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Article

The Development of Ski Areas in Romania. What Environmental, Political, and Economic Logic?

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Abstract: In the last years, Romania has made major efforts to develop the skiing areas and some important projects have been implemented in the Carpathian Mountains. This research highlights the low efficiency of ski slopes and ski areas concerning the functionality during the winter season, even though a number of investments have been made. Some examples of bad practices regarding the development of skiing infrastructure in link with the potential impact on the environment are presented. The status of ski slopes, slope conditions, and snow depth were collected daily, during the 2016–2017 and 2017–2018 winter seasons, from a Romanian website specialized in snow cover information. A statistical analysis based on the collected data has been done. The 225 ski slopes studied have been opened, on average, less than 62 days and more than 20% of them have not even been opened. Only 17.8% of the slopes complied with the “100-day rule” during the first season and 21.3% of them during the second one, which does not ensure profitability. In conclusion, too many ski slopes have been created without considering the actual snow conditions. The investors wasted capital that is unprofitable and needlessly, affecting the environmental sustainability.

Keywords: winter sport tourism; ski slopes; ski areas; sustainability; investment; public policies; development impacts; climate change; Romania



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1. Introduction

Snow, the white gold, and all the sports that are associated with it, have allowed to develop a real tourism industry, first in Western Europe and North America, today in Central and Eastern Europe and in China. If, at the beginning, everything was sacrificed to develop and create ski resorts, nature and landscape, local populations, for economic efficiency, times have changed and sustainable development becomes the ultimate goal. Or, should we say, “should be the ultimate goal”.

Times have changed in another way, too: Global warming with weather disturbances, retreating or disappearing glaciers, and snow that only falls at high altitudes. Everywhere in Europe, low-altitude ski resorts, less than 1200 m, sometimes up to 500 m above sea level, go bankrupt and disappear or are in great difficulty if there are not massive investments to ensure the diversification of the activities offered to tourists.

In this context, the position of public and private decision-makers is not simple, separated by the desire to develop a potential resource—and job-creating activity—and the new environmental constraints. These constraints are no longer only of a conceptual nature, but are included in the programs of the major international bodies.

In 2014, an agreement between the United Nations and the International Olympic Committee (IOC) underlined that the two bodies “share the same values of contributing to a better and peaceful world through sport” [1], in substance, meaning that the IOC integrate the UN 17 Sustainable Development Goals [2].

How do Romanian decision-makers consider these different elements in their policy of developing winter sports, especially skiing? Are investments both economically and environmentally sound?

Situated in the heart of Europe, Romania is a country with an important tourism potential. If we speak about winter sports, the Carpathian Mountains represent the right place to practice skiing in this country. In general, high altitudes guarantee a long functionality of a ski slope during the winter. The relief is not so “generous” in this country from this point of view because 90% of mountain area is less than 1500 m [3]. The highest peak in the country is Moldoveanu (2544 m) and there are 22 peaks higher than 2000 m.

Before the Revolution of 1989, which marked the end of the communist period, the development of ski areas in Romania has not been the main focus of attention. Nor in the next years, during the post-communist transition, has the state of winter tourism improved considerably. The old infrastructure, the non-competitive prices compared to other countries like Bulgaria and Austria, and the poor quality of tourist services led to the loss of winter sports market [4].

Since the 2000s, when the Romanian economy experienced revitalization, a series of studies and projects have been made in order to see if a new ski infrastructure and the modernization of the existing one would be beneficial for the country. These actions have represented the premises for several future national projects [5].

An analysis of the natural tourist potential of the country focused especially on skiing led to the necessity of a project for modernization and extension of the ski areas, ski lifts, and other types of facilities for winter sports [6]. Thus, the Romanian Parliament adopted the Law No 526/2003 of 16 December 2003, approving “The National Program for the development of mountain tourism ‘Super-ski in the Carpathians’” with the main component “tourism for skiing and other winter sports”. According to Article 3 of this law, an integrated study was carried out by the Ministry of Transport, Construction, and Tourism, through the National Institute for Research and Development in Tourism, in collaboration with companies of design and consulting in the field. Three stages have been provided for the implementation of this program: The first one covered the resorts situated in the Prahova Valley area, which is the most representative region of winter sports in Romania, with an existing infrastructure and several tourism development projects in various phases of development; the second one included some resorts and tourist localities other than in the Prahova Valley; and the third one comprised new resorts or tourist centers in new locations, situated close to localities or in areas supported by only one chalet [7]. The areas where winter sports can be practiced (especially skiing) have been identified, and a diagnostic analysis of each one has been done. The partnership between central and local public administration on the one hand, and the private sector, on the other, contributes to the development of these areas.

A series of changes and regulations occurred in 2004, 2006, 2008, 2009, 2013, and 2019. In 2006, the title of the former law was changed, and it became “Ski in Romania”. If at the beginning, three types of resorts were considered, some of them with a background concerning the practice of winter sports, the new changes took into consideration the implementation of an integrated study in order to identify new areas [8].

Even if it was not a perfect legislation from the beginning, these laws represented the premises for the development of the ski infrastructure in Romania, the political part playing a key role in making decisions and implementing development projects. However, these investments were made differently, depending on the following classification of tourist resorts: Of *national interest* (51 resorts) and of *local interest* (75 resorts) [9]. Of these resorts, more than a half is situated in the Carpathian area. According to the article 12 of Government Decision No 122/2002 “the tourist resorts of national interest are included with priority in the annual tourist promotion programs, in the development of tourist products and in the development of the general infrastructure” [10]. It should also be mentioned that the priority for the investment programs financed by the state budget and by European funds. In other words, the developed tourist resorts were preferred for

investments. Nevertheless, the small localities that could not support themselves from agriculture applied for European projects, in order to make them more attractive to tourists.

In 2016, Romania had 183 certified ski slopes, with a total length of 161 km [11]. Taking into account the non-certified slopes as well, Romania counted 266 ski slopes (256.7 km) grouped in 92 ski areas, of which 112 slopes are easy and very easy (42.1%—89.5 km), 114 slopes have a medium level (42.9%—116.6 km), and 40 slopes are difficult (15%—50.6 km) [12]. In 2019, the number of certified slopes increased to 195, with a total length of 169 km [13].

Ski Slopes and Environment in Romania

Signatory of the *Framework Convention on the Protection and Sustainable Development of the Carpathians* adopted in Kiev on 22 May 2003, together with six other countries (Czech Republic, Hungary, Poland, Slovak Republic, Serbia, and Ukraine), Romania engaged to improve the quality of life, to strengthen the local economies and communities, and to conserve the natural values and cultural heritage [14], three elements very close to the “three pillars” of sustainability as defined by the Brundtland report [15].

Regarding sustainable tourism, we focused on the article 9(1) and (2) of this convention, which mentions that “The Parties shall take measures to promote *sustainable tourism* in the Carpathians, providing benefits to the local people, based on the exceptional nature, landscapes and cultural heritage of the Carpathians...”. To detail this general provision, we took into consideration *The Protocol on Sustainable Tourism* to the convention that have been adopted and signed by the parts during the third ordinary meeting, which was held in Bratislava on 25–27 May 2011 [16]. The article 1(3) of this protocol regulates specific substantive obligations.

Alberton et al. [17] underlined that this convention, coordinator of supranational policies, gives three precise and important recommendations in the field of tourism:

- To take into consideration the climate change for future tourism strategies and investments;
- To diversify the tourism in order to not be dependent on snow cover;
- To avoid using energy-intensive snow cannons.

Are these recommendations followed by effects? It is not so clear.

Investments in ski resorts must take into account the climate changes. This variable is underlined by all the authors having studied either the meteorology or the development conditions of ski resorts, not only in Europe but in the world as a whole. Scott, Steiger, Ruddy, and Johnson [18] cited by Goldblatt [19] highlighted, among others, that 11 of 19 previous Winter Olympic cities will be reliable hosts of winter sports in the 2050s and only six in the 2080s. In the traditional ski countries, France, Austria, and Switzerland mostly, ski resorts are closing, or other leisure activities are proposed (snowshoeing, hiking, mountain biking, etc.), and investments are focused on structures such as swimming pools, spas, etc. These resorts are transformed to achieve a functioning called “of the four seasons”. This conversion began during the 1990s, after a three to four-year period of very low snow cover in the late 1980s.

Ski slopes built at low altitudes need artificial snow to be operable as long as possible. The production of this snow involves a high consumption of energy and water, affects the fauna, flora, and soil, and pollutes due to substances introduced into the water [20].

Due to the increasing temperatures during the winter season, the quality of the snow cover is poor, and its existence is uncertain. Even artificial snow cover poses problems. To produce artificial snow, the temperature should fall under 1 °C without the addition of chemicals. As a consequence, only the ski slopes situated at higher altitude or north facing will be operable [16]. Beninston [21] in his study regarding the snow variability in the Swiss Alps argued that “large-scale forcing, and not local or regional factors, plays a dominant role in controlling the timing and amount of snow”. The research conducted by Bojariu and Dinu [22] concluded another way stating that, in Romanian mountain regions, this is exactly the opposite: Predominant in snow-pack variability are the local and regional

factors. A study carried out by Micu [23] regarding snow pack in the Romanian Carpathians showed that in terms of temperature “the 1990s marked indeed the beginning of a more evident warming process at most of the Romanian Carpathian sites, without being closely related to less frequent snowfalls . . . ”. The same study revealed that “warmer extreme winter temperatures tended to rise especially at medium and low altitudes” and the snow-pack duration is shorter at altitudes lower than 1600–1700 m. The author of this study predicted wetter and less snowy weather in the Romanian Carpathian Mountains for the next years.

As a result of a study concerning the impact of reducing the snow cover on the skiing conditions, the Romanian National Meteorological Administration noted in its 2016 report that “The number of days with good snow conditions for skiing during a season is decreasing in the Carpathians, in the context of climate change” [24].

Teodor [12] pointed out that, in order for a ski area to be functional, several relief and environmental factors must be considered, among which we mention: *Natural factors*—ideal slopes, northern, north-western, and north-eastern exposure of the relief, high altitude, level difference, as large as possible (correlated with the length of the slope and its degree of difficulty), accessibility to the ski area; *climatic factors*—temperature, snow depth, wind; *anthropic factors*—transport infrastructure (ski areas accessible to tourists), tourist infrastructure (ski lifts, accommodation, food, etc.); *economic factors* (ski equipment, ski pass, etc.).

Witmer, Filliger, Kunz, and Kung [25], cited by Abegg, Agrawala, Crick, and Montfalcon [26] and Marty [27], referring to the functionality of a ski slope, considered that “a snow depth of 30 cm is considered sufficient, 50 cm good, and 70 cm excellent”. In addition, Witmer et al. [25], cited by Yang and Wan [28], stated that only ski areas that are operable at least 100 days per season would be financially viable (so called “100-day rule”).

The development of any ski resort causes a series of damages, primarily on vegetation, soil, and landscape [29,30]. Deforestation, stripping of vegetation, or, sometimes, improper execution of a ski slope can lead to important damages, with adverse consequences for the environment. Concerning the landscape, we cannot forget the view of the pylons and cables, most often useless during summer but always clearly visible, the use of construction site machinery that compacts or tears up fragile soils, and the noise they make, as well as helicopters used to move loads, scaring wildlife.

Structural errors or failure to comply with environmental conditions can lead to real disasters. *Cocos* slope (1335 m long), an investment of 4.4 million euro of the municipality, built near the city of Bistrita, at a starting altitude of only 676 m, an arrival altitude of 457 m, and equipped with a chairlift and four snow cannons, is the most eloquent example. Although the construction was finished since February 2017, the slope was opened to the public after a year because of unfavorable weather conditions. A few months after the opening of the ski slope, the municipality announced that funding is needed for repairs “because of a landslide upstream of the designated accumulation lake for snow production” [31]. *How efficient can be this investment paid from public money for the inhabitants of this city and not only?* The slope was functional only 10 days in 2018 (January—three days, February—two days, and March—five days), and 14 days in 2019. Concerning the economic impact, a study by Bica, Schuster, and Stefanescu [32] showed that during the 2017–2018 winter season the maintenance costs were nine times higher than the revenues.

The lack of financial resources led to get stall of some ski projects or not be completed on time. An example is the *Rarau* ski slope with a length of 2850 m, a gondola lift, and nine snow cannons, inaugurated in 2019 after 10 years from the beginning of the works and in which 15 million euro were invested with a contribution of 90% of public funds [33].

The ski slope from Horea village was part of a project included in national program “Ski in Romania”. It started in 2010 and involved the construction of an 850 m ski slope, equipped with snow cannons and ski lift. For the technical project and deforestation (30 ha of forest) more than 300,000 euro were spent, but the project was abandoned in 2012 because of the lack of money. Another 2 million euro would be needed to complete

it [34]. However, when will this project be resumed, and if not, how many years are necessary for reforestation?

Copou ski slope near Iasi (the 4th largest city in Romania) was opened in 2014, with a length of only 420 m (departure altitude at 370 m and arrival altitude at 320 m). This slope is equipped with a ski lift and nightlight, its functionality depending on the climatic conditions favorable for skiing a very short period of time. However, even when it is functional, the slope has a series of problems such as technical breakdowns of the ski lift, which is old and unprofitable (the investment was not amortized until today) or the insufficiency of ski equipment for rent (only 20 equipment available) [35]. However, there is a solution for those who want to ski: In Iasi, the first indoor ski simulator in Romania has been opened, equipment used by snowboarders, too.

This list of examples could go on.

2. The Purpose of the Study

Vanat [36], in his yearly international report on snow and mountain tourism referring to winter season 2017–2018, stated that in Romania, “snow conditions can be very good through the end of March or even April”. This assertion is general and would require some refinements depending on the exposure, the runway, the altitude, and the region concerned.

Many important projects have been implemented in the Carpathian Mountains during the last years in order to develop the skiing infrastructure. Some of them considered the modernization of the existing ski resorts while others developed new ones. Two questions arise: What consequences do they have on the environment, mostly on the landscape, and which of them may appear as a real success or a failure, at the economic, sociologic, and environmental level? Taking into consideration the characteristics of Romanian mountain area and skiing infrastructure, this research aims to highlight *the low efficiency of ski slopes and ski areas concerning the functionality during the winter season, despite the fact that a number of investments has been made, either from public money, sponsorships, or European funds. At the same time, this research would like to present some examples of bad practices regarding the development of skiing infrastructure in link with the potential impact on the environment.*

Therefore, we hypothesized that:

1. Investments aimed at the development of ski slopes do not take into account climate change and the slopes can be functional only a few days per season or not at all.
2. Investors, private and public, fail to comply with international commitments regarding the use of snow cannons and other artificial means to maintain ski activity.

3. Materials and Methods

The research was carried out during the 2017–2018 winter season, from 29 November 2017 to 15 April 2018, with a total of 138 days. For certain analyses, we used also the data collected during the previous season (2016–2017), which were divided into two periods: From 19 November to 17 April, and from 21 April to 27 April, with three days break because of the lack of snow. This season lasted 157 days (see Table 1):

For this research we took into account 225 ski slopes from 69 ski areas of Romanian Carpathians Mountains, representing more than 80% of the total number of existing ski slopes in the country. The ski runs technically closed have not been included in the study.

The research design has been structured into two stages.

The *first stage* was focused on the ski slopes characteristics, starting altitude, and arrival altitude, collected from “Romania turistica” website, specialized in snow cover information [37]. Furthermore, the presence or absence of snow cannons has been taken into consideration.

Table 1. The period and the number of days the ski slopes were functional during the two consecutive winter seasons (2016–2017 and 2017–2018).

2016–2017 Month	Period of Time	Number of Days	2017–2018 Month	Period of Time	Number of Days
November 2016	19th–30th	12	November 2017	29th–30th	2
December 2016	1st–31th	31	December 2017	1st–31th	31
January 2017	1st–31th	31	January 2018	1st–31th	31
February 2017	1st–28th	28	February 2018	1st–28th	28
March 2017	1st–31th	31	March 2018	1st–31th	31
April 2017	1st–17th and 21st–27th	24	April 2018	1st–15th	15
Total	19th November–27th April	157	Total	29th November–15th April	138

In the *second stage* the *status of the ski slopes*, *slope conditions* and *snow depth* were collected daily, during the 157 days of the 2016–2017 winter season and 138 days of the 2017–2018, from the same website, for each functional ski slope included in the study. Each day was archived in a Word document, as text or snipped images, and then recorded in an SPSS file.

The variable *status of the ski slopes* was presented on the website with three categories: *Open*, *open-impracticable*, and *closed*. The open-impracticable slopes had some damaged areas because the quality of the snow was affected by warming weather. Consequently, for some statistics calculations, these ski slopes have been considered together with the closed ones. The average for each category of this variable has been calculated, by month, as well as the maximum and minimum percentage values.

The variable *slope conditions* reported on the website has three categories—*closed*, *impracticable*, and *wind*—relating to non-operable ski slopes, and another six for open ski slopes: *Open*, *difficult conditions*, *acceptable conditions*, *good conditions*, *very good conditions*, and *excellent conditions* placed on a scale progressively from bad to excellent. This scale is designed for the purpose of assessing the ease to ski on the slope, and the data are reported for the ski industry. The assessment is made by evaluators, based on several objective elements such as the snowfall from the past 24 h, its consistency, the slope grooming, etc., and could be a little bit different from a resort to another. This kind of scale is used in other countries, too, with more or less categories.

Closed, *impracticable*, and *wind* were considered together for some statistics calculations. The average, maximum, and minimum values, by month, have been calculated for each category.

The *snow depth* has been registered from the website only for the open ski slopes. Additionally, we calculated the average, the maximum, and the minimum of days that the snow depth had the highest value during the season.

Two parameters regarding *the length of the ski season for a ski area* have been considered:

1. The number of days that at least one ski slope was open in a ski area;
2. The number of days that a ski area has been operated at maximum capacity (all ski slopes of this ski area were open).

We created the first dataset, containing the following variables (see Table 2):

On the basis of the collected data, we performed a univariate and bivariate statistical analysis using SPSS Statistics 22.0 software.

Table 2. The variables included in the study for the second stage of the research.

Variables	Open Slopes	Closed and Open-Impracticable Slopes
1. Date	x	x
2. Name of the ski area	x	x
3. Name of the ski slope	x	x
4. Status of the ski slopes	x	x
5. Snow depth	x	-
6. Ski slope conditions	x	-
Total number of records (2016–2017)	35,325 (157 days × 225 ski slopes)	
Total number of records (2017–2018)	31,050 (138 days × 225 ski slopes)	
Total	66,375 records	

4. Results and Discussion

4.1. First Stage

4.1.1. Starting Altitude and Arrival Altitude

Analyzing the data concerning *starting altitude*, we observe that 19.11% of slopes are situated at less than 1000 m, 35.55% at less than 1200 m, and 66.22% at less than 1500 m. The *arrival altitude* is less than 1000 m for 35.56% of ski slopes, while almost 80% are less than 1500 m. The ski slopes situated entirely at least 1500 m high represent 20.44% of the total, in fact, a small percentage, considering the impact of climate change on their functionality (see Table 3).

Table 3. Contingency table: *Starting altitude* and *arrival altitude* of the 225 ski slopes.

Starting Altitude (m)		Arrival Altitude (m)				Total Slopes
		<1000	1000–1199	1200–1499	1500–1999	
<1000	Count	43.00	0.00	0.00	0.00	43.00
	% of Total	19.11	0.00	0.00	0.00	19.11
1000–1199	Count	21.00	16.00	0.00	0.00	37.00
	% of Total	9.33	7.11	0.00	0.00	16.44
1200–1499	Count	13.00	27.00	29.00	0.00	69.00
	% of Total	5.78	12.00	12.89	0.00	30.67
1500–1999	Count	3.00	7.00	20.00	33.00	63.00
	% of Total	1.33	3.11	8.89	14.67	28.00
≥2000	Count	0.00	0.00	0.00	13.00	13.00
	% of Total	0.00	0.00	0.00	5.78	5.78
Total slopes	Count	80.00	50.00	49.00	46.00	225.00
	% of Total	35.56	22.22	21.78	20.44	100.00

If we refer only to the 175 functional ski slopes during the 2017–2018 winter season, the departure is situated at less than 1000 m for 16% of slopes, less than 1200 m for 30.86%, and less than 1500 m for 63.43% of them. The percentages of the arrival altitude are similar to those calculated for the entire sample: 32% of slopes less than 1000 m, 55.43% of them less than 1200 m, and 77.72% of ski slopes less than 1500 m (see Table 4).

Table 4. Contingency table: *Starting altitude and arrival altitude* of the 175 functional ski slopes during the 2017–2018 winter season.

Starting Altitude (m)		Arrival Altitude (m)				Total Slopes
		<1000	1000–1199	1200–1499	1500–1999	
<1000	Count	28.00	0.00	0.00	0.00	28.00
	% of Total	16.00	0.00	0.00	0.00	16.00
1000–1199	Count	15.00	11.00	0.00	0.00	26.00
	% of Total	8.57	6.29	0.00	0.00	14.86
1200–1499	Count	10.00	23.00	24.00	0.00	57.00
	% of Total	5.71	13.14	13.71	0.00	32.57
1500–1999	Count	3.00	7.00	15.00	27.00	52.00
	% of Total	1.71	4.00	8.57	15.43	29.71
≥ 2000	Count	0.00	0.00	0.00	12.00	12.00
	% of Total	0.00	0.00	0.00	6.86	6.86
Total slopes	Count	56.00	41.00	39.00	39.00	175.00
	% of Total	32.00	23.43	22.29	22.29	100.00

4.1.2. Snow Cannons

About a half of the ski slopes were equipped with snow cannons (48.89%). If we count only the functional slopes, snow cannons were present on 56.67% of them. More important is to know at what altitude are situated the slopes who benefit from this facility. Therefore, we analyzed this variable crossing with starting and arrival altitudes. The values of these variables have been grouped by class intervals.

At a first analysis of the data, the ski slopes with departure at least 2000 m altitude were not equipped with snow cannons. The highest proportion was registered for the slopes situated at less than 1000 m (67.44% of them, calculated for all the ski slopes and 85.71% of them, if we take into consideration only the functional slopes during the 2017–2018 winter season) (see Table 5).

Table 5. Contingency table: *Snow cannons and starting altitude*.

Starting Altitude (m)		All Ski Slopes (225)			Functional Ski Slopes (175)		
		Snow Cannons			Snow Cannons		
		Yes	No	Total	Yes	No	Total
<1000	Count	29.00	14.00	43	24.00	4.00	28
	% within SA *	67.44	32.56	100	85.71	14.29	100
1000–1199	Count	17.00	20.00	37	15.00	11.00	26
	% within SA	45.95	54.05	100	57.69	42.31	100
1200–1499	Count	38.00	31.00	69	35.00	22.00	57
	% within SA	55.07	44.93	100	61.40	38.60	100
1500–1999	Count	26.00	37.00	63	25.00	27.00	52
	% within SA	41.27	58.73	100	48.08	51.92	100
≥2000	Count	0.00	13.00	13	0.00	12.00	12
	% within SA	0.00	100.00	100	0.00	100.00	100
Total	Count	110.00	115.00	225	99.00	76.00	175
	% within SA	48.89	51.11	100	56.67	43.43	100

* SA—Starting altitude.

In order to extend the functionality period of the slopes, investments were made in snow cannons even on the slopes located at least 1500 m altitude (48.08% of them being equipped).

Concerning the cross-classification table between the snow cannons and arrival altitude we observe that there are ski slopes equipped with snow cannons in all the four class intervals. As the arrival altitude increases, the percentage of snow cannons presence decreases. The highest proportion of slopes with snow cannons was registered at an arrival altitude less than 1000 m (61.25% of them, calculated for all the ski slopes and 73.21% of them, calculated for the functional slopes during the 2017–2018 winter season) (see Table 6).

Table 6. Contingency table: *Snow cannons and arrival altitude.*

Arrival Altitude (m)		All Ski Slopes (225)			Functional Ski Slopes (175)		
		Snow Cannons			Snow Cannons		
		Yes	No	Total	Yes	No	Total
<1000	Count	49.00	31.00	80	41.00	15.00	56
	% within AA *	61.25	38.75	100	73.21	26.79	100
1000–1199	Count	25.00	25.00	50	23.00	18.00	41
	% within AA	50.00	50.00	100	56.10	43.90	100
1200–1499	Count	24.00	25.00	49	23.00	16.00	39
	% within AA	48.98	51.02	100	58.97	41.03	100
1500–1999	Count	12.00	34.00	46	12.00	27.00	39
	% within AA	26.09	73.91	100	30.77	69.23	100
Total	Count	110.00	115.00	225	99.00	76.00	175
	% within AA	48.89	51.11	100	56.67	43.43	100

* AA—Arrival altitude.

The Romanian ski slopes were equipped with snow-making facilities not only at low altitudes, due to climate change affecting the snow cover duration and, implicitly, the length of the ski season.

4.2. Second Stage

4.2.1. Efficiency of the Ski Slopes: The Status of the Ski Slopes

The winter season 2017–2018 started at the end of November 2017, with an average of 5.11% open ski slopes (compared to 1.04% in the previous season) and a maximum of 7.11% (3.11% in 2016–2017 season). In December, there were no remarkable values in terms of ski slopes status, on average about 24% of them being operable (26.11% one year before), with a maximum of 46.22% open slopes compared to 47.11% a season earlier. In fact, we are witnessing a staggered season, the highest average being registered in February (68.9%), even if the maximum of open ski slopes was reached in March. The previous season recorded a maximum of 67.11% in January and February, and the highest average in February (63.83%). In average, the number of open ski slopes throughout the season was 44.33%, compared to 35.96% in 2016–2017. Furthermore, it should be noted the high average percentage of closed and impracticable ski slopes in December 2017 (76.03%) as well during all the winter season (64.04% in 2016–2017 and 55.7% in 2017–2018) (see Table 7, see Table 8).

The season 2016–2017 began in November with a small percentage of open slopes, which is normal for this period. As shown in Figure 1, in December, we observed increases and plateaus, reaching a maximum of 47.11% open slopes in the last day. Only on 5 January was the percentage of open slopes (50.67%) higher than those of closed and open-impracticable, with a maximum between 29 January and 2 February (67.11%). 9 March was the day when the percentage of functional slopes decreased below 50%. The curve

continued to decline until 17 April. The lack of snow led to the closure of the ski slopes for three days (18, 19, 20 April). Starting with 21 April, less than 10% of the slopes were reopened for another seven days and the ski season closed on 27 April (see Figure 1).

Table 7. The ski slope status—average, maximum and minimum values, by month, during the 2016–2017 winter season.

Status	Month Index	November 2016	December 2016	January 2017	February 2017	March 2017	April 2017	Total Season
Open (%)	Av ¹	1.04	26.11	60.16	63.83	35.00	3.63	35.96
	Max ²	3.11	47.11	67.11	67.11	62.22	9.33	67.11
	Min ³	0.44	3.56	47.11	61.78	6.67	1.78	0.44
Open-Impracticable (%)	Av	0.00	1.84	1.95	4.89	11.44	0.15	3.90
	Max	0.00	3.56	7.11	7.11	16.89	3.56	16.89
	Min	0.00	0.00	1.33	1.78	3.56	0.00	0.00
Closed (%)	Av	98.96	72.06	37.89	31.29	53.56	96.22	60.14
	Max	99.56	96.44	32.44	32.44	89.78	98.22	99.56
	Min	96.89	49.33	31.11	29.78	31.11	89.78	29.78
Closed + Open-Impracticable	Av	98.96	73.89	39.84	36.17	65.00	96.37	64.04
	Max	99.56	96.44	38.22	38.22	93.33	98.22	99.56
	Min	96.89	49.33	31.11	29.78	31.11	89.78	29.78

¹ Average value, by month; ² Maximum value, by month; ³ Minimum value, by month.

Table 8. The ski slope status—average, maximum and minimum values, by month, during the 2017–2018 winter season.

Status	Month Index	November 2017	December 2017	January 2018	February 2018	March 2018	April 2018	Total Season
Open (%)	Av ¹	5.11	23.97	53.5	68.90	51.80	11.64	44.33
	Max ²	7.11	46.22	70.67	72.44	73.33	22.22	73.33
	Min ³	3.11	8.00	44.44	64.89	25.33	8.00	3.11
Open-Impracticable (%)	Av	0.00	1.09	0.79	0.08	0.10	0.18	0.48
	Max	0.00	3.56	1.78	1.33	0.44	0.89	3.56
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Closed (%)	Av	94.89	74.94	45.26	31.02	48.82	88.18	55.22
	Max	96.89	91.56	54.22	35.11	74.67	92.00	96.89
	Min	92.89	53.33	29.33	27.56	26.67	77.78	26.67
Closed + Open-Impracticable	Av	94.89	76.03	46.05	31.10	48.92	88.36	55.70
	Max	96.89	92.00	55.56	35.11	74.67	92.00	96.89
	Min	92.89	53.78	29.33	27.56	26.67	77.78	26.67

¹ Average value, by month; ² Maximum value, by month; ³ Minimum value, by month.

Concerning the 2017–2018 winter season, two points draw particular attention: 18 January 2018 when the percentage of open ski slopes exceeded the threshold of 50% (52.44%), 15 March 2018 when this percentage fell below 50% (46.22%). It follows that the best period of this season (18 January–14 March) had a duration of only 56 days, which represents 40.58% days out of the total number of 138. In addition, we observed that the highest percentage of open slopes (73.33%) was reached on 4 March 2018 and not in the winter months. In fact, percentages higher than 70% were registered between 17 February 2018 and 12 March 2018 (24 days); following that, until 17 March 2018, the number of open slopes decreased (remaining opened only 25.33% of them, which seems to be normal for this period in Romania). Due to the snowfall in the second half of March, the curve became ascending again, with a peak of 44% on 27 March 2018, following a downward slope until 15 April when the ski season ended (see Figure 1).

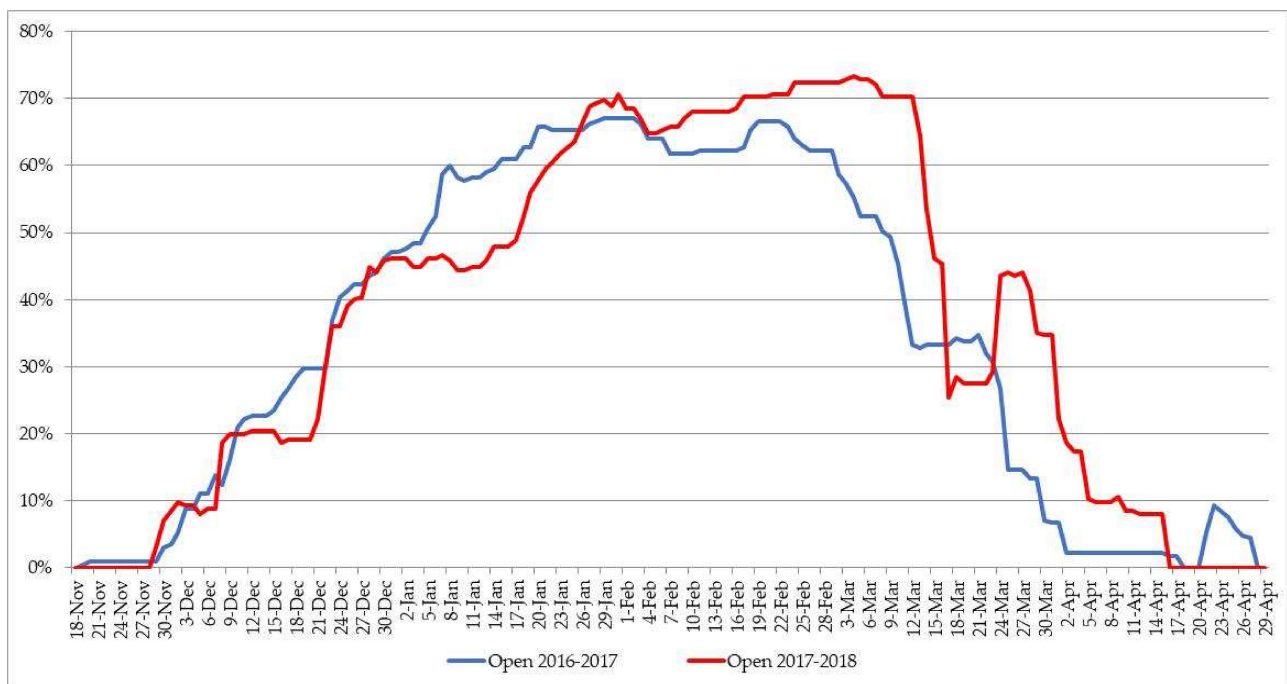


Figure 1. The percentage of open ski slopes during 2016–2017 and 2017–2018 winter seasons.

Although slightly longer in terms of number of days (157 days) the 2016–2017 winter season was not so efficient concerning the functionality of the ski slopes, compared to the previous one. Therefore, in our analysis, we mostly used 2017–2018 winter season.

The length of the season was different in function of ski area location and weather conditions. Taking into consideration only the 175 functional slopes, the operating season covered, on average, 78.6 days, with a minimum of two days and a maximum of 138 days. The average calculated for all the 225 slopes included in the research gave us a value of only 61.1 days.

If we consider the “100-day rule”, we can say that only 21.3% (48 slopes) of 225 slopes complied with this rule, most falling within the range of 50–99 days (43.6%, 98 slopes), while 35.1% (79 slopes) were open less than 50 days (29 slopes) or were closed (50 slopes).

However, at what altitudes are these ski slopes situated that comply with the 100-days rule?

Considering only the 48 ski slopes opened at least 100 days, we observe that 62.5% of them have a starting altitude at least 1500 m and none of them below 1000 m. At the same time, 16% of functional ski slopes have the departure at less than 1000 m but were open less than 100 days per season (see Table 9).

Table 9. Contingency table: The number of days that ski slopes were open and starting altitude during the 2017–2018 winter season.

Starting Altitude (m)	Number of Days that Ski Slopes have been Opened						Total	%
	1–49	%	50–99	%	100–138	%		
<1000	11	37.93	17	17.35	0	0.00	28	16.00
1000–1199	4	13.79	15	15.31	7	14.58	26	14.86
1200–1499	11	37.93	35	35.71	11	22.92	57	32.57
1500–1999	2	6.90	29	29.90	21	43.75	52	29.71
≥2000	1	3.45	2	2.04	9	18.75	12	6.86
Total	29	100.00	98	100.00	48	100.00	175	100.00

The contingency table between the number of days that ski slopes were open and arrival altitude shows us that about 40% of ski slopes that comply with “100-day rule”

have the arrival altitude at least 1500 m. Additionally, 60.42% of the functional ski slopes were open less than 100 days per season and have an arrival altitude less than 1500 m (see Table 10).

Table 10. Contingency table: *The number of days that ski slopes were open and arrival altitude during the 2017–2018 winter season.*

Arrival Altitude (m)	Number of Days the Ski Slopes were Open						Total	%
	1–49	%	50–99	%	100–138	%		
<1000	17	58.62	32	32.65	7	14.58	56	32.00
1000–1199	6	20.69	24	24.49	11	22.92	41	23.43
1200–1499	4	13.79	24	24.49	11	22.92	39	22.29
1500–1999	2	6.90	18	18.37	19	39.58	39	22.29
Total	29	100.00	98	100.00	48	100.00	175	100.00

Table 11 shows us that 35.42% of ski slopes, which comply with “100-day rule” are equipped with snow cannons.

Table 11. Contingency table: *Snow cannons and the number of days the ski slopes were open during the 2017–2018 winter season.*

Number of Days the Ski Slopes were Open		Functional Ski Slopes (175)		
		Snow Cannons		
		Yes	No	Total
1–49	Count	17.00	12.00	29
	% of Total	58.62	41.38	100
50–99	Count	65.00	33.00	98
	% of Total	66.33	33.67	100
100–138	Count	17.00	31.00	48
	% of Total	35.42	64.58	100
Total	Count	99.00	76.00	175
	% of Total	56.57	43.43	100

However, 82 slopes (46.86% of functional ski slopes) with snowmaking facilities fail to be open at least 100 days.

4.2.2. The Snow Depth and the Ski Slope Conditions

The data collected for the variable *ski slope conditions*, presented on the website as an ordinal scale, were associated with *snow depth*. We calculated the maximum and minimum values for each category of the scale, highlighting several intervals. These values are presented in Table 12, in the following ascending order:

Analyzing the data from Table 12, we notice that the ski slopes were open if the natural snow depth was minimum 15 cm, with the snow cannons adding crop snow if necessary.

The highest *snow depth* value recorded for each functional ski slope during the season was maintained on average 22.6 days per season. As depicted in Table 13, 55.43% of functional ski slopes have maintained the highest value of snow depth less than 20 days per season, while only 21.71% of them exceeded 40 days. The maximum was 81 days, while three ski slopes registered only two days.

Table 12. Minimum and maximum snow depth values during 2017–2018 winter season, according to slope conditions.

Ski Slope Conditions	Minimum Value (cm)	Maximum Value (cm)
1. Open-impracticable	4	50
2. Open	15	70
3. Open-difficult conditions	15	25
4. Open-acceptable conditions	15	60
5. Open-good conditions	18	120
6. Open-very good conditions	30	210
7. Open-excellent conditions	45	210

Table 13. Functionality of ski slopes—the number of ski slopes and days with highest snow depth values, during 2017–2018 winter season.

Number of Days with Highest Snow Depth	Number of Ski Slopes	%
1–19	97	55.43
20–39	40	22.86
≥40	38	21.71
Total	175	100.00

In general, the highest snow depth lasted at least 40 days on a slope characterized by a departure altitude greater or equal than 1500 m. It is the case of 65.78% of the ski slopes (25 slopes of 38). However, the highest percentage (32.57%) was registered for the slopes situated between 1200 m and 1499 m (see Table 14).

Table 14. Contingency table: *The number of days with highest snow depth values and starting altitude during 2017–2018 winter season.*

Starting Altitude (m)	Number of Days with Highest Snow Depth							
	1–19	%	20–39	%	≥40	%	Total	%
<1000	15	15.46	10	25.00	3	7.89	28	16.00
1000–1199	15	15.46	6	15.00	5	13.16	26	14.86
1200–1499	38	39.18	14	35.00	5	13.16	57	32.57
1500–1999	22	22.68	8	20.00	22	57.89	52	29.71
≥2000	7	7.22	2	5.00	3	7.89	12	6.86
Total slopes	97	100.00	40	100.00	38	100.00	175	100.00

If we refer to *the number of days with highest snow depth and arrival altitude*, 39.47% of the ski slopes with highest snow cover maintained at least 40 days are situated between 1500–1999 m. The highest percentage calculated for functional ski slopes was 32% and concerned the slopes with arrival altitude less than 1000 m (see Table 15).

Table 15. Contingency table: *The number of days with highest snow depth values and arrival altitude during 2017–2018 winter season.*

Arrival Altitude (m)	Number of Days with Highest Snow Depth							
	1–19	%	20–39	%	≥40	%	Total	%
<1000	29	29.9	17	42.5	10	26.32	56	32.00
1000–1199	25	25.77	11	27.5	5	13.16	41	23.43
1200–1499	24	24.74	7	17.5	8	21.05	39	22.29
1500–1999	19	19.59	5	12.5	15	39.47	39	22.29
Total slopes	97	100.00	40	100.00	38	100.00	175	100.00

The variable *ski slope conditions* presented on the website was divided into nine categories, listed at point 3. Concerning the functional ski slopes, from December to April (2017–2018) the highest percentage corresponded to “acceptable conditions” category, with a pick in February (44.29% of ski slopes were open in “acceptable conditions”), while in November, during the two days at the beginning of the season, “very good conditions” represented the highest percentage (4.67%) (see Figure 2).

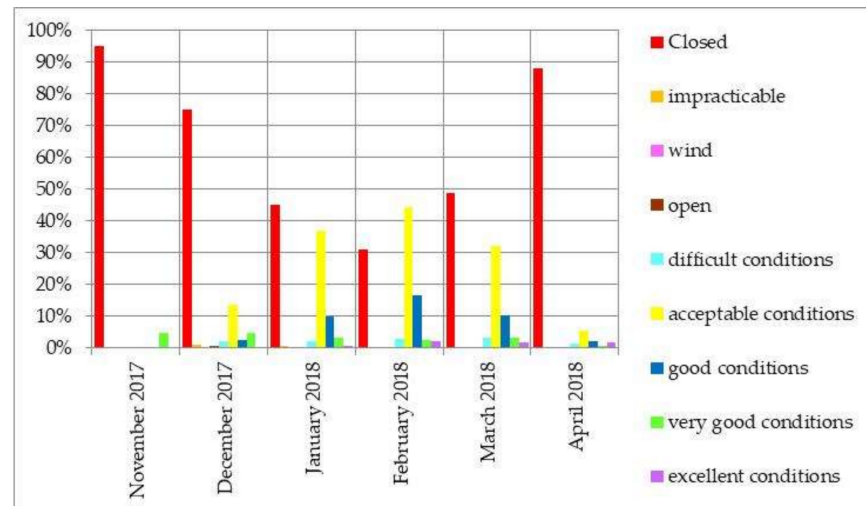


Figure 2. The slope conditions, by month, during 2017–2018 winter season.

The percentages of each category, by month, are shown in Appendix A (see Table 1).

4.2.3. Efficiency of the Ski Areas

As is shown in Table 16, 21.74% ski areas of 69 included in the study have not had at least one open ski slope during the winter season and less than one-quarter (21.74%) of them functioned with one or more open ski slopes at least 100 days.

Table 16. Functionality of ski areas: Number of days with at least one open ski slope, during the 2017–2018 winter season.

Number of Days with at Least one Open Ski Slope	Number of Ski Areas	%
0	15	21.74
1–49	11	15.94
50–99	28	40.58
100–138	15	21.74
Total ski areas	69	100.00

Analyzing the number of days that a ski area operated at full capacity (all the ski slopes of the ski area were open), we observe that 42.03% of 69 ski areas have not operated or have had open only a part of ski slopes. If we perform the same calculation, this time taking into account the 54 ski areas where at least one ski slope was open (functional ski areas), we notice that 25.93% did not operate at full capacity and only 5.56% have had open all the ski slopes at least 100 days per season (see Table 17).

Table 17. Functionality of ski areas at maximum capacity during the 2017–2018 winter season.

Number of Days at Maximum Capacity	Number of Ski Areas	%	Functional Ski Areas	%
0	29	42.03	14	25.93
1–49	15	21.74	15	27.77
50–99	22	31.88	22	40.74
100–138	3	4.35	3	5.56
Total	69	100.00	54	100.00

Climate change largely affected the ski areas in Romania, with more than a half of them operating at full capacity less than 100 days a year and one-quarter never reached their maximum capacity during the 2017–2018 season, which is not enough to ensure the profitability of the investments.

The elements of presented analysis confirm the first hypothesis. The investments made from the beginning of the ski development policy in Romania are neither questioned nor reoriented under the influence of climate change observable everywhere. The policy put in place actually concerns only the practice of skiing without reorientation in view of the mediocre use of certain infrastructures that are used only a few days a year or not at all. Some ski slopes have been created recently, in the last few years, and have never been used because are located at too low altitude, whereas snow cover problems due to this variable were already well known.

The underuse of existing equipment stems from the lack of natural snow cover that investors are trying to offset by the multiplication of snow cannons in order to create artificial snow (or “snow making”) contrary to the international agreement, the *Framework Convention on the Protection and Sustainable Development of the Carpathians*, presented above. Romania did not comply with none of the three recommendations adopted in this agreement; therefore, the second hypothesis is confirmed.

The capital spent by investors, mostly public money, was unprofitable and the environmental sustainability has been affected. The construction of ski slopes and, even more, ski resorts, has an obvious and significant impact on the environment. Direct impact is because of the cutting of trees in large numbers, the installation of pylons for the lifts—which implies noise and visual nuisances—the creation of artificial water reservoirs for snow cannons, the laying of pipes for these cannons—which requires the use of heavy equipment that compact the fragile soil, etc. Indirect impacts are the creation of roads to bring tourists, the arrival of water, electricity, and the disposal of garbage and wastewater that should be reprocessed hence the creation of treatment plants or waste reprocessing. However, we can fear that this part does not enter into the short-term considerations today in Romania when we know that it took more than 30 years for the French ski resorts to manage to get rid of their waste properly. At the same time, the low level of activity demonstrated cannot lead to a significant economic activity, creating a significant number of jobs. Under these conditions, the sacrifice of the variable “environment” in favor of the variable “economy and employment” is not acceptable.

5. Limitations of the Study and Future Research

This research has some limitations concerning the source of data collection. The records concerning the slope conditions and snow depth were collected from a website specialized in snow cover information [37]. These indicators are intended for the ski tourism industry and are provided by qualified persons used to designate the conditions of skiing, the assessment methodology, and the description of these conditions being not specified.

In Romania, there are no official, ministerial, or national nivo-meteorological data targeting each ski slope. The National Meteorological Administration in Romania provides nivological information only from four meteorological stations in the monitored mountain area. If the same study would have been carried out in France and other Western European countries, more reliable data could be used, as there are official bodies, which are method-

ologically structured. However, it took time to structure the observatories and disseminate their results.

This research concerned only the development of Romanian ski slopes and ski areas. A comparison between several countries will bring new knowledge and a more complex statistical analysis. Furthermore, other ski area characteristics (e.g., number of ski lifts, transport capacity) and climate factors could be considered for future research to highlight new connections between the variables.

6. Conclusions

Although Romania is not yet a very important destination to practice winter sports, in the last 10 years, the country has been making major efforts to develop the ski infrastructure in order to attract more visitors, even for a few hours a day.

Since the 2000s, and after a series of studies and projects, it has been decided to modernize and extend the winter sports facilities, mostly for skiing. A first law was adopted in 2003, followed by a series of nearly ten amendments and regulations until today. This incomplete law made the process of modernization and construction of the new ski slopes long and expensive, and the spending of public money and European funds was, in some cases, reckless.

The investments have depended on the resort's classification, national interest, or local interest, the first attracting the most capital. Ascension to power of different political parties, with different visions and objectives, has led to the obstruction of some projects concerning the development of skiing in this country. In addition, a significant number of ski projects were carried out improperly, with ski slopes at too-low altitudes, poorly oriented, and developed with large sums of money spent in vain. The 225 ski slopes studied were open, on average, less than 62 days during the winter season and more than 20% of them were not even open at all. Only 17.8% of the slopes complied with the "100-day rule" during the first season included in the study and 21.3% of them during the second one, which does not ensure profitability. It can be deduced that too many slopes have been created without taking into account the climate change and actual snow conditions. More than a half of ski slopes included in the study were not equipped with snow cannons.

These are negative but also significant examples of a management method, of the use of public money. Although these were initiatives that were officially intended to promote sustainable development, by changing the lives of local communities, by creating economic activity and jobs, the approval and implementation of some of them were the subject of legal investigations.

We may wonder why investments that do not respect any logic of profitability, the environment, or international commitments are made. For those who agree to read between the lines it appears that Romania, like other countries of the former Eastern bloc, is experiencing difficulties in fully becoming a State subject to the rule of law with decision-makers, politicians, and other, concerned with respecting the commitments signed by the State and the use of public funds, national and European.

These results are not due to chance. A series of studies on global warming have been conducted in Romania and in other parts of the world. All of these show that temperature is rising. Even if the study was conducted only for two seasons, we cannot expect an improvement of the existing situation in the future. Solutions exist, but these must be correctly implemented.

Even if the financial and legislative efforts are extended over a long period of time, Romania is trying to develop in this field, increasing its ski area from year to year.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table 1. Percentages of ski slopes—slope conditions, by month, during 2017–2018 winter season.

Slope Conditions	Month Index	November 2017	December 2017	January 2018	February 2018	March 2018	April 2018	Total Season
Open (%)	Av ¹	0.00	0.56	0.29	0.00	0.00	0.00	0.19
	Max ²	0.00	0.89	0.89	0.00	0.00	0.00	0.89
	Min ³	0.00	0.44	0.00	0.00	0.00	0.00	0.00
Open-difficult conditions (%)	Av	0.44	2.18	2.38	2.83	3.20	1.36	2.47
	Max	0.44	4.44	4.44	4.00	5.33	3.11	5.33
	Min	0.44	0.44	0.89	0.89	1.33	0.00	0.00
Open-acceptable conditions (%)	Av	0.00	13.84	37.02	44.29	32.14	5.36	28.21
	Max	0.00	28.00	47.56	45.78	45.33	12.89	47.56
	Min	0.00	0.89	28.44	41.78	13.78	3.56	0.00
Open-good conditions (%)	Av	0.00	2.44	9.96	16.73	10.42	2.25	8.77
	Max	0.00	6.22	17.78	17.33	18.67	3.56	18.67
	Min	0.00	0.00	4.44	16.00	3.56	1.78	0.00
Open-very good conditions (%)	Av	4.67	4.75	3.28	2.70	3.47	0.89	3.29
	Max	6.67	8.44	7.11	4.44	6.67	2.22	8.44
	Min	2.67	1.33	0.44	1.78	0.89	0.00	0.00
Open-excellent conditions (%)	Av	0.00	0.00	0.87	2.37	1.85	1.78	1.29
	Max	0.00	0.00	2.22	2.67	2.67	1.78	2.67
	Min	0.00	0.00	0.00	2.22	0.89	1.78	0.00
Closed (%)	Av	94.89	74.94	45.26	31.02	48.82	88.18	55.22
	Max	96.89	91.56	54.22	35.11	74.67	92.00	96.89
	Min	92.89	53.33	29.33	27.56	26.67	77.78	26.67
Open-impracticable (%)	Av	0.00	1.09	0.79	0.08	0.10	0.18	0.48
	Max	0.00	3.56	1.78	1.33	0.44	0.89	3.56
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Open-wind (%)	Av	0.00	0.22	0.14	0.00	0.00	0.00	0.08
	Max	0.00	4.44	4.44	0.00	0.00	0.00	4.44
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00

¹ Average; ² Maximum value; ³ Minimum value.

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