

## Physical-geographical study of the Prahova Valley between Comarnic and Predeal, Romania

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**Abstract** *Prahova Valley is one of the most important tourism regions in the Romanian Carpathians due to its natural potential and multiple tourist facilities. The paper presents, in terms of geomorphology, the uniqueness and individuality of this Prahova Valley sector. Prahova Valley is framed into several mountain units that are various in both morphological and petrographic terms and give the landscape distinctive features. An area with a length of 35 km and a width depending on the watershed was analyzed. The aim of this study is to present how the geographical landscape of Prahova Valley has changed due to the Comarnic – Predeal highway, also called the road of snow. The national road was modernized and extended in several steps, traffic exceeding the infrastructure capacity and, thus, the decision to modernize this was taken. The maps that were necessary for tracing the possible route were the topographic map at 1: 25 000 scale and QuantumGIS Grass and ArcMap 10.1 software were used.*

**Key words** *Romanian Carpathians, River, Valley, Prahova, Highway*

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### Introduction

Prahova Valley Road was first mentioned in 1358 in a document in which the Hungarian king permitted free passage between and Buzau and Prahova to the merchants of Brasov. The first road was made by Sinaia Monastery monks. Timiș - Comarnic road was built by the Austrians in 1736, and then national road construction began in 1845. Around the 2000s, the axis of Bucharest-Ploiesti-Brasov-Comarnic traffic reached values much higher than any other road of the Carpathian Mountains arch. It was necessary to choose the route of Olt defile with localities Cozia, Turnu Roșu and Prahova Valley. In selecting this route, the values recorded on the two traffic corridors (22 413 cars per day on the route Bucharest - Ploiești - Brașov and 12.492 on the Bucharest - Pitești - Râmnicu - Vâlcea), topography and urban centers crossed by cars were taken into account, but also the fact that railway transport sector had reached the maximum. The requirements to be accomplished this highway are: 27 m minimum width, that means 2 bands/ direction of traffic, lack of intersections with major roads or railways, lack of speed restrictions due to curvature and declivity.

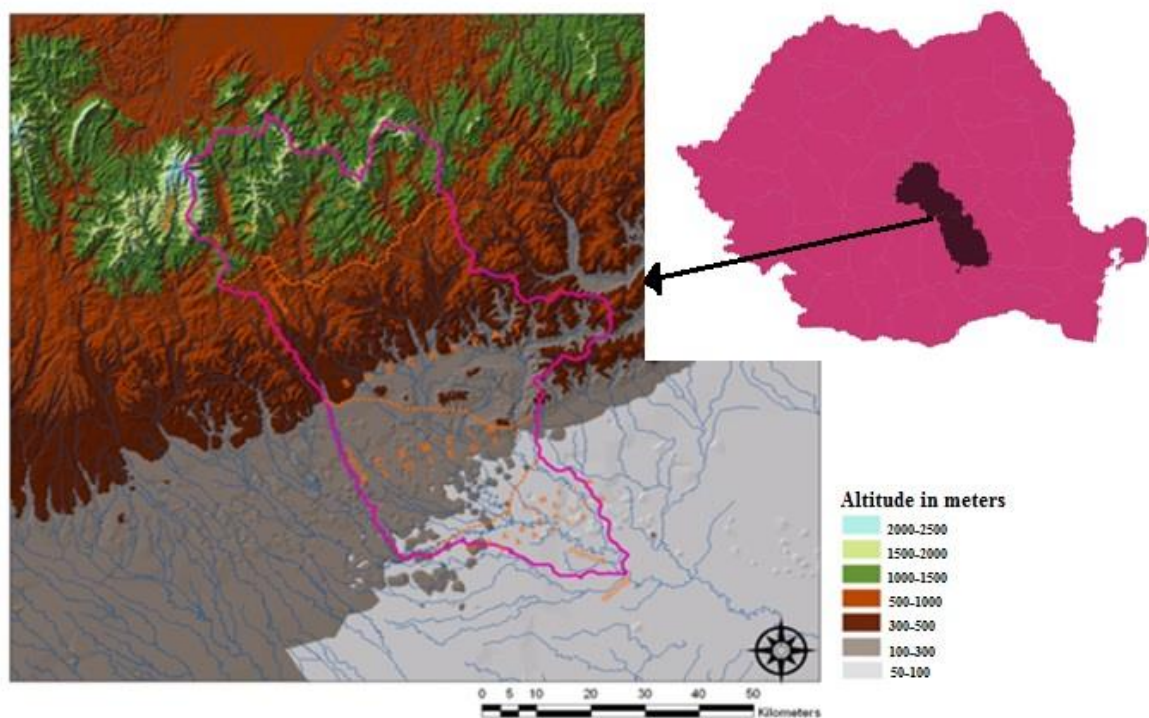
Prahova River is a second order tributary of the Danube, which springs from the Predeal town from Predeal – Clăbucetele area at about 1100 m altitude and flows into the river Ialomița on Gherghiței Plain. Prahova valley basin occupies a central position in the country, crossing the Carpathians Mountains from north to south and it is geographical boundary between the Eastern Carpathians and Southern Carpathians from east to west. Curvature Sub-Carpathians are crossing from north-northwest to south-southeast. Downstream, Prahova River crossing the Romanian Plain, but after about 100 km changes course and flows from west to east, conducting to the subsidence area from Plain Gherghița – Sărata. (Niculescu, 1960)

Prahova Basin extends into Carpathian, Sub-Carpathian and Romanian Plain, with an average elevation of 541 m. The basin is asymmetric because the right bank is 88% of the total basin surfaces.

Prahova Corridor is a way which links relief component of transcarpathian Bucegi Mountains. The landscape has changed continuously, with a rapidly evolving demonstrated by the expansion of human settlements, but also in terms of tourism or road.

## Results and discussion

The relief units of the studied area, is included in Carpathians (Bucegi), and in the Eastern Carpathians group (Baiului Mountains), separated by Prahova River and the southern boundary is Comarnic. Comarnic is located in the depression with the same name being the contact area with the Prahova Subcarpathians, extensions of Baiului Mountains. Between Prahova spring and Comarnic city and there are a lot of depressions along the river, bordered by Bucegi synclinal and Baiului anticline. In terms of river Prahova river basin is included in the southeastern group having a basin estimated at 880 km<sup>2</sup>, or approximately 0.369% of Romania surface (Figure 1).



Source: our processing ArcGIS

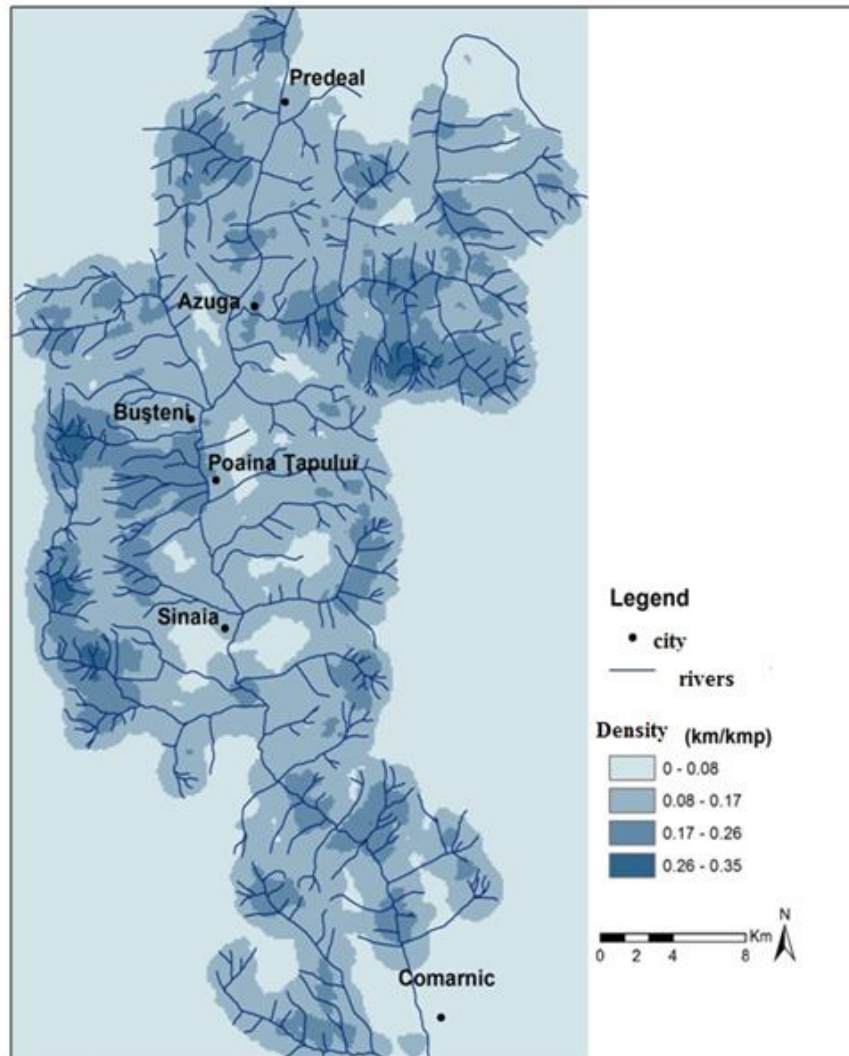
**Figure 1. The geographical position of The Prahova Valley in Romania**

### The morphometric and morphographical characterization of the study area

The drainage density is an important feature of the landscape as it provides necessary information for developing the tourism potential of the area. The map was made in specialized GIS software (ArcGIS, QuantumGIS). The topographic map and the river network were digitized and drainage density was calculated using the Density tool in ArcGIS software.

By analyzing the map, it can be noticed that density values of Prahova Valley between Comarnic and Predeal are 0 and 0.35 km/km<sup>2</sup>. Prahova Valley has the lowest density values between 0 and 0.08 km/km<sup>2</sup> in the northern part of Predeal City, in Azuga upstream and in the Buşteni City at the entrance, at the confluence with Cerbului Valley, Mărului Valley lower sector Grecului Valley and in upper sector of Seaca Valley (Figure 2).

The main values between 0.08 and 0.26 km/km<sup>2</sup> are found along the valleys, for example, in: Joiţa Valley, Polistoaca Valley, Vlad Valley, Ursoaia Valley, Great Valley, Little Valley and Ursoaia Valley due to the densest network of tributaries and anthropogenic activities, in this area being numerous deforestation. High values of drainage density are at the confluence with Azuga River and Prahova River in the middle of the Azuga village, but also in the Sinaia area. This is due to the presence of Sinaia and Azuga layers which have a high hardness and favoring the development of slope dynamic processes (runoff, torrents, and surfaces washes).



Source: our processing ArcGIS

Figure 2. The drainage density map

### The drainage density map

The depth of the relief drainage also indicates the degree of deepening of the valleys, is expressed in m/km. This is closely related to the density of drainage and vertical erosion intensity shows on watercourses. The map was made using ArcGIS applying Neighborhood function - Point Statistics. Depth values are derived from the difference between the maximum and minimum altitude of the relief measured per km<sup>2</sup>. High levels of energy relief are also found in areas where relief fragmentation is strong. It is noted that high relief energy values is recorded on the upper valleys of the main tributaries on the right side of Prahova River (Figure 3).

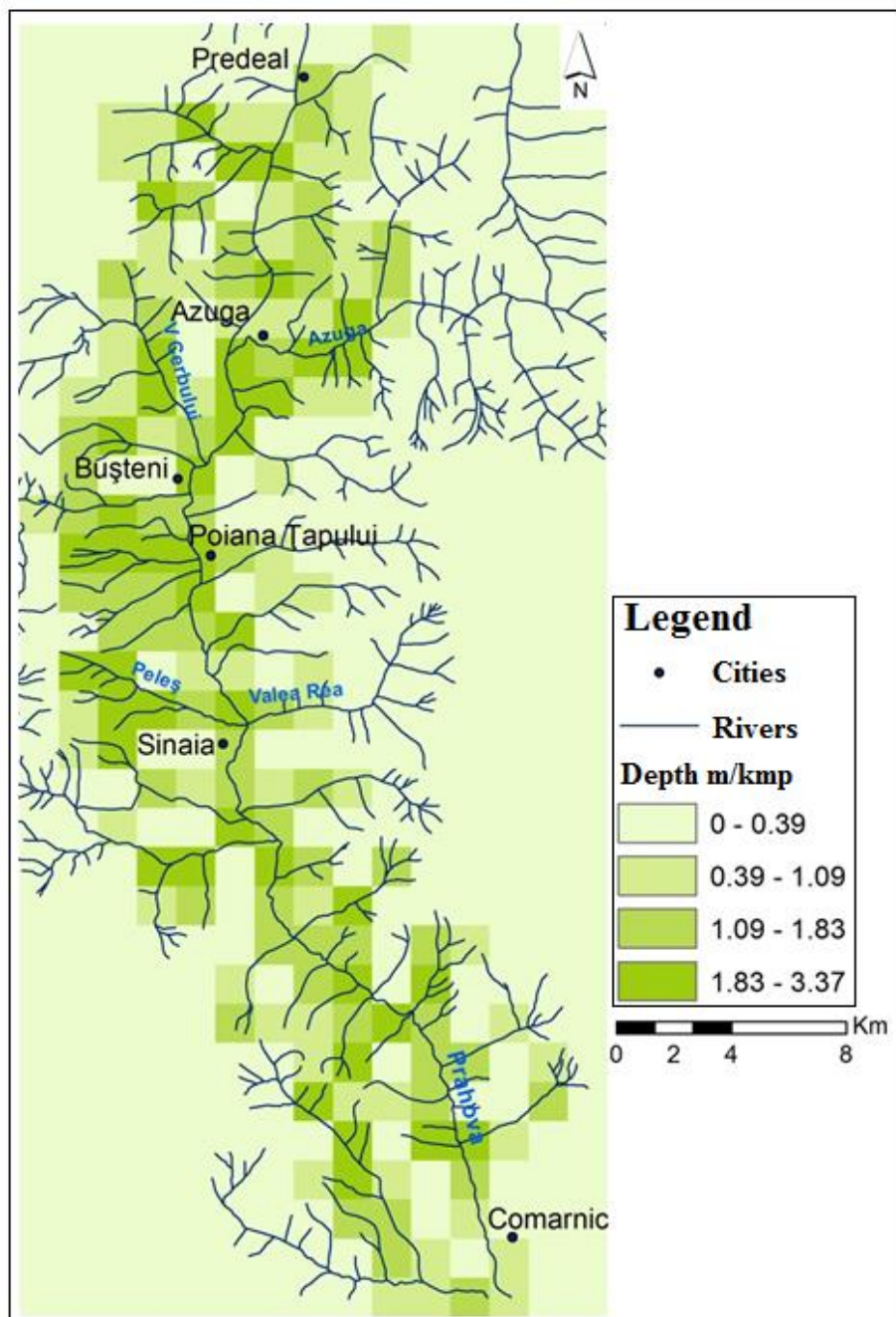
Drainage density resulting from the water courses activity of erosion that produce an improvement in relief surface or fragmentation of the relief plan. It also determines the vertical fragmentation resulting from deepening of each watercourse.

The most common relief energy values are between 0.39- 1.83 m / km<sup>2</sup> also are located at the confluence of tributaries (the creek Sec, Ursoaia Mare Valley, Ursoaia Mică Valley, Stănei Valley, Azugăi, Mărului Valley and Fetei Valley).

High values of up to 3.37 m / km are on the left tributaries courses of the Azuga village. The lowest values, below 0.39 m/km are meeting in the cities of Predeal and Bușteni.

The relief declivity map was created by applying functions to calculate slope by a numerical altitudinal model. The smaller slope below 5 ° correspond to interfluves and river floodplains, generally they fall into the category of 10 ° - 40 °, but there are slopes of 40 ° to 60 °.

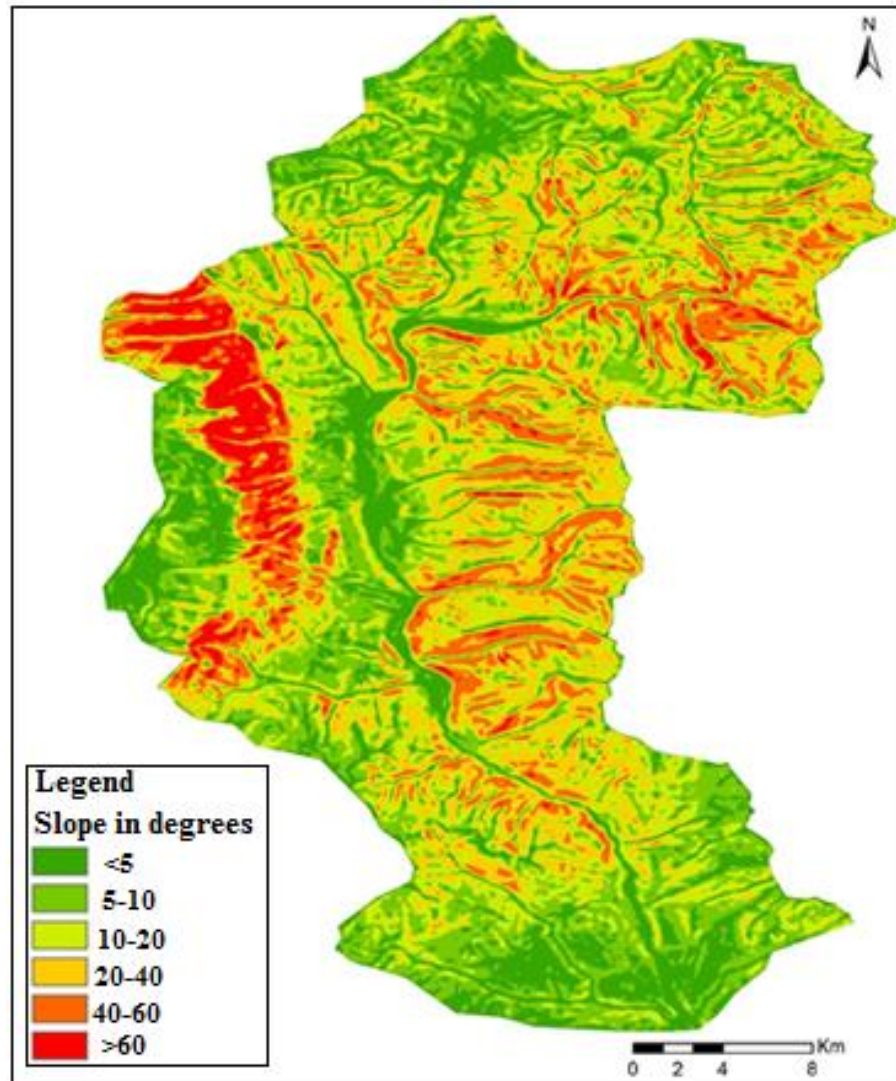
Valeria Velcea in 1961 classify slope from the Carpathian Prahova valley into two categories: major slopes, between  $40^\circ$  and  $60^\circ$  located on the eastern part of Bucegi Mountains. In these areas are common areas with ravines, slopes and petrography cliffs.



Source: our processing ArcGIS

Figure 3. The depth drainage map

The second categories of slopes are up  $40^\circ$  in the Bucegi Mountains massif, Baiului Mountains and Clăbucet.



Source: our processing ArcGIS

Figure 4. The slope map

### Conclusions

In conclusion, by performing these maps it can be better understand the evolution of the relief in the basin of Prahova Valley and the modeling processes are influenced by the movement of tectonic relief and action continuous of molding agents. An important role in the modeling is owned by hydrographic network.

Comarnic – Predeal - an impact on the landscape. The motorway route will include 18 tunnels with a total length of 2890m, plus a lot of bridges, overpasses, viaducts with huge opening up to 175 m and along its provided highway junctions in Sinaia, Bușteni and Predeal so highway would enter in mountains. To protect the ecosystem, was chosen as the construction underground galleries solution on the distance between Posada – Valea Largă.

Geological surveys were performed and revealed that there are frequent geomorphologic processes and the land has soft and friable rocks.

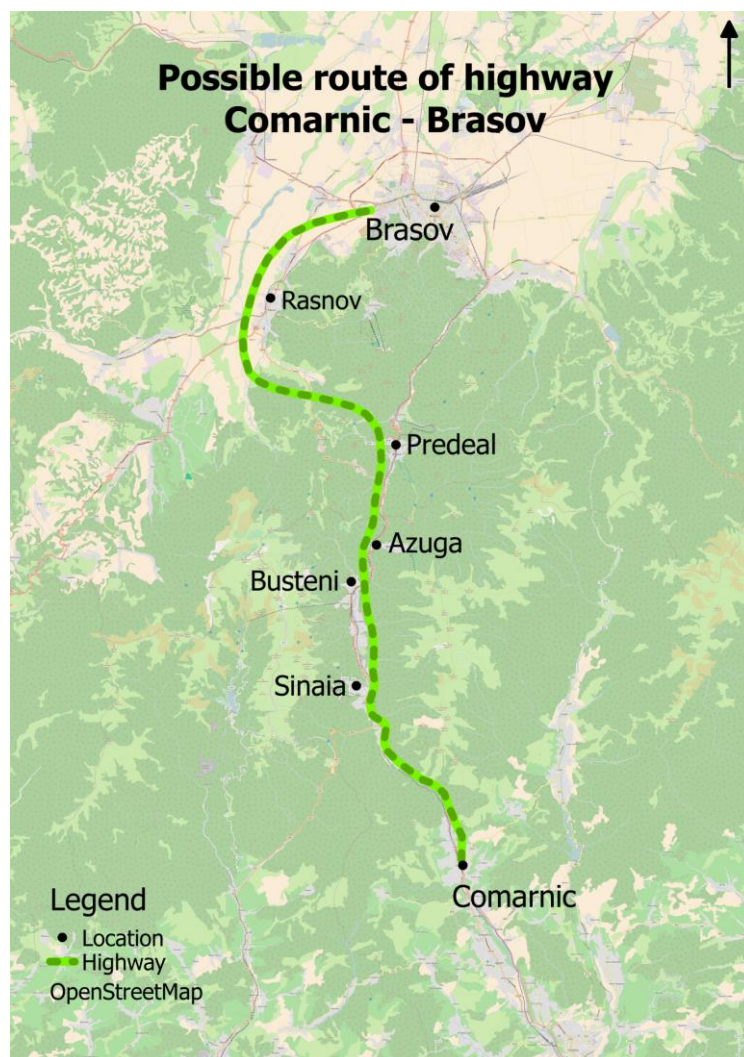
Geomorphological tunnels help to eliminate risk, and reduce building on a single thread (Dracului Valley, Posada – south Sinaia). Areas where the construction is unfavorable are caused by lack of space construction, both in mountain basins, and in urban centers, so most of the highway will run from Prahova river bed. In sector length between Comarnic – Predeal  $\frac{3}{4}$  is in river bed Prahova, which will influence the dynamics changing of the riverbed and slope changes course, banks, dams, canals, and building a lake for regulating the flow. This work lead to the disappearance of microforms, changing base levels and increased erosion downstream linear lake and the upstream side. Will be constructed embankments along the

riverbed to minimize gradients, to exclude the risk of flooding and link the glacia or rock of terraces. They must be equipped with drainage ditches and drainage tunnels for water evacuation.

Cuttings have a role in reducing the slopes values and ramps and will be achieved by cutting cones of dejection or the secondary interfluves.

These structures have a low weight and can be located at the entrances to underground passages. The wire domes and curtains protection will be made based on unstable slopes affected by the construction, especially in the south east to Sinaia and Predeal depression (Figure 5).

In conclusion, an impact on environmental relief in the area analyzed is high, for example in the gate area of Posada due underground galleries. Apart from the fact highway will provide positive aspects to be taken into account that significant changes will occur to the ecosystem and all elements of the environment will be affected.



Source: our processing ArcGIS

Figure 5. Possible route of highway

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