

PERFORMING A CARTOGRAPHIC WORK TO UPDATE THE TOURIST MAPS WITH THE ROUTE OF THE WATER MILLS IN THE NATURAL RESERVATION "CHEILE RUDĂRIEI"

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Abstract. In the country of Almaj, the locality of Eftimie Murgu represents a gateway for presenting the tourist beauties of the area. It is located in the southeast part of the Municipality of Reșița, the county seat, about 80 km away. Here there is a place where the mills "grind time without time and the rocks hold their grudge, and the world of the past is of astonishing freshness where the clock stands still". The main tourist attraction is the Natural Reservation "Cheile Rudăriei", where the opening of the tourist route is represented by a chain of water mills with stilts that extends for 3 km along the beautiful valley of the Rudărica river. The purpose of this work is to update the cartographic base of the tourist route in the Rudăria mulinological park, with the presentation in 2D and 3D format, both digital and analog, by highlighting the altitudinal differences on level curves on plans and thematic maps. The work was requested by the Eftimie Murgu Local Council for a better presentation and tourist promotion of the "Cheile Rudăriei" Natural Reservation, highlighting it as the main attraction of the Almăj Country. For the creation of these maps and the interpretation of data from the field, specialized graphic processing programs were used, such as: Autocad, Raster Design, TopoLT, Global Mapper and GIS. The purpose of the data processing was to create a package of thematic maps in which the rough terrain was highlighted through level curves. At the same time, the tourist routes of the reservation were presented with the positioning of the water mills and the glade with the name "Lilac Day".

Keywords: thematic cartographic maps, level curves, 2D and 3D shapes, water mills.

INTRODUCTION

Before 1970, the locality known today as Eftimie Murgu, had the old name of Rudăria, in honor of the Rudărica river. The commune is located in the SE part of the municipality of Reșița, below the 45° parallel, having the coordinates on the northern latitude of 44°52'44.18", and on the eastern longitude of 22°05'39.66", being located at a height of 329 m from the sea level. (Figure 1.). (<https://www.primariaeftimiemurgu.ro/>)

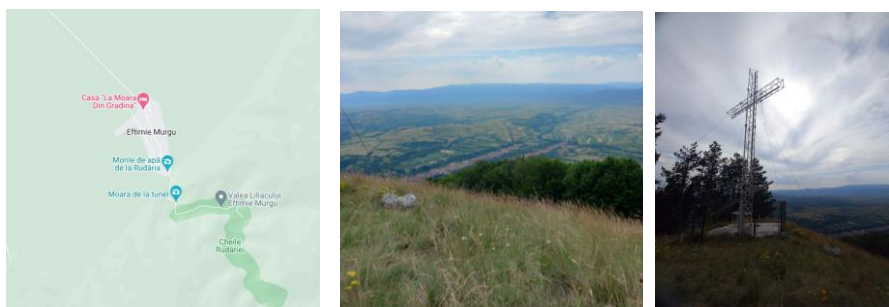


Figure 1. Layout of the Eftimie Murgu locality

The name Rudărica comes from the Slavic language, and "ruda" means iron ore and "reka" means river, thus suggesting the "iron river", referring to the place where iron ore is

extracted. This name reflects the area's rich history related to mining activities and its natural resources.

Around 1874, there were more than 600 water mills in the Almăj region, of which more than 300 mills were still in operation, fifty of which were located along the Rudăria river.

Today, only twenty-two mills remain, arranged like a string of beads along the banks of the water, in the village and downstream on the keys that stretch towards the mountain for a distance of nearly three kilometers. To amplify the power of the stream that moves the stones, the locals resorted to various methods, including digging tunnels in the rock, building dams from tree trunks or adapting the site of the mills to the narrower areas of the water.

The water mills on the Rudăria valley are testimonies of the traditional folk technique from Banat, lasting for over 100 years, being located on the course of the Rudărica river, more precisely in Rudăria keys in Eftimie Murgu commune, Caraș-Severin county.

These mills form a unique mulinological reservation. They have been included in the UNESCO heritage since 2004, representing an important symbol of the cultural and technological heritage of the region.

Today, the main tourist attraction in the "*Cheile Rudăriei*" is represented by the 22 water mills chain over a length of 3 km near the town of Eftimie Murgu, at an average height between 320 - 350 m above sea level, and a fairly significant fall of water on the course of the Rudărica river, also materialized through the construction of existing dams (Figure 2.).



Figure 2. Image of the water mills on the Rudărica valley

The water mills in this area are generally small in size, having a single shaft and being built predominantly of wood. The mills are generally used collectively - having several owners - and depending on the ownership share, each owner is assigned to use the mills, a certain number of hours per week for the purpose of grinding.

The main objective of the work consisted in the development of a detailed map of the area, highlighting the existing tourist routes, the positioning of the water mills and other points of interest in the park. An analysis of the relief was also carried out, taking into account the fall of water on the course of the Rudărica river and its influence on the altitude in different points of the park.

MATERIAL AND METHODS

For a better analysis of the proposed work area, it was necessary to carry out a prior recognition of the area and the shape of the land with the related rough. The office work required, in addition to the existing material, the establishment of the necessary material, which

was procured from the Reșița Cadastre and Real Estate Advertising Office and from the Administration of the Astra Sibiu Museum regarding the "*Cheile Rudăriei*" natural reservation.

Thus, the topographical maps of the area at different scales were established within the material requirements. (HERBEI, M. et al., 2013). In this regard, a number of 16 topographical plans at a scale of 1:5000 and a military topographical map at a scale of 1:50000 with the nomenclature L-34-117-A were purchased (Figure 3.).

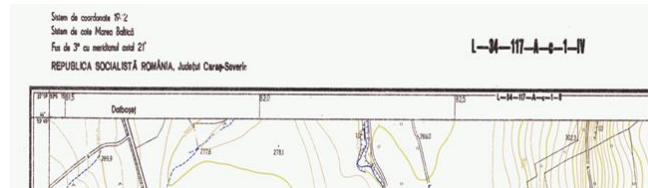


Figure 3. Topographic plan to scale 1:5000 L-34-117-A-c-1-IV

The tourist cartographic base made available by the Eftimie Murgu Town Hall was also used, which is to be updated and brought to the current standards and requirements for such an important tourist area.

After the analysis of the maps, the necessary work steps were established in order to digitize and vectorize the maps from analog format to digital format. Specialized graphic programs such as AutoDesk Raster Design, TransDatRO, TopoLT and Global Mapper were used for the informational realization of the computerized process. Google Earth and Google Maps online programs were also used (HERBEI, M. et al., 2016).

As methods used, with the help of TransDatRO, the geographical coordinates of the topographic plans and maps were transformed into absolute rectangular coordinates in Stereographic projection 1970, and with the AutoDesk Raster Design and TopoLT application, their digitization was carried out. The land analysis was carried out by the Global Mapper program and the online programs Google Earth and Google Maps (HERBEI, M. et al., 2012).

The atlas of conventional signs for topographic maps was used for the correctness of the representation of planimetry and relief details.

The next method, more precisely vectorization, is the process by which digital data is built with the help of images. The vectorization of plans and maps on the classic digital format was achieved by digitizing the characteristic elements and in 3D plan, bringing the images into an altitudinal vector format with the possibility of further exploitation.

This study was performed on layers and thematic layers for the final virtual maps. The created graphics were saved in files with the extension: CDR, EPS, TIFF, JPG, GIF, PNG, or other formats depending on the theme of each individual drawing (HERBEI M. V. et al., 2011).

Using cartographic data, the level curves were delimited and drawn on the basic thematic map, highlighting the variability of the land's altitude in relation to the water flow. This information will give visitors a better understanding of the relief and the difficulty of the tourist route according to the height of the land (PIȘLEAGĂ MIHAELA et al., 2017).

Finally, the paper presents the results obtained in the form of updated and detailed thematic maps of the Rudăria Mulinological Park, providing useful information for planning and carrying out tourist activities in the area.

RESULTS AND DISCUSSIONS

In the first part, for the realization of the project, a topographical map at a scale of 1:50000 (BÂRLIBA C. et al., 2015) was used from the area that includes the route of the "Rudăria keys" natural reservation along the Rudărica river, respectively a military map with the nomenclature L-34-117-A (Figure 4.).



Figure 4. Topographic map at scale 1:50000 L-34-117-A

The topographical map at this scale made it possible to analyze the land in detail (BÂRLIBA LUMINIȚA LIVIA, et al., 2014), as well as to identify the existing route, but especially the correct location of the water mills and other points of interest within the natural reservation "*Cheile Rudăriei*".

The map contains essential topographical details for drawing level curves and highlighting the altitudinal variations along the Rudărica river course and has been georeferenced and imported into the Raster Design computer environment for digitization (ELEȘ G, et al. 2016).

From the point of view of vectorization, the main planimetry and relief details were highlighted on the layers, especially the level curves, the access roads and the tourist itinerary, the water course of the Rudărica river and its tributaries (Figure 5.).

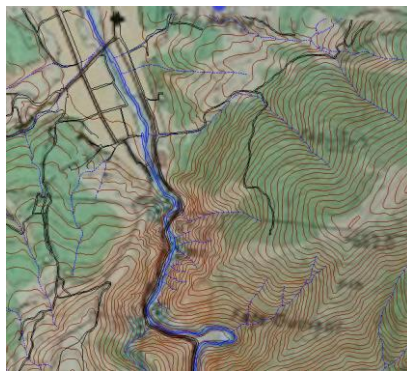


Figure 5. The map digitized by the AutoDesk Raster Design program

As part of the digitization process of the level curves, they were made in 2D plan using the "Spline" command (POPESCU G. et al., 2020). This allowed the detailed

representation of relief and altitudinal variations, which highlighted the position of other details of the land.

Using the Global Mapper computer environment by superimposing the work on the "Aster" satellite image, a three-dimensional image of the land was obtained in which the altitudinal position of all the details in the area of interest can be highlighted. This allowed to obtain a more realistic and accurate representation of the relief and a clearer visualization of the land rough, respectively the inclination of the water course (Figure 6-7.).

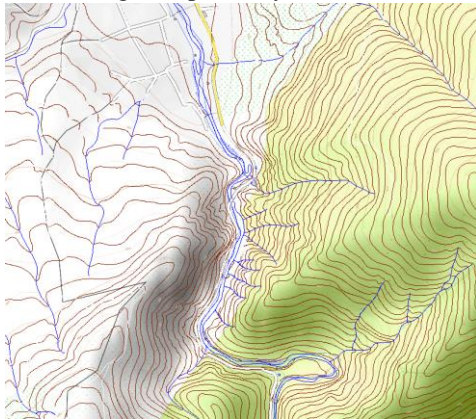


Figure 6. Level curves represented in 2D format

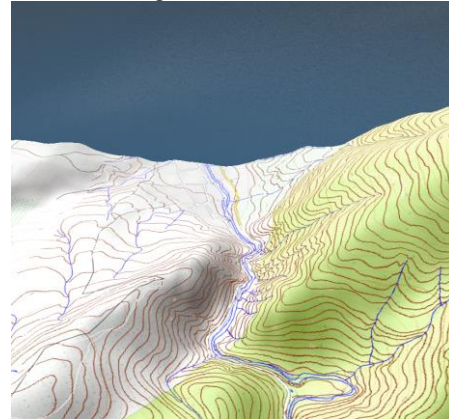


Figure 7. Level curves represented in 3D format

Therefore, by digitizing the level curves in 3D and integrating them into the original map, a more complete and accurate representation of the relief was obtained, providing useful and valuable information regarding the cartography or geographical research of the area, as well as for important activities in the area such as tourism. Thus, based on the land analysis, a complete and dynamic 3D topographic map was created (Figure 8.).

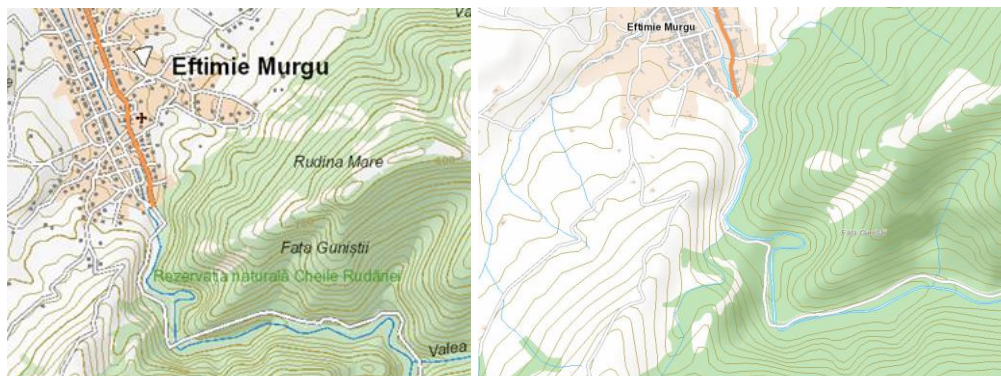


Figure 8. Final topographic map represented in 2D and 3D format

Land rough has been presented and overlaid on the current orthophoto in 2D and 3D format. This made it possible to extract accurate land elevation information at various points by assigning the correct elevations to each point of intersection between the contour lines and the orthophoto image (Figure 9.).



Figure 9. Overlay on orthophoto in 2D and 3D projection

The positioning of the water mills on the digitized map was carried out based on a satellite topographic survey (BOS, N. 2015) using the GNSS RTK system (SMULEAC, A. et al., 2015 and 2019) which was realized on both banks of the Rudărica river, in which the Z component was also taken into account. This made it possible to accurately represent the location of the mills in the geographical context of the area (Figure10.).

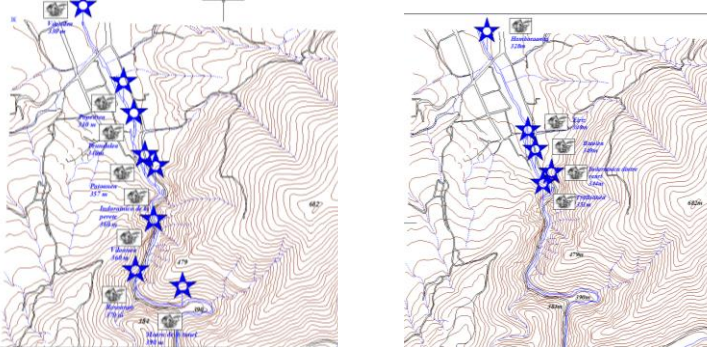


Figure 10. The location of the water mills on the left and right side of the Rudărica river

In order to create the tourist certificate of the area, the obtained data were processed through specific GIS programs (<https://ro.scribd.com/document/465568848/gis>) and handed over to the beneficiary in a package of thematic maps that included the aspect of the land, its exhibition and the disposition of the tourist attractions worth visiting in the area of the "*Cheile Rudăriei*" natural reservation presented in figures 11-13.

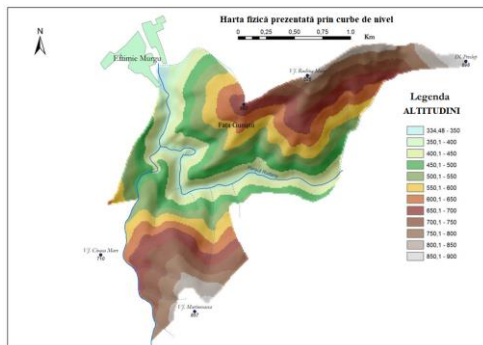


Figure 11. Level curves represented by hypsometric shades

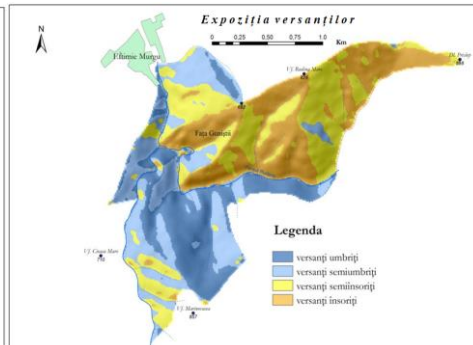


Figure 12. Presentation of the exhibition of slopes in 3D format

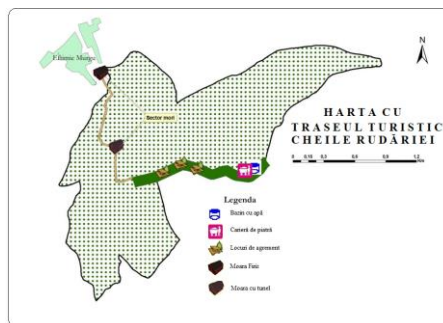


Figure 13. Map of the "Rudăria keys" tourist route

CONCLUSIONS

If you want the knowledge and history of the Kaplan turbines of the big hydropower around the world, it is opportune to visit Almăj Country in mountain Banat, on Rudăria valley, where there is a unique mulinological reservation in Europe.

The digitized maps made for the "*Cheile Rudăriei*" Natural Reservation are valuable documents, providing a new image of the altitudinal differences in the area and a better understanding of the route of the water mills.

These thematic plans represented an effective means for visualizing and analyzing the relief of the area as well as the distribution of water mills along the river course. They represent a better graphic presentation and improved tourist promotion of the "*Cheile Rudăriei*" Natural Reservation.

By making these thematic plans with the main touristic purpose, the value and natural beauty of this area, the water mills and the route in the Reservation can be highlighted.

Together with the photos taken in the area, new, more expressive leaflets could be created to be distributed to tourists wanting an adventure in the "Land of the Rudăria Water Mills".

In conclusion, thanks to digitized maps, more accurate and attractive promotional and tourist materials can be created for any of the tourist attractions in Romania, with the possibility of permanent updating.

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