total orchards	**437,1**	**157,8**	**565,7**	**35,4**	**633,9**	**212,6**	**173,0**	**155,6**	**157,3**	**335,2**	**162,4**	**3026,0**	1,79
Vineyards	**0,0**	**389,7**	**4,9**	**0,0**	**464,8**	**0,0**	**0,0**	**0,0**	**225,5**	**12,8**	**0,0**	**1097,7**	-41,6

Sources: Personal calculations

The average size of land used for plums production during last period in Berovo municipality was 390.8 ha which coincides with 128,975 trees. For future years, on regional level, the highest increase in size of land used for plums production will happen in Berovo municipality (Chart 3). Yearly increase will amount to average of 0.8 ha. Total land area by 2020 will be 404 ha, and in 2030, 411.8 ha which is related to increase of 5.4%.

The research showed that for the last 23 years vineyards in Eastern region grew on 1,880.4 ha on average, with 2,732 trees per hectare on average. In the following period, there will be continuous decrease in size of the land used for vineyards. By 2030, there will be 1,097.7 ha, or 41.6% less than average size of the land used for vineyards.

Chart 3. The projection for land area for plum production in Berovo
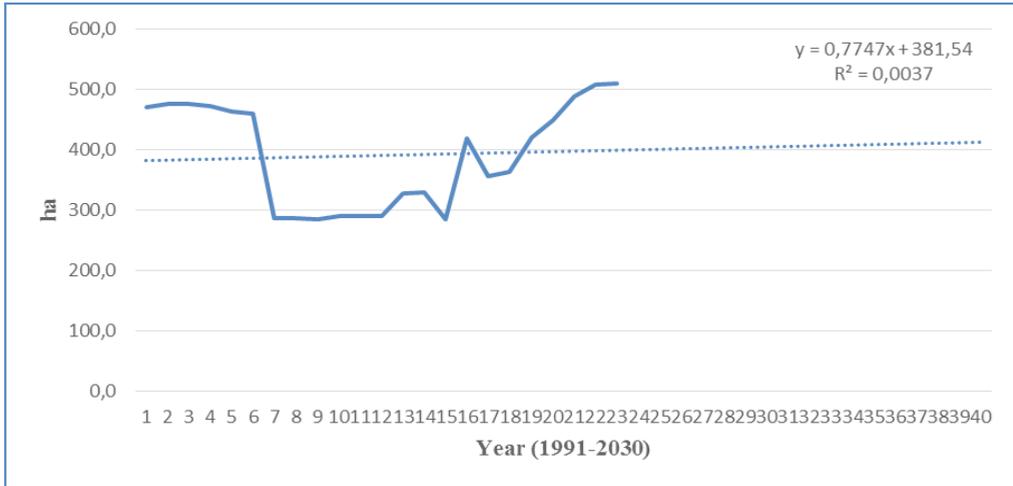
The largest size of land used for vineyard cultivation in Eastern region will be in Karbintsi municipality. Karbintsi municipality, which was part of Shtip municipality until 1997, will have dominant share in total land area used for vineyards in Eastern region (42.3%). Here, the land size used for vineyards will be increasing by 5.2 ha until it reaches 464.8 ha in 2030 (Chart 4).

Conclusion

Due to the methodological reasons, Eastern region and the rest of the country, has differences in land surfaces which are presented according to the category of usage (Table 1) along with those land surfaces that are presented as land per arable crop (Table 2 and 3). Consequently, the land surface used for crop and vegetable production is 37.8% larger than the area categorized as arable land and gardens, while orchards are 18% and vineyards 47.6% smaller. Because of that, the calculations for trend development were made only for those arable crops that have available statistical data.

The degree of yearly changes in the land surfaces for the last period has deciding role in calculations for the following period until 2030. Due to that, different degree of changes can be seen for different arable crops. The research has shown that the least negative change will affect tobacco areas (-2.3%), while the most negative change will affect sunflower (-100%). On the other hand, by the year 2030 the area for cucumber production will be 14% larger and for poppy production 70% larger. In fruit production, the biggest decrease in land area by the year 2030 will affect pear production (66.4%) and the least for plum production (4.1%). In the same time, the most positive changes will happen for cherry (173.1%) and the least positive (9%) for sour cherry production. By 2030., the average land area for vineyards will be almost 42% smaller than the average area for vineyards between 1991 and 2013.

Chart 4. The projection for land used for vineyards in Karbintsi
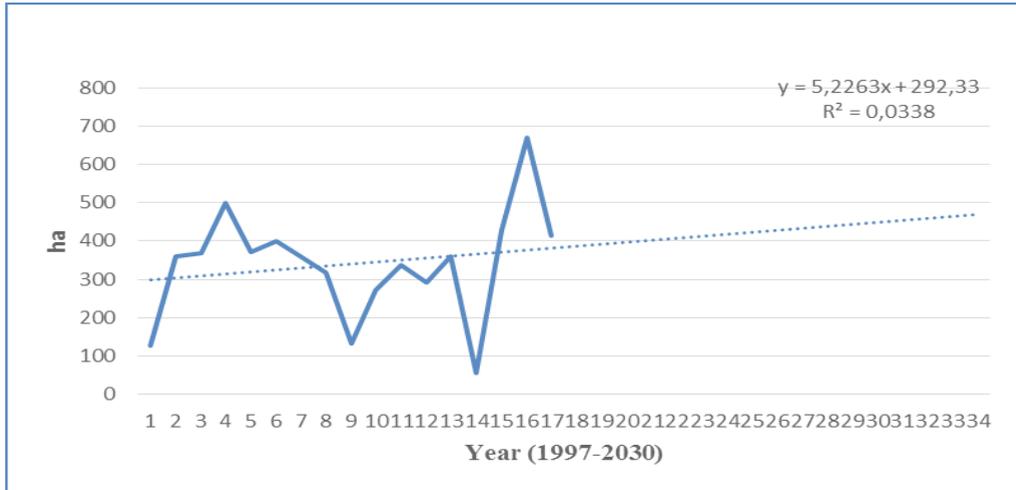
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