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RELIEF SUITABILITY TO PURPOSE OF DEVELOPING THE SKI DOMAIN IN OBÂRȘIA LOTRULUI AREA

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Relief suitability to purpose of developing the ski domain in Obârşia Lotrului area

Laurenţiu Ilie

Relief suitability to purpose of developing the ski domain in Obârşia Lotrului area. Relief and climatic conditions represent two defining elements for the development of a ski area in mountain area. The study proposes an evaluation of parameters of particle morphology and morphographic of relief, in order to identify the eligible areas. Analysis of slope and exposure of the hips, to which we can add the geology and current use of the land a high accuracy GIS project. The longitudinal profiles of the proposed slopes, constitutes a good tool for determining the degrees of difficulty of the slopes. At the same time, the study proposes new areas in order to develop tourist infrastructure for winter sports in accordance with European standards and in harmony with the environment.

Key words: Relief suitability, sky slopes, GIS, relief, Obârşia Lotrului

Sustenabilitatea reliefului în vederea dezvoltării domeniului schiabil în regiunea Obârşiei Lotrului. Relieful si conditiile climatice reprezinta doua elemente definitorii pentru dezvoltarea unui domeniu schiabil in arealul montan. Studiul de fata propune o evaluare a parametrilor morfometrici si morfografici ai reliefului in vederea identificarii arealelor celor mai eligibile. Analiza pantelor si a expozitiei versantilor la care se adauga geologia si utilizarea actuala a terenurilor au constituit un proiect GIS de mare acuratete. Profilele longitudinale ala partiilor propuse constituie o buna unealta pentru stabilirea gradelor de dificultate ale partiilor. Totodata, studiul propune noi areale in vederea dezvoltarii infrastructurii turistice pentru sporturi de iarna in conformitate cu normele europene si in armonie cu mediul.

Cuvinte cheie: pretabilitate, domeniu schiabil, GIS, relief, Obârşia Lotrului

1. INTRODUCTION

The area chosen for this work represents one of the areas "unexplored" of the Meridional Carpathians, in the case of Latoriţei Mountains in Parang mountains [1, 9]. The resort which will offer support of ski domain, namely, the resort Obârşia Lotrului, are the perfect setting for this development. In addition to the favorable development of the ski domain issues, presented in this paper, the development of the ski domain in Vidra area represents another factor indicating suitability of the area.

The work aims the development of the ski area in Obarsia Lotrului but also the union of this domain with those of Vidra resort, through cable transport installations. By merging the two ski areas this area could turn into the biggest ski area in Romania, internationally competitive.

Evaluation approaches of the relief are more important for the purpose of monitoring specific aspects of the favorable ski areas.

The selection of the mountains that will serve as the future domain holder, must be carried out according to certain criteria specific to mountain improvement dedicated to winter sports.

The integration of geographic data required the selection of the most expressive aspect that lie at its core [2] they were structured according the properties and their role in determining the potential of the relief.

After the altitude (Table 1): optimal 1000-1400 m, ideal 1400-2000 m, below 1000 m unfavorably. After exposure the slopes: optimal North, North-West, North-East; unfavorably: Southern Exposure, South-East. From the point of view of snow depth, optimal conditions it must have a thickness of over 10 cm of snow in continuous layer, the slope of the mountain must be between 11 degrees and 35 degrees, and the geomorphological risks are minimal.

In order to integrate the critical aspects of a ski area, in addition to the criteria of relief that an area must meet the criteria should be added the criteria linked to climatic factors. Climatic factors being the main actors that contribute to keeping snow depth, thermal comfort of prospective practitioners of winter sports but also with major involvement in what regards the production of same natural hazards [3].

The main climatic factors in order to maintain a continuous layer of snow are: solar radiation and cloud cover.

For a more accurate identification of the slopes, these criteria listed must be stacked to give a suitable area in all respects. Restricting or even elimination of variables will lead, in a safe way, to a space with a high percentage of pretability [4].

In addition to identifying suitable slopes is required to identify the areas with a low inclination (flat), which will serve for development of the tourist base, and the constructions needed to make the transport infrastructure on cable which slopes need.

Flat surfaces must be identified especially at the base of the slopes but also on their peaks for the installation of the various posts that will take into account the monitoring of slopes, and skiers. Extension of the flat surface on the base of the slopes is directly proportional to the surface on which is possible to build.

Nr.	Pameter	Class	Value
1	Altitude	Favourable	1400-2000m
		Optimale	1000- 1400m
		Least favourable	sub 1000m
2	Slope Exposure	1 Favourable	N
		2	NV, NE
		3	V, E
		4	SV, SE
		5 Least favourable	S
3	Slope Gradient	1	0-10 %
		2 Least favourable	10-15%
		3 Favourable	15-25%
		4 Very favourable	25-35%
		5 Unfavourable	35-45 %
4	Geomorphologic risk	Small	
		Medium	
		Large	

Table 1 Ideal parameters for the development of the ski domain

So after gathering information and indication of an area compatible with requirements, we need a proper development strategy in order to certify the suitability of the area for the purpose of developing ski domain [7].

Sport	Sex	Difference of level	Slope width
Downhill	Men	800-1100 m	min. 30 m
	Women	500-800 m	min. 30 m
Super G	Men	400-650 m	30 m
	Women	400-600 m	30 m
Giant slalom	Men	250-450 m	40 m
	Women	250-400 m	40 m
Special slalom	Men	180-220 m	min. 40 m
	Women	140-220 m	min. 40 m

Table 2 Standards approval ISF (International Ski Federation) for skiing competitions

The length of the ski slopes (Table 2) (L), is a very important variable in order to establish the national or international level of the resort. The length of the slopes is expressed in linear meters and is a determining factor for the suitability of the slopes.
The width of the ski slopes is another factor which must be carefully studied. Standard width for a cross-country ski run is 30 meters. The width of the slope can vary depending on the degree of inclination of the slope, to be able to give practitioners the opportunity to meander in the sectors in which the slope exceeds 30 degrees.

2. METHODOLOGY

In order to identify the geomorphological factors, present in this area, was used ArcMap and Arcscene software from package ArcGIS 10.1. These programs have been used for the extraction of data from the 1: 25,000 topographic map and the ortophotoplan with a resolution of 10 meters at the 2007's year level [6]. The data extracted from the surface topographic map were modeled during 5 stages with the purpose to establish the routes of the ski slopes (Table 3).

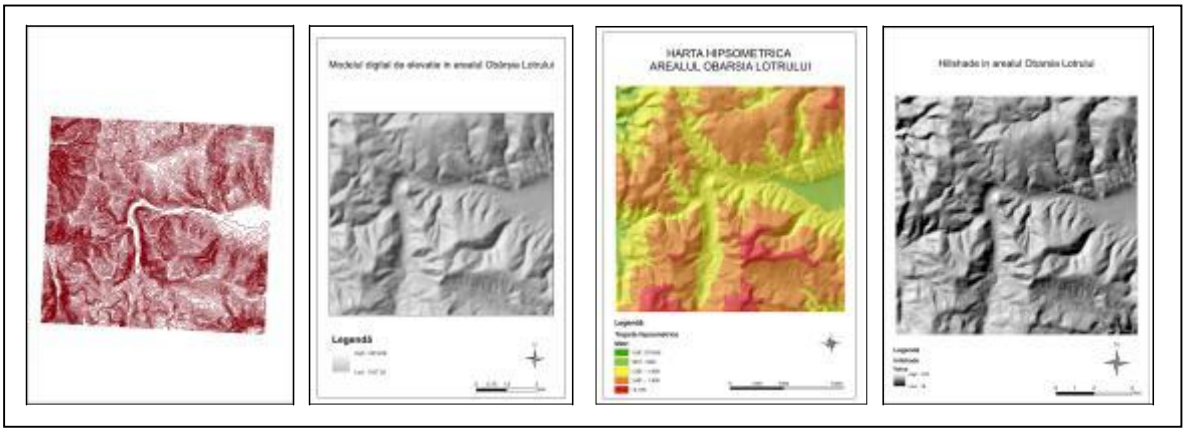

Figure 1. The first stage of the method

Digital raw data	Data sourse	Typology	Vectors associated fields	Use
Level curves with margins of 10 m	Topographic map scale 1:25.000, Images SRTM	Vectors of line type	Altitude	DEM (digital elevatiom model), orientation of slopes geodeclivity,
Hydrographic network	Topographic map scale 1:25.000	Vectors of line type	All the time Temporary	Relief's fragmentation
Altrimetrics odds	Topographic map scale 1:25.000	Vectors of line type	Descriptions	Hypsometric map
DEM	Topographic map scale 1:25.000 Images, SRTM	Raster data grid type	Elevation and geographical coordinates	different maps : orientation of the slop Map of the
Land use	Date Corine Land Cover, Ortophotoplan	Date vectors data polygon	Description, code	Land use map of the functionality of slopes

Table 3 Data source table

The first stage consisted in extracting level's curves, to which were attributed the elevational factor by introducing the altimetric odds. In the second stage, from extracted level curves has made a digital elevation model (DEM) [10] of the land through the command arctoolbox-spatial analyst command tools-interpolation-topo to raster (Figure 1). During this stage has made two maps necessary for determining the minimum and maximum altitudes.

These have been determined on the basis of model Dem of hypsometric map and hillshade. The way to achieve the hillshade is: Spatial analyst tools\/Surface\/Hillshade. In the third stage have made the following maps: the map of the slopes and the map of the exposure of the slopes, these two maps having a classification generated with a program, following the general aspects.

The fourth stage (Figure 2) was to reclassify those two maps, generated in the previous stage, depending on the ideal parameters in order to identify the areas with high pretability level.

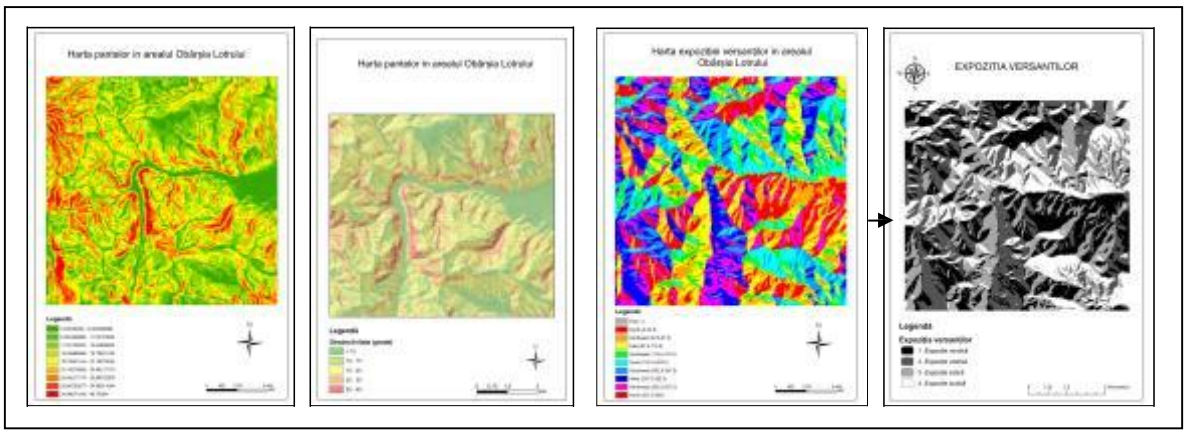

Figure 2. The fourth stage of the method

The last stage (Figure 3) of the method used, consisted in a new reclassification of the two maps, performed in the third stage, by assigning an index to each class in order to achieve a multiplication of rasters. Multiplying these two rasters quantify in the map of the area's pretability with the purpose of developing ski domain. Multiplication is performed through the computer raster function from subcategory Map algebra\/Spatial analyst tools.

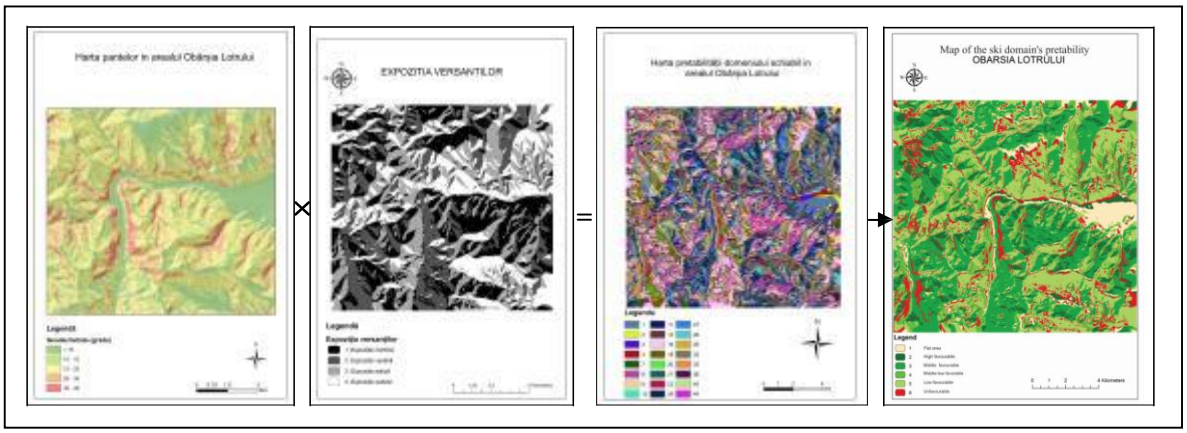

Figure 3. The last stage of the method

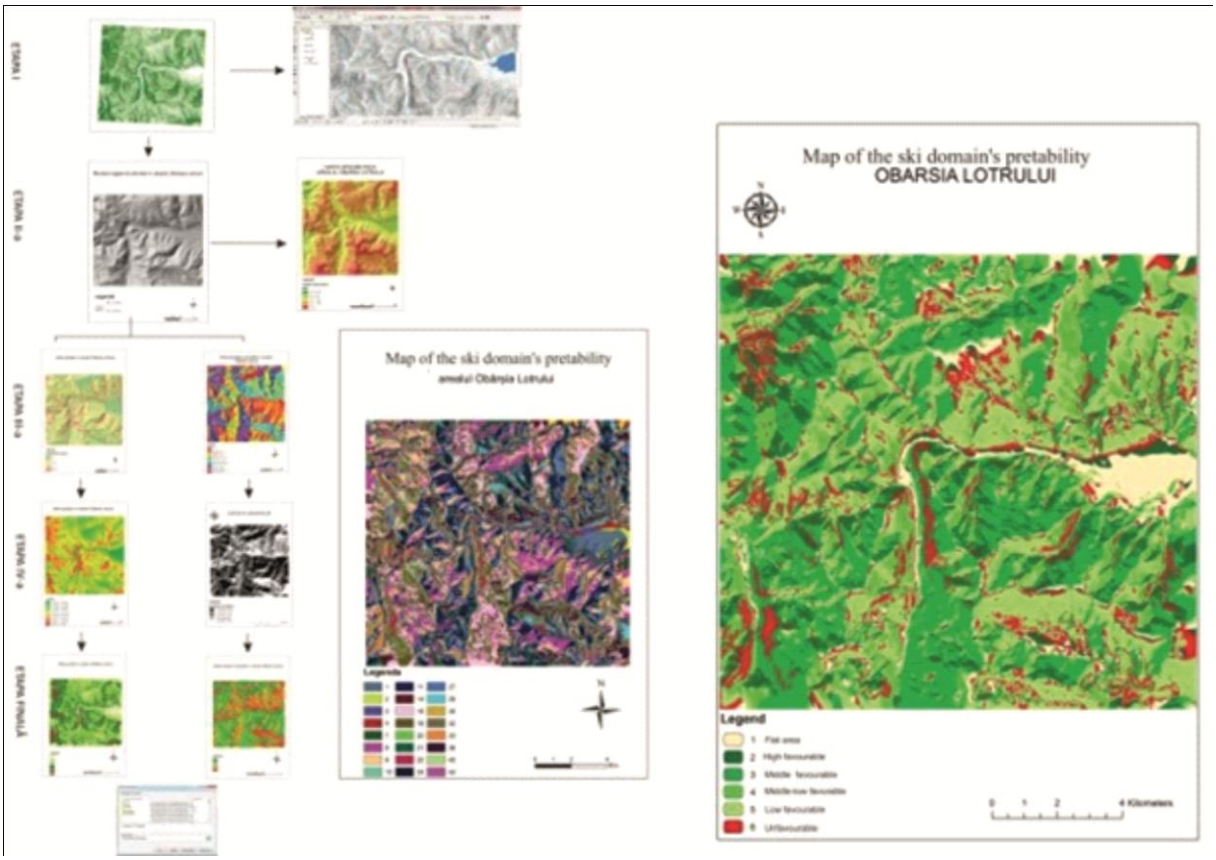

Figure 4. Scheme performed in order to achieve suitability map

Map of the ski domain's pretability, is the most important chart in order to prepare this study. This map is a overlying of many data, with the result of the areas suitable for the development of the ski domain (Figure 4).

The data which lead to the identification of the designated trails for winter sports are: slopes declivity and slope exposure and orientation of the slopes according the cardinal points. By overlaying the map with the orientation of the slopes according to the cardinal points with a map of the slopes was obtained this graphical material.

Following the development of the map, it was classified the areas included in this zone, in six classes, in order to identify areas with high pretability with the purpose to realize the ski domain in the area Obârşia Lotrului.

The six classes were made to designate the best slopes, with a declivity between 20 and 35 degrees and the best orientation of the slopes according the cardinal points meaning an orientation North and Northeast [8].

Due to the overlapping of the two maps of slopes and orientation of the slopes, was possible to identify the flat areas. Areas with a particularly high importance because they indicate the place where the constructions can be placed. Flat areas presented on the slopes are important for the construction of the heads of cable transport cars [5]. The flat area is represented by the first class of the legend. All through the making of this

classification, and encounter five classes, which confirm the suitability of the slope designated as a support for the ski slopes.

The area that includes mount Mieruţul Mieru and Vârful lui Ştefan, falls in green color spectrum, which is framed in two shades of green of the first two classes, with an overlay of the area with very high pretability level with the one with medium pretability level.

The map confirms the suitability of the natural conditions in order to develop the ski domain. (Figure 5)

3. RESULTS AND DISCUSSIONS

The method used to identify areas with a high pretability level, made possible the development of a model of the ski domain. (Figure 6)

For attestation of the slopes and for recognition of their favorability, each path presentation is required and highlight of the representative aspects. Key aspects are: the difference in the level of the slopes, the degree of inclination of slopes given at 1,000 meters, the exposure of the slopes where are these ski slopes, length, width, altitude slopes at which it take place and altitude at the base of the slope, optimal capacity of the ski slope, the flow of the ski slope.

On the northern slopes of Mieruţul and Mieru we proposed the development of 21 (Table 5, Figure 7) routes for ski trails. Of which: 8 tracks with slight difficulty, 10 with medium difficulty pistes and 3 slopes with high difficulty.

Index	Type of cable transport	Superior station altitude	Lower station altitude	Level difference	Route length	No. of seats	No. of places on seats	Total capacity	Time travel
T1	Chair lift T1	1805	1315	490	1980	80	4	240	11 min
T2	Chair lift T2	1645	1333	313	1060	42	4	168	5.8 min
T3	Chair lift T3	1959	1298	661	2600	104	4	465	14.4 min
T4	Chair lift T4	1952	1310	642	2550	102	4	448	14.1 min
T5	Chair lift T5	1879	1329	550	2010	80	4	320	11.1 min
T6	Chair lift T6	1630	1327	303	1580	60	4	240	8.7 min
TT1	Gondola lift TT1	2030	1330	1000	3800	140	66	840	10.5 min
T-t1	Ski lift T-t1	1558	1325	233	800	52	52	52	6.7 min

Table 4. List of ropenwise and general characteristics

Index	Mark	Exposure	Max altitude	Min altitude	Level difference	Medium angle	Length meters	Accesibility
P1	red	N,N-E	2030	1327	703	20	5260	Gondola lift T6 T1
P2	red	N,N-E	2030	1327	703	19	4380	Gondola lift T1
P3	blue	N	1630	1315	315	16	1500	T1
P4	red	N	2030	1310	720	24	4630	Gondola lift T4 T3
P5	black	N	2030	1298	732	28	4450	Gondola lift T4 T3
P6	blue	N	1558	1325	233	16	1000	Ski lift
P7	red	N	2030	1300	730	22	4750	Gondola lift T4 T3
P8	blue	N	1646	1333	313	15	1510	T2
P9	blue	N	1646	1333	313	14	1310	T2
P10	black	N	2030	1328	702	30	3960	Gondola lift
P11	red	N	2030	1310	720	18	4890	T4 T3
P12	black	N	2030	1328	702	31	4070	Gondola lift
P13	blue	N	1630	1327	303	16	1520	T1 T6
P14	red	N	1835	1315	520	21	2400	T1
P15	blue	N	1646	1328	322	15	1680	T2
P16	blue	N	1558	1325	233	16	1000	Ski lift TT1
P17	blue	N	1558	1298	260	17	1100	Ski lift TT1 T3
P18	red	N	2030	1329	701	23	4600	Gondola lift T4 T3 T5
P19	red	N	2030	1330	700	25	4700	Gondola lift T
P20	red	N	2030	1310	720	24	4800	Gondola lift T4 T3 T5
P21	red	N	2030	1329	701	23	4700	Gondola lift T4 T3 T5

Table 5. List of slopes and general characteristics

The total length of marked trails for winter sports, are measuring about 72 km.

All slopes are going down to the minimum altitude of 1300 meters on the base of the slopes.

Forest roads existing on these two hillsides Mieruţul and Mieru, will be used as parts, they will have a low degree of difficulty and their arrangement will have a minimal impact on the environment and especially on forest, excluding deforestation process. The presence of the forest roads is an advantage for ski domain because they allow climbing equipment, on a main top in order to arrange points of arrival for the cars of transport cable.

In order to facilitate the access of tourists to the ski slopes we have identified 8 routes for cable transport installations. Those 8 cable transport installations are divided

into 6 chair lifts with four seats, a ski lift and a gondola lift. Total transport capacity being of 1881 people in a range of 22 to 24 minutes (Table 4). Cable transport installations must be equipped with all the related equipment; foundations, metallic pillars and consoles with guide rollers, cable tracker, chairs. This will be the main access route to the Alpine abis in winter time when existing roads will be snowbound.

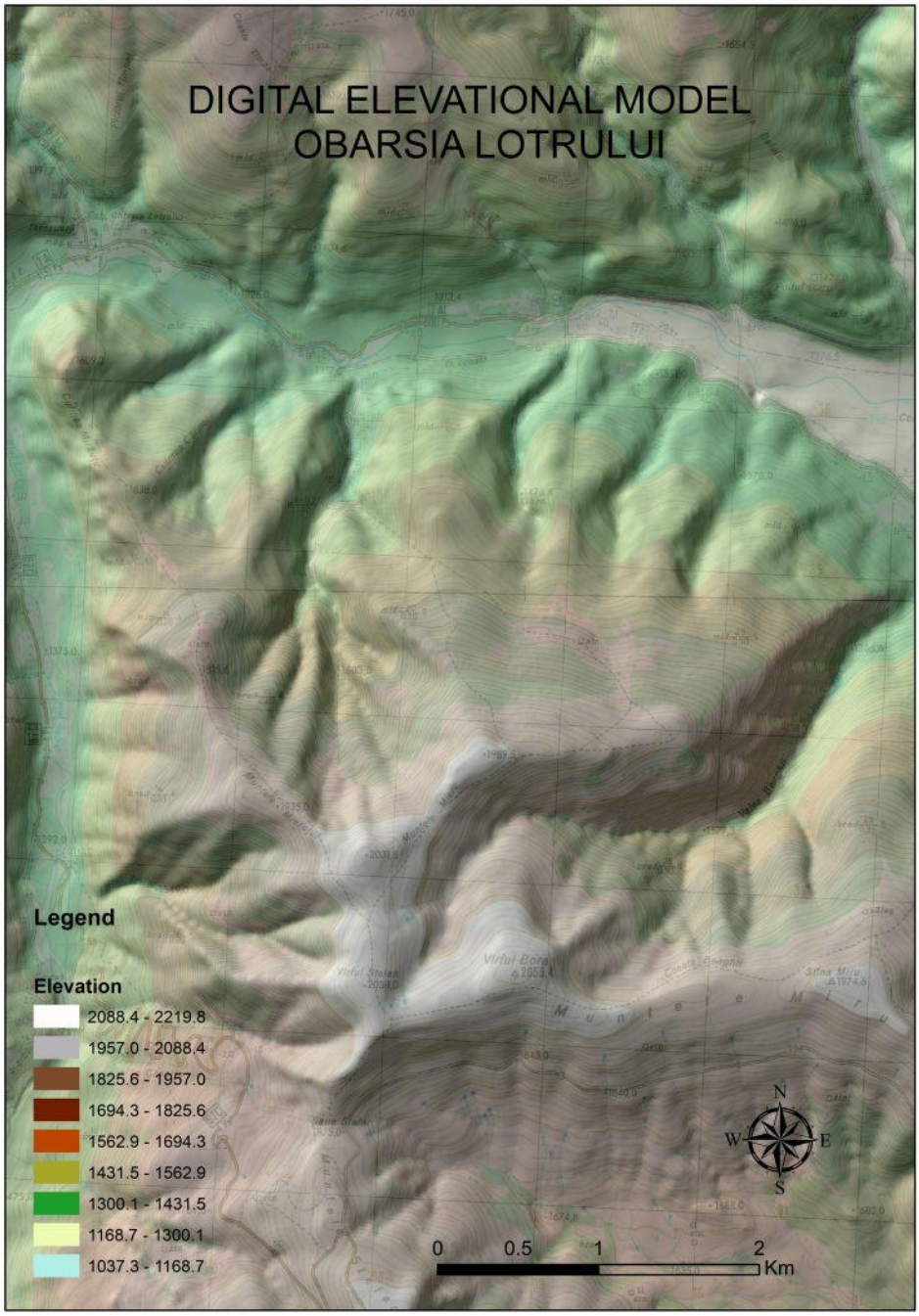

Figure 5. Digital elevation model in Obârșia Lotrului area

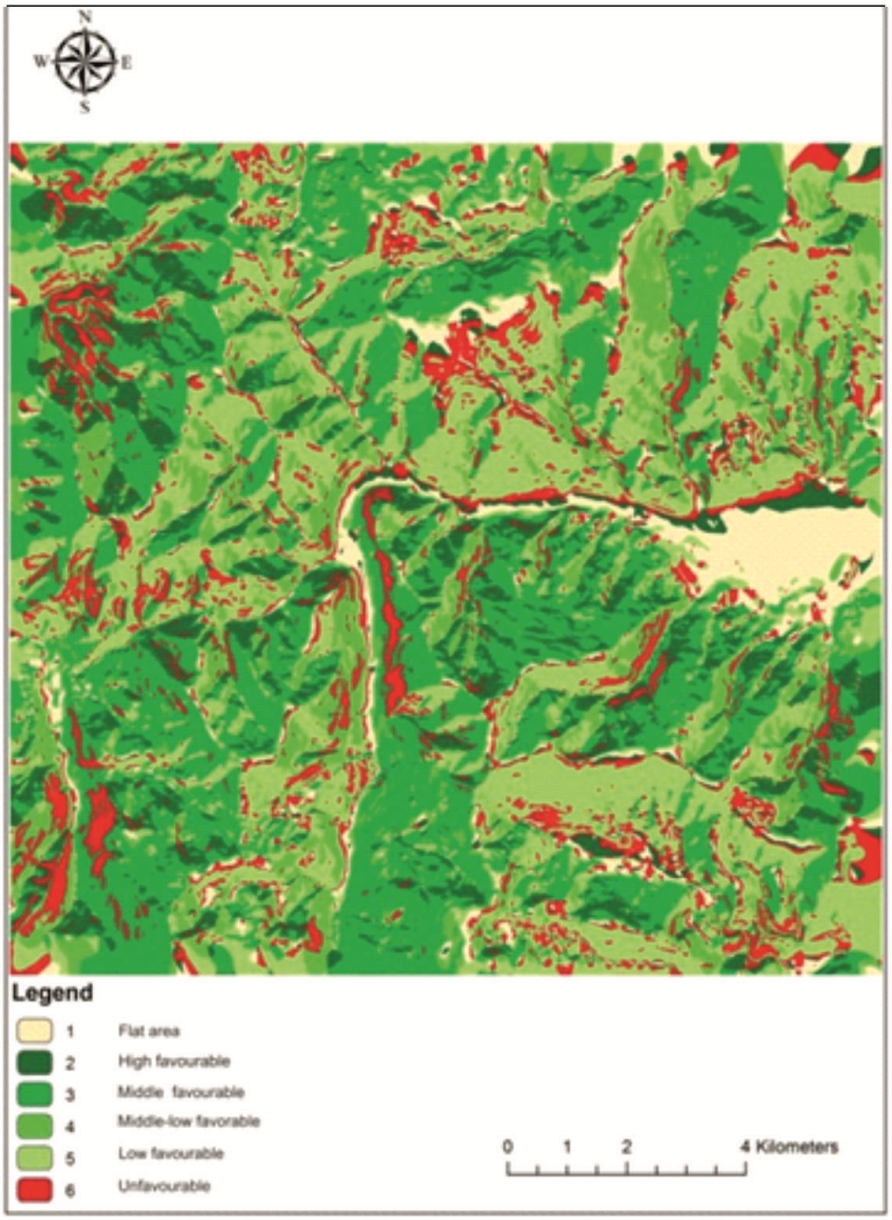

Figure 6. The map of ski domain

4. CONCLUSIONS

In the study, the resort Obârşia Lotrului possesses all the natural environment for the proper development of the ski area. They are: altitude, terrain, orientation, landscape slopes toward the cardinal points, the geographical position, geology, climatic conditions and especially the thickness of the snow and the average duration of melting snow.

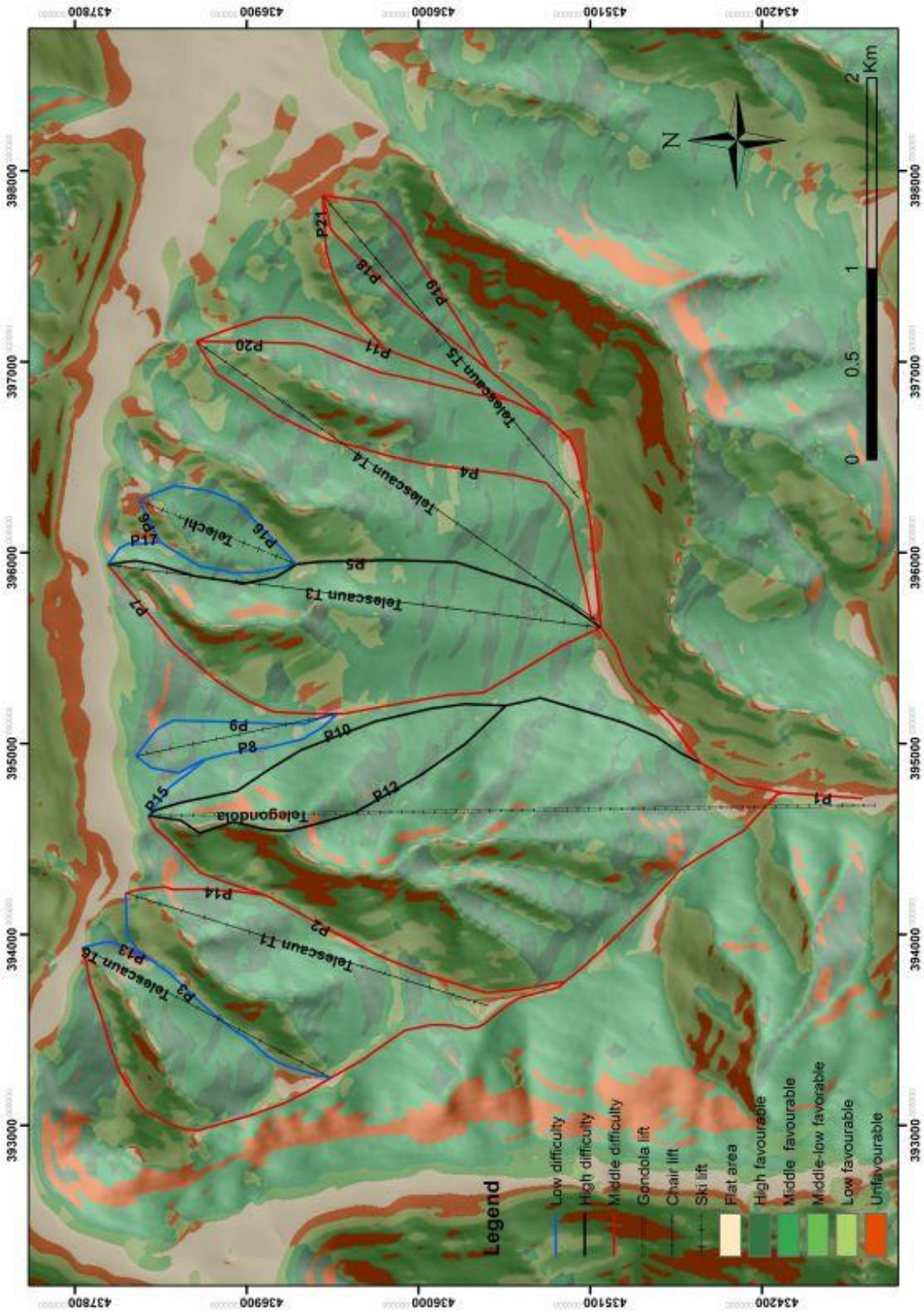

Figure 7. The ski domain in Obarsia Lotrului area

By placing cable transport installations and the routes of the slopes, skiers can reach the extreme Western point of the domain from the extreme east point without having to give up their skis but only using the carriage on cable. Distance from the West end to the East end of the ski area totaling approximately 7 km.

The tourist potential of the area is truly exceptional, and here it could be arrange a mountain resort with winter sports profile at European level which can also operate in other seasons for rest, recreation, treatment.

By joining cable transport installations of the resort Obârşia Lotrului with those present in the Vidra ski domain, this area may become the biggest ski area in Romania, internationally competitive.

The total length of marked trails for winter sports, are measuring about 72 km.

This resort lacks the accommodation unit. Now are two units of housing that can accommodate a minimum number of people in good conditions. I believe that with the development of tourist structure, there will be a rapid development once the ski domain is made in Vidra resort.

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