

ARTICLES

NATURAL GEOGRAPHICAL FEATURES AND LAND USE IN THE MUNICIPALITY OF ZAVRČ

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ABSTRACT

Natural geographical features and land use in the municipality of Zavrč

This paper presents the characteristics of land use in the municipality of Zavrč in 2014 as well as changes in land use in the period of 2000-2014. We will analyze the impact of the major factors in the natural geographic distribution of land use categories in the province. Special attention was paid to the analysis of potential changes in the period of 1824-2014 with the focus on vineyards. Then, surfaces were determined on the basis of topoclimatic characteristics.

KEY WORDS

soil types, viticulture, GIS, Haloze, Zavrč

1. Introduction

The municipality of Zavrč is located in the eastern part of Haloze. The area is considered to be a typical vineyard landscape. One of the greatest connoisseurs of Haloze, dr Vladimir Bračič, in his monograph - Haloze (1967) wrote that the position of the thermal zone of eastern Haloze is among the top 5% of the best vineyard sites in the world. The change of the social system in Slovenia's independence in 1991 brought changes in relation to arable land, which is largely a result of changes in values and attitudes towards different economic activities. Among the economic sectors that are starting to lose its former importance one can reliably classify agricultural activity.

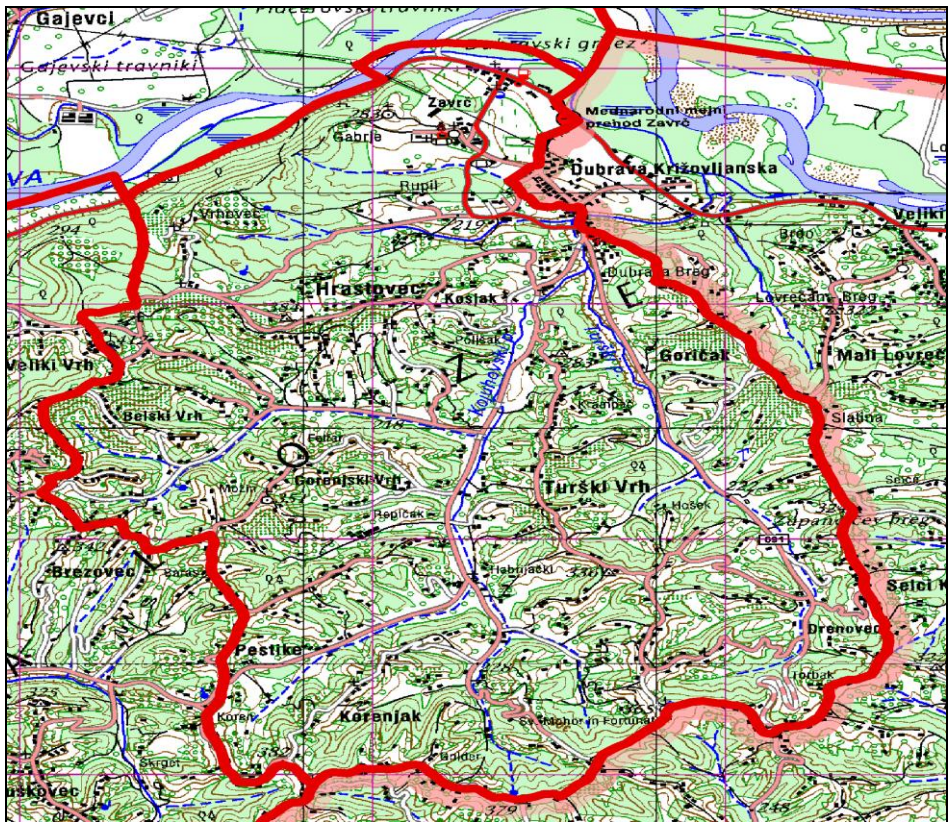


Figure 1: In the municipality of Zavrč.
Source: TTN50, GURS, 2005.

The process of abandonment of arable land in Slovenia has been present the whole time after the Second World War until today. The process of greening, vegetation and reforestation, unfortunately, is present in areas with high

production potential, that is, in northeastern Slovenia, which is contrary to logic and threatens food sovereignty of our country (Žiberna, 2013). In the period of 2000-2012, Slovenia lost 31,796.4 ha (14.7%) of fields and gardens, 3865,0 ha (15,2%) and vineyards 9018.7 ha (22,0%), other state land (Žiberna, 2013). In the period of 2000-2012, Slovenia lost 31,796.4 ha (14,7%) of fields and gardens, 3865,0 ha (15,2%) and vineyards 9018,7 ha (22,0%), the rest of the land. Among the forms of land use, forests have the highest growth (up to 25,718.9 ha or 2,1%), grasslands (for 16,950.9 ha or 4,8%) and overgrowing land (6.923,2 ha or 27,2%). There were also increased fruit growing areas namely 3.619,4 ha or 14,5%. There is a concern about that in order to reduce space with intensive forms of land use and areas with high magnification. Arable land in this period reduced the dynamics of 7,2 ha per day (Žiberna 2013).

Change management, potential (abolition of agricultural complexes) and denationalization had generally a negative impact on the wine. With the return of the former owners of the vineyard, we may be required to correct the injustices of the past, but the new owners of potential vineyards did not often have the knowledge or the will of capital to manage the vineyards to the same extent, which further contributed to the withdrawal of vineyards.

In the area of Zavrč we wanted to determine the following:

- Communication between land use and natural selected elements
- changes in land use in the period of 2000-2014 in the light of the geographical elements and production potential
- potential changes in the area of Hrastovec, Turkish summit, Goričak and Drenovec in the period of 1824 - 2014, in the light of vineyards bonuses.

2. Methodology

In the municipality of Zavrč, we have created a database of GIS layers for the following elements: height, the relative height, gradient of slopes, functional gradient of bevel, the slopes of exposure, global solar radiation (kWh/m²), vineyards in 1824 by the Franciscan cadastre, use of land in 2000, the use of land in 2014, soil types, lithologic units.

The layers were prepared in the format raster in the cell size (pixels) 5m x 5m. Source for data and digital terrain model (from which we have created layers of slope, aspect and global solar radiation) database enables DMV Geodetic Authority. Information on land use and soil types in vector format is available on the website of the Ministry of Agriculture, Forestry and Food. Information about the lithological units are taken from the digital geological map sheet of Čakovec. Information about the growth of areas were obtained from the

Franciscan cadastral maps that are available in the Archives of the Republic of Slovenia in the digital (scanned) form. In the municipality of Zavrč, each time we first merged sheets into one file, and then georeferencirali into the Gauss-Krueger coordinate system, and then digitized vineyards. The relationship between land use and natural elements also analyzed the correlation of coefficient.

3.Natural geographical characteristics, important for land use in the municipality of Zavrč

The municipality of Zavrč occupies far eastern part of Haloza, which is known as one of the areas with a local climatic point of view perfect for growing grapes and fruit trees. Height of the area under consideration in the range of 200 m along the Drava river on 412 m at the top of Vrbanjska. There are dominated by the altitude range of 250-275 m above sea level (23,6%) and between 225 and 250 m (23,3 m), which is also a move to the bottom of the thermal belt.

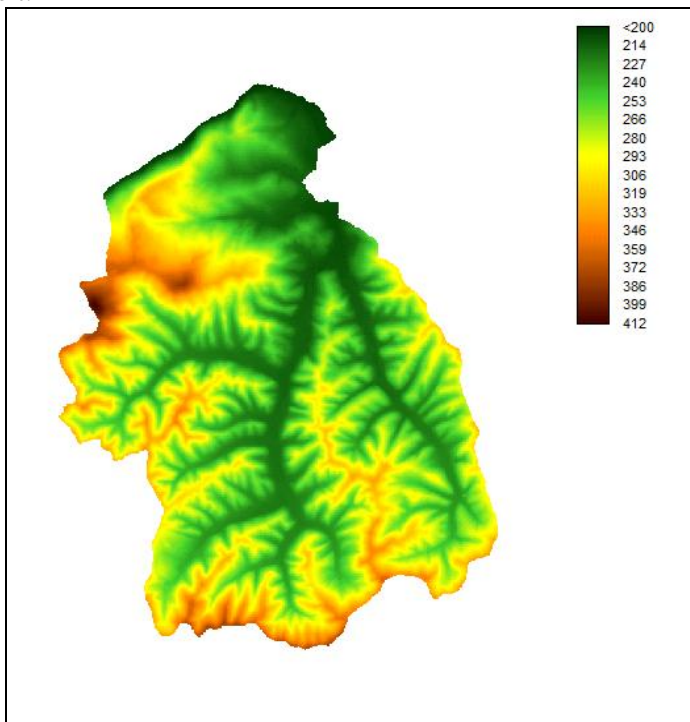


Figure 2: Altitudes in the municipality of Zavrč
Source: DMV5, GURS, 2008; Own calculations

In the lowland zone of the municipality, the relative height less than 25 m is 31,7% of the municipality area, between 25 and 50 m of height ratio 24,0% in real thermal zone with a relative height of 50m for even 44,3% of the county.

More than one fifth of the municipality (22,0%) is located on a slope between 15 and 20 °, 35,7% of the municipality is located on a slope of 20 °. For agriculture, these are otherwise unfavorable conditions, even more for wine and fruit growing, at least in the past controled the greater income for the local population. It is true that the transition to evaluation of the workability of such land changed (Žiberna 1992). Class of inclination between 12 ° and 24 °, which represents the upper limit of useful agricultural mechanization which is 40,4% of the municipality area, above this there is still a quarter of the surface. In this context, there is a large slope - if they are evaluated in terms of workability. In the past, this problem is solved by stepwise slope, while the number of vines or fruit trees per unit of area decreased (Colnarič Gregorič Hamster Korosec 1985).

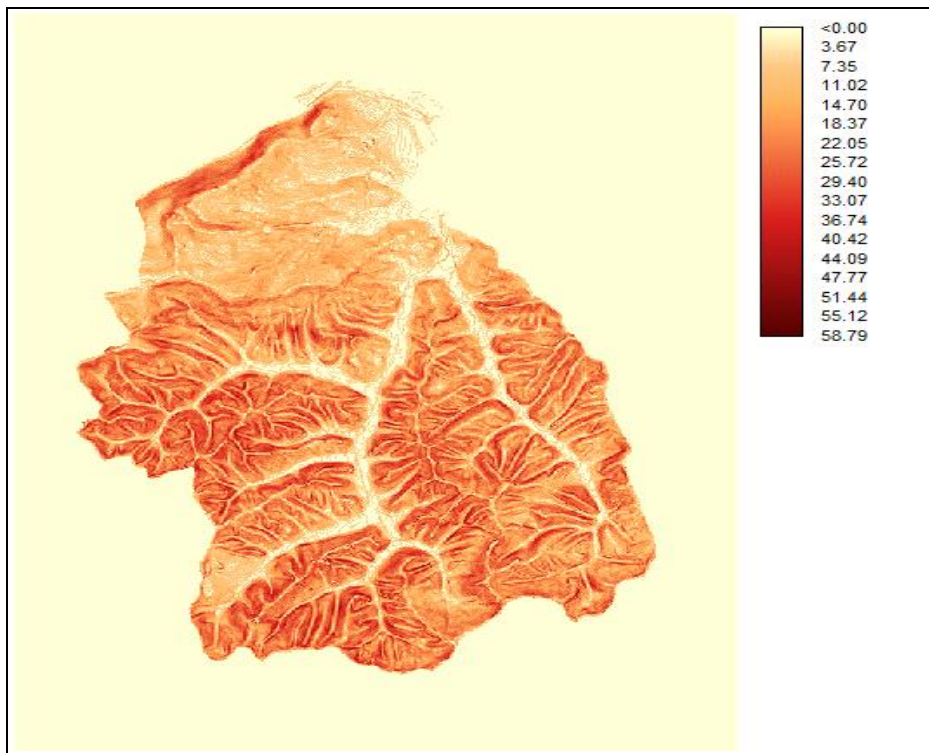


Figure 3: Slopes in the municipality of Zavrč
Source: Own calculations

To the level of the Council in the municipality only 8,2%. Dominated by southeastern exposure (12,9%), northeastern and northern exposures (both at 12,8%) and eastern exposure (12,6%). Pure southern rate 10,8%, while the southeast 12,9% compared to the prevailing south-west (8,6%). Attractive morphology (relatively large gradient of bevel and sunny location) affect the fact that, as 49,7% of the municipality area receives over 1000 kWh/m² of global solar radiation.

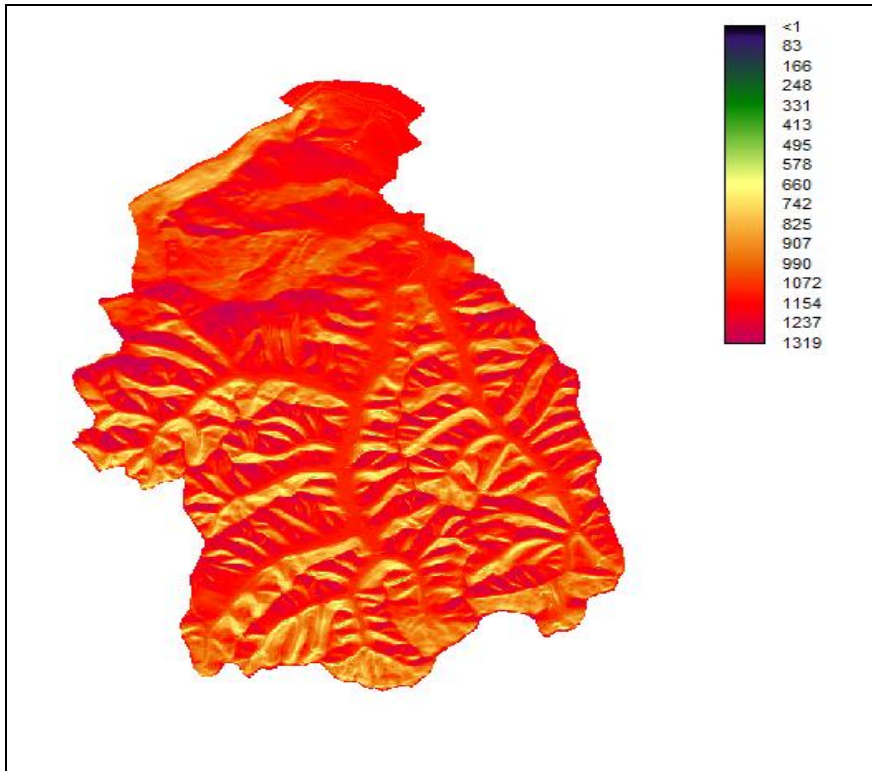


Figure 4: Global solar radiation (kWh/m²) in the municipality of Zavrč
Source: Own research

Lithologic area is relatively simple: in the alluvial plain of the Drava river in the northern part of the county and in the valleys of Kojuhovskega and Turkish stream there is sand and gravel (14,1%), while most of the municipalities covered by sandy marl and sand (63,7%), limestone, marl and conglomerate are located in the in the northern and northwestern part of the county, where there is the highest altitude. Due to the prevailing of soft carbonate rocks, 53,0% of

the area is covered by rendzina. A common type of soil are rigolane soil which mainly occur in the vineyard covering 18% of the area. Eutric brown soils which are found exclusively on marl and limestone in the northern and northwestern part of the county were presented by 14,3%, while the pseudogley slope and alluvial soils together cover about 15% of the municipal territory.

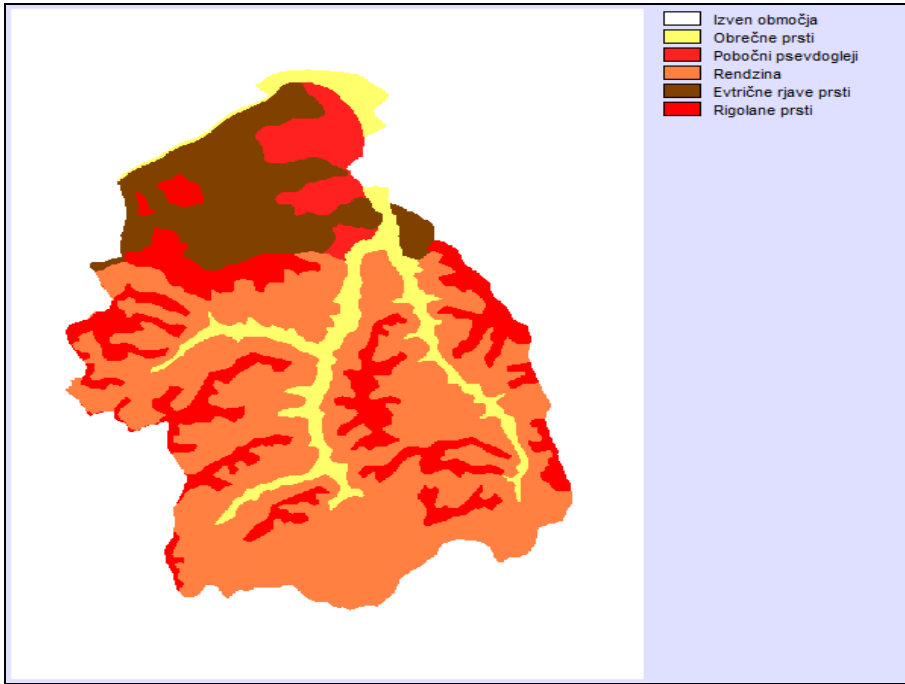


Figure 5: Types of soil in the municipality of Zavrč
Source: MKGP, 2014

4. Land use and land-use changes in the period of 2000-2014 in the area of Zavrč

In the municipality of Zavrč we analyzed land use for 2014 and changes in land use in the period from 2000 to 2014 by selecting the physical geographic factors. In 2014, in the municipality of Zavrč with 800,5 ha (41,4%) dominate forests that were followed by meadows (474,9 ha or 24,6%), vineyards (262.3 ha or 13,6%), arable land (145,1 ha or 7,5%), built-up areas (107,5 ha and 5,6 ha) of land and abandoned (89,1 ha or 4,6%). Other categories together cover less than 3% of the municipal territory. Less than half of arable land is located at altitudes below 250 m. The fact is that the bevel of the slope at high altitudes will quickly increase. Vineyards occur in thermal band, so that below 250 m only 2,9% is higher than in the band between 275 and 300 m (90,3 ha or 34,4%).

The range of altitude between 250 and 325 together is 81,8% of all the vineyards in this area. In the range of altitude between 350 and 375 m vineyards represent 30,7% of all forms of land use in this band. Even in fruit growing areas there are concentration in the thermal band, while the orchards occur at altitudes above 225 m. Fruit trees are particularly vulnerable to spring because of the cold, but not as a vine (Žiberna 1992). Unfortunately, we can see that in favorable positions in the thermal band there are usually abandoned land, as it is in the thermal band between 250 and 350 m with 68,4% of this category of land use. Forests in all zones of altitude, except in the range between 200 and 225 m (dominated by arable land), the most common category of land use. 48,2% of the populated areas occur in a band between 200 and 250 m, the second concentration is in the band between 275 and 350 m, which is 37,2% of the total number of residential areas. In the other case, especially for residential houses and cottages in the thermal band that has always been tied to traditional viticulture (Korošec 2012).

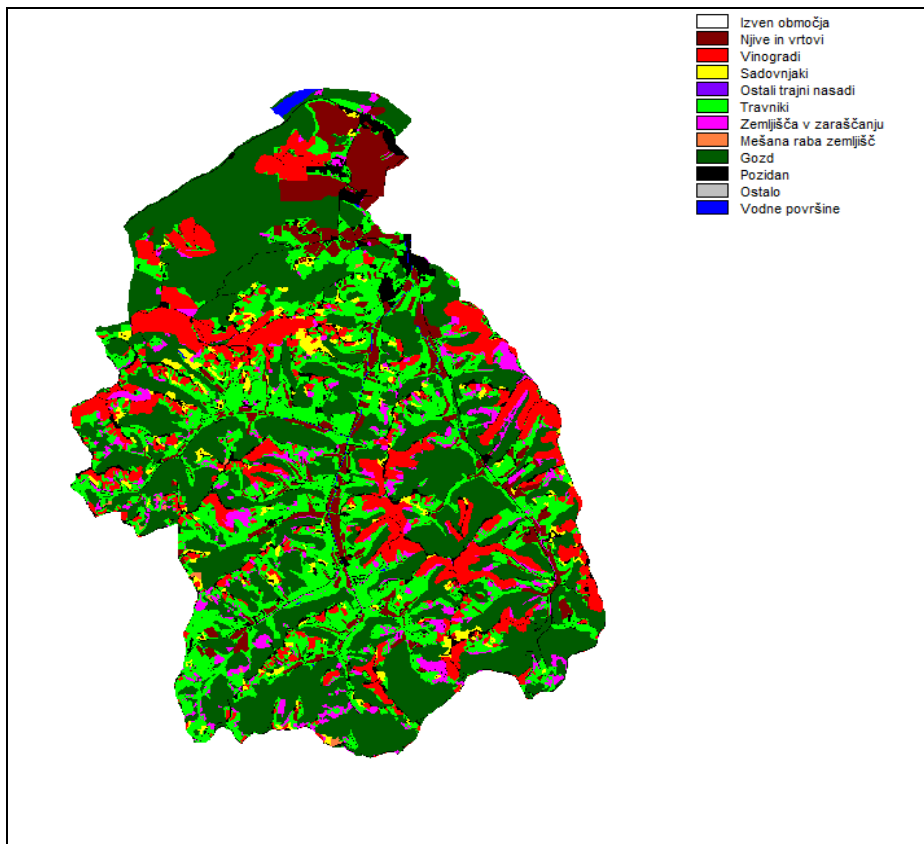


Figure 6: Land use in the municipality of Zavrč in 2014
Source: MKGP, 2014

This especially applies to the specific cultures (vines and fruit trees). The thermal zone is located a few meters above the local depression. Namely, especially at night it is above the minimum temperature. The result is a lower incidence of frost and fog or low clouds. The phenomenon of thermal belt is particularly present when anticyclonic weather has no strong wind.

At that time, even in the summer, when the conditions for a short night for the production of thermal belt and inversion radiation belt (Žiberna 1992). For this purpose, with a digital thermometer, the measurement of the temperature elevation of profiles is performed in Zavrč (225 m) and Vrbanjska (412 m). Digital thermometer was placed on the antenna of a vehicle so that radiation engine had no effect on the measurement. The measurement is performed in an anticyclone of weather type in July 2, 2014 5: 18-05: 26 CEST, at a time when it was most strongly developed.

The results showed the existence of strongly developed thermal belt, as well as the temperature difference between the bottom of the valley Zajza and Vrbanjska (height difference between two points is about 150 m) was 4,5°C. The temperatures have started to increase significantly, especially over 310 m above sea level. The arrangements for the development of the thermal band was also recorded by two automatic weather stations, where we are at a height of 2 m of temperature measurements performed also with temperature data logger and resolution measurements for 10 minutes. First automatic weather station was installed on the lawn at an altitude of 215 m, and the other at the top Vrbanjska (412 m).

The results shown in all the days marked the emergence of the thermal band, which began to develop after 20 hours of CEST (SEPC) and lasted until around 7:00 after SEPC, when the bottom of the valley due to the higher elevation of the sun were warmed enough. An exception occurred in the night of 02-03 July 2015, when in the territory of Slovenia came the cold front, it was a cloudy and rainy night with a slightly stronger wind.

This forecast has prevented development of thermal belts, so that the night temperatures in the lowland zone larger. The apparent existence of the thermal belt always give favorable conditions for the growth of vines and fruit trees. Even 81,2% of the vineyards are concentrated on the belt of relative height of 50 m. To the same extent is altitude of 54, 8% of all orchards. Vineyards and orchards in the band represents 27,7% of all forms of land use. However, the thermal band is still followed by a disproportionate share of extensive forms of land use. Forest land in the zone of 50 m cover 43,6% of the area in the zone, overgrown land 16,7%.

Distribution of forms of land use in relation to the bevel of the slope is expected to: arable land is still located on the slopes with steep bevels up to 15° above this limit, their share dropped significantly. At the higher slope increases the share of vine (those most-27,4% - in the class between 15° and 20°) and orchards. Meadows are located on steep slopes of 25°, built-up areas to 20° of inclination. The share of forests by increasing the rate of growth of the slopes relatively increases.

The forest on steep slopes have especially important protective function, because they prevent erosion and denudation: class of slope between 35 ° and 40 ° forests cover a third of the surface, on the slopes of greater than 40 ° even three-quarters of the land. Even in the distribution of land use in relation to the global solar radiation is considered a logical layout, but with the indication that most of the irradiated areas are not used to a large extent. The band is with the global solar radiation above 1100 kWh /m2 with maximum surface covered with vineyards (123.8 ha), but immediately followed by meadows (89,3 ha) of forest area (51,4 ha) of overgrown land (23,7 ha), areas of fruit in this class only 8,6 ha (or only 19, 6% of all areas of fruit-growing).

In the area of Zavrč, we analyzed changes in land use in the period of 2000-2014. The results show a distinct transition process of intensive land into less intensive, especially through the process of greening, vegetation and reforestation. In intensive forms of land use there is also reported a significant decrease. They are grown only in the field of fruit-growing.

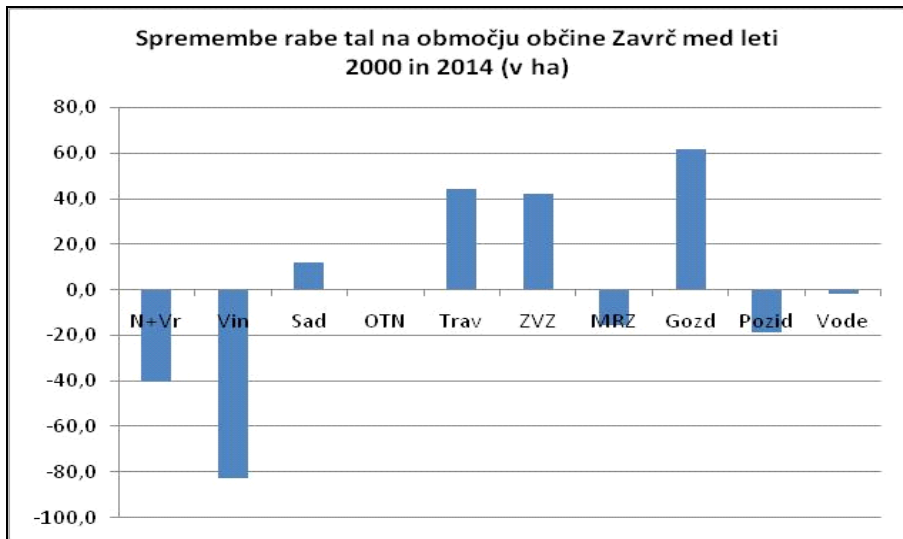


Figure 7: Changes in land use in the municipality of Zavrč between 2000 and 2014

The relationship between the processes of intensification and extensification in the municipality of Zavrč in this period in the ratio of 1:4.28. In other words, for every hectare of land use changes in the direction of intensifying played 4,28 ha in the direction of extensification.

There is a particular concern about the increase of overgrown land, which is in this period increased by 88,5%. On the positive side, there is increased fruit growing in the area, that is 12,1 ha or 37,8%. We have already mentioned that the eastern Haloze, especially in the area of Zavrč has been always known for its excellent vineyards. Viticulture administered by province, has always had typical landscape and identity (Bračič 1967). However, lately we witnessed the rapid potential for reduction. In this regard, we have an area of four cadastre where the proportion of potential maximum (when it comes to Hrastovec, Turkish summit, Goričak and Drenovec) analyzed changes in potential between 1824 and 2014.

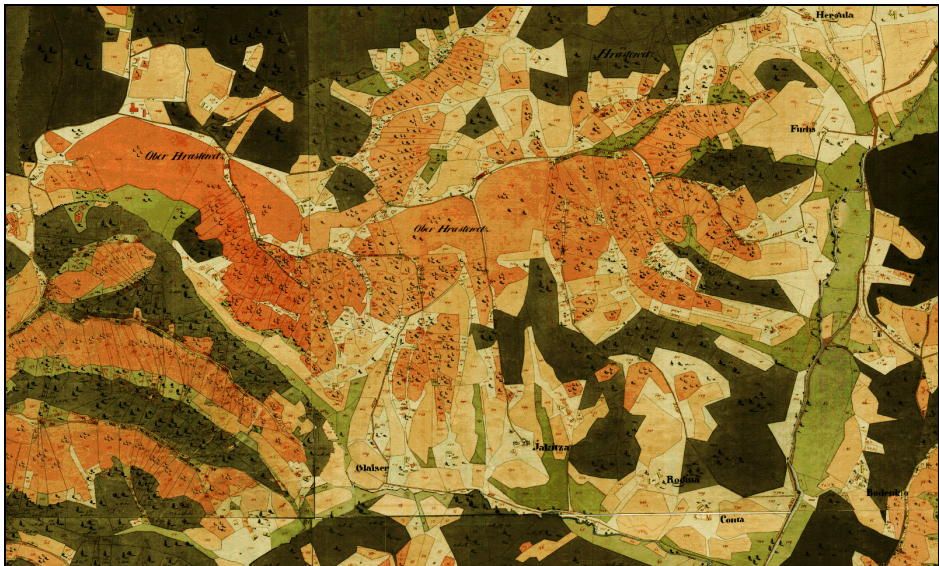


Figure 8: Hrastovec area on the map of the Franciscan cadastre in 1824. The red color shows the wine-growing areas, they were highly prevalent.

Source: Archives of Republic of Slovenia, 2014

It can be seen that the vine growing area of 1824-2000 increased by 37,9 ha. At the end of the 19th century, there were a lot of damage of vineyard vines, so they have a lot of insects of vines and vineyards should be build again. Vineyard sites at that time were in a very unfavorable abandoned sites (Valenčič 1970).

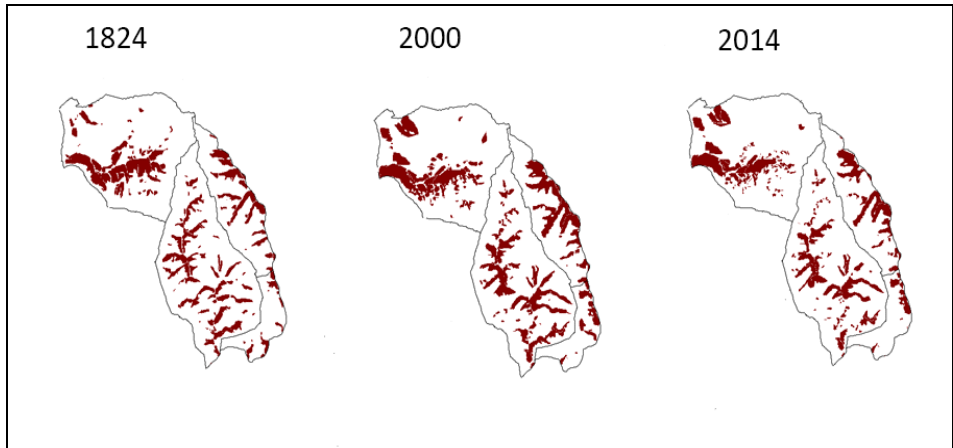


Figure 9: Viticulture areas in Hrastovec, Turški Vrh, Goričak in Drenovec in 1824, 2000 and 201 (in ha).

Source: Own calculations.

The period of withdrawal of potential re-accelerated after World War II (process of deagrarisation), and even more intensively since 1991. With a new social order and with the opening of borders, the role of agriculture weakened, but the process also accelerated the termination of service of agricultural complexes and denationalization (Žiberna 2014).

Because we want to demonstrate the utilization of the wine-growing potential, we have produced a map of vineyard bonuses. The criteria for the evaluation of vineyard were global solar radiation (in this indicator are the hidden data on the gradient and orientation of each location) and the relative height. For this purpose, we divided them into four classes according to their suitability for viticulture, with first-class positions representing the position of the highest quality.

Table 1: Viticultural Creditworthiness

Relative height	Global Radiation (kWh/m ²)		
	Under 1000	1000-1200	Above 1200
Under 25 m	4 class	4 class	4 class
25-50 m	4 class	3 class	2 class
Above 50 m	3 class	2 class	1 class

Source: Own calculations

It is somewhat surprising conclusion that the use of prime land highest in 1824 (41,4 percent), but today it is only 38,1 percent. In general, there are the higher utilization of the sub-prime areas, but at least for the time since the Second World War, it can be explained by the transition to mechanized cultivation of vineyards. In this context, due to the excessive costs of giving up, but well-irradiated sites, which have historically been processed manually. However, such an interpretation is also critical. Due to the large slopes in Haloze during the 60 years of the 20th century, there continues to be the most vineyards in the stands, it was possible machining on steep slopes. In any case, we can conclude that the potential of viticulture in the municipality of Zavrč is very large, but underutilized.

5. Conclusion

In the municipality of Zavrč, after natural geographic features, mainly due to the steep and complex terrain, a small part of the area and the moist soil at the bottom of the valley are less suitable for agriculture. Among the agricultural activities that are of such natural conditions that may include mainly viticulture and fruit growing in normal economic conditions can provide the most revenue. Vineyards located in Haloze include relief and local climatic criteria among the best in the world.

Unfortunately, the analysis of trends in land use change indicate different processes of greening, vegetation and reforestation. The potential for vineyards are largely unused, and then due to some adverse developments in the past (depopulation and denationalization), which now took its toll. Optimism sets completely vital demographic structure in Zavrč. In any case, there will have to be market-oriented agriculture - mainly vineyards and fruit growers - in eastern Haloze better integrated and unique and aggressive in placing their otherwise high-quality products, not only in the domestic market, but also beyond the borders of Slovenia.

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