Research Article

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Depopulation in the Visok micro-region: Toward demographic and economic revitalization

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Abstract: The demographic potential of the settlements in the Visok micro-region has been significantly disrupted since 1948. The latest census (2022) shows that the Visok micro-region now consists of very small settlements, all with fewer than 100 inhabitants. In all 22 villages of the Visok micro-region, there are only 504 inhabitants, with unfavorable age structures. The region's average age has remained above 65 for the last 30 years, significantly older than the surrounding areas. Low salaries, bad infrastructure, and the industrialization of Pirot City represent the main reasons for depopulation. The Zavoj Lake catastrophe caused three villages to be submerged, which accelerated depopulation even more. Most of the remaining inhabitants are engaged in farming or work in the construction, stone, and forestry industries, with sheep farming being a notable tradition. The local population shows strong ecological awareness, advocating for industries that align with nature, creating an ideal environment for nature enthusiasts and scientists. The only way for revitalization is to have organized seasonal migrations based on the summer tourist season. The main aim for revitalization would be a national-level plan for creating a brand of untouched nature, with traditional agricultural products for the complete experience.

Keywords: Stara Planina Mountain, age structure, perception of the local community, respondents, sustainable tourism, demographic and economic revitalization, Serbia

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1 Introduction

Demography is gaining heightened significance in response to the world's population challenges. Consequently, demographers frequently assert that demography holds the potential to evolve into an indispensable science for future planning [1]. The research and findings derived from demographic studies play a pivotal role in shaping the development strategies of both urban and rural areas. One of the biggest problems is extremely intensive depopulation, especially in rural areas [2].

As highlighted by Lukić et al. [3,4], depopulation is a significant challenge confronting rural settlements in Serbia as they enter the twenty-first century. The ongoing pattern of population decline necessitates a fundamental shift in public policies, emphasizing a change in development strategy and promoting more balanced rural development. The Republic of Serbia has been struggling with the issue of regional and subregional depopulation for several decades [5]. The extent of population emigration varies between regions and districts, with regional depopulation being significantly more pronounced in the southern part of the country than in the north. This trend was most pronounced during the census cycles of 2002–2011 and persists after the latest census (The Statistical Office of the Republic of Serbia). The mesoregion of Eastern Serbia, in particular, exhibits the most pronounced depopulation [6]. At the level of statistical units, Southern Serbia is losing its population 16 times more intensively than the Northern Serbia region [7].

In this article, we delve into the study of the intensity and dynamics of depopulation at the settlement level, focusing on the demographic changes and potential of the micro-region of Visok. Utilizing descriptive statistical methods, we present the general demographic characteristics of the Visok area, along with fundamental demographic dynamics from 1948 to 2022.

All settlements are severely affected, and currently, none of the villages have a population exceeding 100 inhabitants. The examination of the causes of depopulation in southeastern Serbia has been a prominent topic in academic

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discourse for three decades [1,5–8]. Spasovski and Ilić investigated the demographic development of rural areas in Serbia, relying on general demographic characteristics obtained from census data [9].

The main causes of depopulation and the lack of a chance for the revitalization of this region are identified as the dominance of an older population and decades-long migration of young and reproductive-capable individuals in urban areas. Subsequent discussions on depopulation in Serbia have delved into examining the impacts of individual factors, such as the influence of age structure on depopulation in southeastern Serbia [10], the influence of migrations, and finally, the investigation of individual depopulation factors on settlements with a small number of inhabitants [7].

Contemporary research suggests that border areas, primarily underdeveloped and grappling with population emigration, will remain demographically threatened, regardless of the implementation of diverse population policy measures [11,12]. Such vulnerability is particularly evident in the region of Eastern Serbia [6]. The unfavorable age structure, coupled with extremely small settlements, leaves no room for any demographic revitalization of this area.

Projections from 2018 to 2050 indicate that the South and East Serbia region is poised to lose nearly half of its population (48%). Similar trends are expected for the Šumadija and Western Serbia region (42%). Conversely, the Belgrade region shows the least decline in the total population (4.5%), followed by the Vojvodina region (27.8%) [5]. Estimations from researchers investigating the depopulation phenomenon suggest that the demographic potential of southeastern Serbia is permanently compromised [7].

2 Study area

The Visok micro-region represents the Visočica and Toplodolska rivers watersheds with the ending point on Mrtvački most bridge [13]. Using the ALOS PALSAR RT1 DEM model with horizontal resolutions from 1 arc-second (30 m) (SRTM) to 12.5 m [14,15], we bordered the investigated area and calculated that Visok represents an area of 710.71 km^2. It is located between Stara Planina and Vidlič mountain as a border region between Serbia (~593 km^2) and Bulgaria (~118 km^2) (Figure 1). The Serbian part of the watershed is located within the borders of the municipalities of Pirot and Dimitrovgrad. Out of a total of 26 settlements, 22 (without 3 flooded villages in the Zavoj catastrophe) are located within the territory of the Republic of Serbia and analyzed through this study. The bigger cities near the investigated area are Pirot and Dimitrovgrad, but also Sofija, the capital city of Bulgaria and Niš, as the biggest regional centers, are in relative proximity (Figure 1).

The north-eastern borders of the Visok micro-region are almost identical to the border between Serbia and Bulgaria. It is represented by the ridge of the Stara Planina Mountain. The western border is defined by the ridge of Vidlič mountain, characterized by very steep slopes. The Visočica River

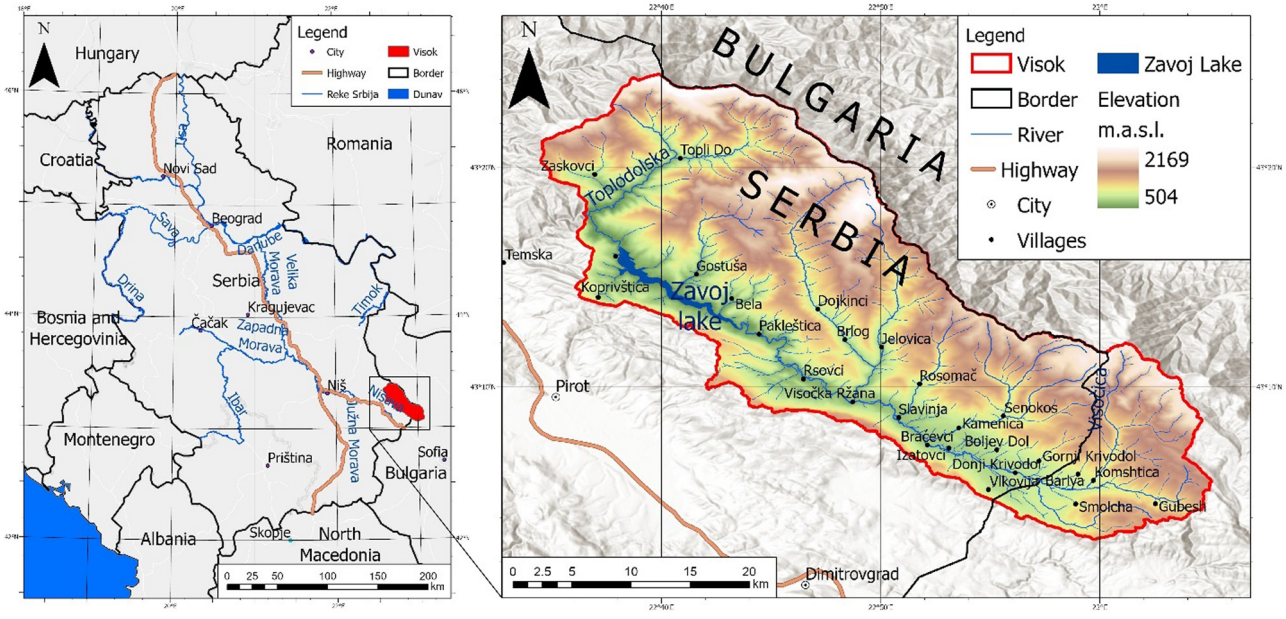

Figure 1: The geographical position of micro-region Visok with all settlements presented.

divides its watershed into two highly asymmetrical parts, with the majority of the watershed located on the slopes of the Stara Planina Mountain. The investigated area is primarily at higher elevations (ranging from 504 to 2,169 m a.s.l.), leading to the region's recognition for livestock breeding, particularly with a predominant focus on sheep breeding [13,15–17].

The investigated area is characterized by outstanding geological, geomorphological, and hydrological characteristics. Stara Planina and Vidlič mountains are renowned for their extraordinary Permian, Triassic, and Jurassic deposits distinguished by distinct paleontological and sedimentological features [18]. These deposits predominantly include marine sandstones and shallow marine ramp limestones ranging from the uppermost Lower Triassic to the entire Middle Triassic period [19]. Additionally, this region has specific climatic conditions, including higher precipitation for this geographical region, due to the much higher terrain than the surrounding areas [20]. These conditions have resulted in the formation of exceptional geoheritage [21,22], represented by approximately 70 waterfalls and numerous hydro-karstic phenomena (Figure 2a and b; [15]). Not all waterfalls have been documented, primarily due to the limited extent of tourist marketing and the challenging accessibility of the terrain. The majority of them are cataloged in Stojadinović [23].

Still, the most impressive hydrological feature is the Zavoj Lake. During periods of high water, it forms a 17-km-long water accumulation located 18 km from Pirot city. Named after the submerged village of Zavoj during a significant catastrophe in February 1963, Zavoj Lake today serves as a reminder of a landslide and erosion impact on this region [15]. In 1961, the village of Zavoj had a population of 1,335 inhabitants [24]. The village of Zavoj was situated at geographical coordinates 43.2652778°N and 22.6813889°E, with an altitude of 535 m.a.s.l. [25]. After the catastrophe, all inhabitants of Zavoj village were relocated to Novi Zavoj, which is now part of Pirot city.

The extensive natural disaster occurred on February 25, 1963, and resulted from landslide processes induced by water saturation, as the consequence of rapid snow melting [13]. The landslide occurred at elevations ranging from 790 to 960 m a.s.l. On February 26, loose material obstructed Visočica, forming an earthen dam with a volume of 1,950,000 m^3. The dam's base width measured 530 m, while its height at the top reached up to 140 m of relative height [25].

Due to the significant risk of dam failure, precautionary measures were implemented in 1964, with military authorities constructing a channel to initiate the controlled drainage of the reservoir. Following the construction of the artificial dam in 1977, two additional villages, Velika Lukanja and Mala Lukanja, became submerged because of this construction. This artificial reservoir, established as a result, currently plays a crucial role in the operational framework of the Hydropower Plant "Pirot" [26]. Presently, the Zavoj accumulation extends over a length of 17 km, stretching from the village of Gostuša to the site of the catastrophic event. The lake serves as a reservoir for energy exploitation,

Figure 2: (a) Waterfall Tupavica, (b) waterfall Donji Piljski, (c) houses of submerged village Velika Lukanja, (d) Gostuša village architecture, (e) women from Topli Do defending their River, (f) local inhabitants defending their River, and (g) Topli Do village.

and during this process, all water from the lake is occasionally utilized. During the low water levels of the Zavoj accumulation, submerged villages are exposed, serving as witnesses to this disaster and illustrating the size of former villages in this micro-region (Figure 2c).

In the last two decades, the Visočica River watershed has been monitored to prevent the recurrence of disasters. Studies show that the intensity of erosion is decreasing over time, a trend attributed to significant depopulation and depolarization [27,28]. This has resulted in the natural revitalization of the investigated region, forming one of the most nature-preserved areas in Serbia.

In the 1950s, this region was well-known for animal husbandry. It had an exceptional number of sheep, and many households produced various products from wool. Milk was traditionally processed, contributing to the region's enduring reputation for dairy products to this day [13,29]. The specific geology influenced the development of the construction craft. Most houses are constructed using wood, mud, and local Permian red sandstones. Additionally, there are some distinctive stone roofs, as seen in the village of Gostuša (Figure 2d).

Even though not many people live here nowadays, the residents are well-known for their ecological stance against poorly planned mini hydropower projects in Topli Do, which led to significant ecological damages [30–32] (Figure 2e–g). Toplodolska River's significance lies in the fact that it has the most waterfalls of all rivers in Serbia. It would be a catastrophe for the water regime and life in these precious ecosystems to put all of this drinkable water into pipes.[1]

3 Materials and methods

Insights into the number and structure of the population in the micro-region Visok are primarily based on official census results and unpublished data obtained upon the author's request. The focus of these data includes the age structure of the population and population dynamics for settlements within the Visok area. The study incorporates census data from all available cycles between 1948 and 2022 and focuses on settlements as the fundamental unit of analysis [24].

Using descriptive statistical methods, we highlight trends such as changes in population during the census period and age structure. To examine the claim that the age structure of the population can be the main cause of today's depopulation in the Visok area, we will present the changes over the past three decades regarding the average age of the population in the Visok area. Also, the aging index was calculated, representing the number of post-productive population (aged 65+) compared to the total number of pre-productive population (aged 0–14). The purpose of this indicator is to highlight the significant imbalance between the large number of elderly people and the low birth rate.

In addition to the standard methods used in demographic research, survey research has been applied for deeper investigation of the potential causes of depopulation in the Visok micro-region, as well as the perceptions of the local population regarding the possible demographic and economic revitalization of the area. The survey covers a sample of 70 respondents, both male and female. Additionally, we analyzed the inhabitants of the village of Temska. Geographically, this village is not part of the Visok micro-region but serves as a link to the Topli Do and Zaskovci villages and had numerous connections to the Visok micro-region in the past and present. Temska village is the only functional village with a population of 449 inhabitants and an active primary school.

During the research process, we defined two assumptions that can be considered as one of the main causes of depopulation in the examined area. The first assumption is that a natural disaster and the subsequent consequences (forced population displacement due to the Zavoj Lake catastrophe in 1963) have influenced depopulation, leading to a decrease in the demographic potential of the Visok. We examined this assumption by monitoring the population dynamics and age structure of the Visok area. The second assumption is that there are no basic conditions for leading a "normal" life (such as communal infrastructure, accessibility of health and educational services in the settlements of the Visok micro-region, employment opportunities, etc.) and that this is one of the causes of emigration.

3.1 Survey and sample

The survey aimed to investigate the perceptions of the local inhabitants regarding the causes of the depopulation and the chance for the revitalization of the micro-region Visok. Data collection was performed by a survey on a sample of 70 respondents living in the settlements of the Visok region. The survey was conducted from February 10 to

1 Nowadays, the only thing that is stopping this part of Serbia from being the area with no pollution is the small biological minimum of Zavoj Lake and the fact that water is pumped out from the bottom of the lake. Water from the depths is considerably colder than surface waters in this region. In Temska, at an elevation of 300 m.a.s.l., temperatures are 8–10°C lower than in Topli Do at 850 m.a.s.l. The concept of the Visok and Temska inhabitants involves constructing a floating system capable of regulating the water's extraction depth.

April 28, 2024. Participation in the survey was voluntary and the respondents were informed about the main purpose of the given research. The recruitment of participants was conducted online through Facebook groups followed by the local population. Thus, due to the old age of the population, a big majority of the responses were obtained directly in the field, face to face, by visiting houses and arranging interviews on the spot.[2]

For this research, we opted to use a non-probabilistic sampling method. Since the size of the population is known, we employed proportional quota sampling. This approach enables us to determine the quota of individuals needed to be included in our sample to ensure it is representative of the respective population. We divided the population into three mutually exclusive subgroups. These subgroups are selected concerning certain known features, in our case, we will use the age of the population as the main criterion. We chose the age quota rather than other measures for two reasons. First, the age structure of the population is the most specific characteristic of the demographic structure in the Visok micro-region. Second, the age structure of the population is one of the main causes of the depopulation of the area.

We drew a sample of 70 respondents, and the total population of the micro-region Visok is 953 people (504 without Temska). Our sample will reflect the proportion of each age group in the whole population (Table 1). We divided the sample into three groups:

1. The first group of respondents represents the young population (ages 15–29). In this group, we have 4 respondents.
2. The second group of respondents represents the working-age population (ages 30–64). In this group, we have 31 respondents.
3. The third group of respondents represents the population outside the employment market (age 65 and over 65 years old). In this group, we have 35 respondents.

The gender structure of the micro-region Visok (with Temska) looks like this: 529 male and 424 female; in percentages, 55% of the total population is male, and 45% are female. Regarding the gender structure of the sample, the majority of the respondents are male – 50 persons (71.4%) and 20 (28.6%) of them are female. The findings of the research indicate that the sample is biased in terms of gender, specifically that men are overrepresented compared to women, considering the overall population structure.

Table 1: Age structure of the population and sample

	Population Number of inhabitants	%	Sample Number of respondents	%
15–29	61	6.4	4	5.7
30–64	341	36	31	44.3
65+	505	53	35	50

3.2 Instrument

The questionnaire was used to collect data for the study. The questionnaire consisted of 26 questions divided into three groups. The first group of questions focused on the socio-demographic characteristics of the respondents. The second group investigated respondents' perceptions of the main causes of depopulation, including natural, social, political, and similar factors contributing to the depopulation of the studied area. The third group explored the local population's views on opportunities for the revitalization of the area, with a focus on specific measures needed to encourage the immigration of residents to this region. In this part, we also assessed respondents' perceptions of which specific measures, in their opinion, would mostly contribute to increasing the number of tourists in the Visok region.

Due to the limited space available, this research utilized question batteries to examine local residents' attitudes through two groups of questions. The group of questions pertained to the socio-demographic characteristics of the respondents (age, gender, place of birth, education, income, residence, and employment) we used to present the structure of the survey sample. In the next step, we include the group of questions aimed to address the causes of depopulation and to understand the respondents' perceptions regarding the main reasons for migration from the micro-region Visok. The second group of questions was dedicated to examining the respondents' attitudes toward the tourism potential of the micro-region Visok. In this article, the touristic potential of the region is seen as an opportunity for its revitalization.[3] We chose this group of questions because

2 10 surveyors participated in conducting the Field research. Most of them were students led by Teaching Assistant Rastko Marković, from the Department of Geography, Faculty of Sciences and Mathematics, University of Niš.

3 Additionally, we also explore the collective memory of a natural disaster. The aim of this segment of the survey is to document and analyse memories and interesting information related to the

we try to analyze the connection between the main cause of the depopulation and the chance for revitalizing the area.

3.2.1 Measures

With the aim of examining the respondents' attitudes toward the main causes of depopulation, we presented six statements, which represent one possible cause of depopulation. Statements were assessed on a five-point Likert scale (1 – strongly disagree, 5 – strongly agree. The question text follows:

> *According to your opinion, what are the main reasons why people are leaving your settlement? There are 6 statements and we would like to know what you think about each of them. Please read the statement and rate it on a scale from 1 to 5, where 1 means that you strongly disagree and 5 means that you strongly agree.*
>
> *First: Unavailability or poor quality of healthcare facilities; Second: Closure of schools and kindergartens; Third: Poor infrastructure and public services (roads, water supply, electricity, telephone, and internet); Fourth: Unemployment; Fifth: Low wages and limited chances to earn an income sufficient for a "normal" life; Sixth: Challenging living conditions in a mountain area.*

In the next step, we analyze respondents' attitudes toward measures that need to be implemented to address immigration in the Visok area. We presented five statements, each representing one possible measure for the revitalization of the micro-region Visok. The question text follows:

> *According to your opinion, what needs to be done to motivate people to move into your settlement? There are 5 statements, and we would like to know what you think about each of them. Please read the statement and rate it on a scale from 1 to 5, where 1 means that you strongly disagree and 5 means that you strongly agree.*
>
> *First: Investment in municipal and transportation infrastructure, Second: Subsidies for the purchase of houses and estates at the state's expense; Third: Invest in agriculture, Fourth: Invest in and develop rural tourism. Five: Build new schools and clinics.*

Finally, we asked respondents for their opinion about some concrete measures that can utilize the tourist potential of the micro-region Visok. We presented six statements, each representing one possible measure that can contribute to the increased number of tourists in the micro-region Visok. The question text follows:

> *According to your opinion, which measures are the best to implement with the aim of increasing the number of tourists in the micro-region Visok? There are 6 statements, and we would like to know what you think about each of them. Please read the statement and rate it on a scale from 1 to 5, where 1 means that you strongly disagree and 5 means that you strongly agree.*
>
> *First: Improvement of basic infrastructure, primarily roads and accommodation capacity; Second: Regular maintenance of hiking trails; Third: Expansion of the ski resort; Fourth: Development of infrastructure for cycling tourism and renting mountain bikes; Fifth: Investment in marketing, creating interactive maps Sixth: Introduction of guided tours of the most famous sites in local tourist.*

4 Results

4.1 Official statistical data

Using descriptive statistical methods, we highlight trends such as changes in population during the census period and age structure. To examine the claim that the age structure of the population can be the main cause of today's depopulation in the Visok area, we will present the changes over the past three decades regarding the average age of the population and the aging index in the Visok area.

4.1.1 Population

In the Visok area in 1953, only four settlements had over 1,000 inhabitants (Topli Do, Rsovci, Zavoj, and Gostuša), average population size in the settlement was around 600 inhabitants in the Pirot municipality. In contrast, settlements in the Dimitrovgrad municipality had an average population size of around 300 inhabitants after World War II. Ultimately, all settlements in the Visok area have consistently experienced a decline in population since 1953 [24].

Immediately after World War II, a total of 15,425 people lived in the settlements of the Visok area (12,595 in the Pirot municipality and 2,830 in the Dimitrovgrad municipality). According to the latest census, the total population in these same settlements is now 504 (446 in the Pirot municipality and 58 in the Dimitrovgrad municipality). This means that the population in this area has decreased by more than 30 times compared to the post-World War II period. After people from Zavoj village were moved to Novi Zavoj, official data still counted

significant natural disaster that led to the formation of Lake Zavoj, occurring at the end of February 1963. The questionnaire consisted of a mixture of close-ended and open-ended questions. Questionnaire was modeled on an "open source" platform, a concrete google platform.

them as Visok micro-region inhabitants, but this would be statistically and geographically incorrect. Interestingly, nowadays, just in the part of Pirot where people were moved named Novi Zavoj, there are significantly more inhabitants (1,200) than in the entire Visok area (504) (Figures 3 and 4) [24].

4.1.2 Age structure

The age structure of the Visok micro-region represents one of the most dramatic examples in terms of the demographic profile of southeastern Serbia. However, this is not surprising, as the settlements of this micro-region belong to two municipalities that, as early as 2002, were categorized among those experiencing deep aging (Pirot) and the deepest demographic aging (Dimitrovgrad) [33]. This finding is confirmed in this study through a comparative review of average ages and the calculated age index. The data show that the settlements of the Visok micro-region experience a different change in the increase of the average age compared to the Pirot city, Pirot district, and national level. The average age at the national level in Serbia was 40.25 years in 2002, while in the Pirot district, it was more than 3 years higher (43.5), in Pirot city, it was 41.8, and in the Visok area, it was almost 30 years higher (69.04) compared to Serbia. In the subsequent census cycle in 2011, there was an increase in average age on the national level for 2 years, up to 42.2; the same situation is in the Pirot district (45.4) and the Pirot city (47.17), but in the Visok area, we have a decrease up to 67.21; also, the difference between average age on the national level is now 25 years. In the 2022 census, the difference in average age between the studied area and the national average is almost 22 years, while when compared to the Pirot district difference is over 19 years, and a 20 years difference between Visok and Pirot city [24] (refer Table 2).

The unfavorable age structure of the Visok micro-region becomes more evident when comparing the aging index over the last three decades. The most significant difference in the aging index within the Visok micro-region

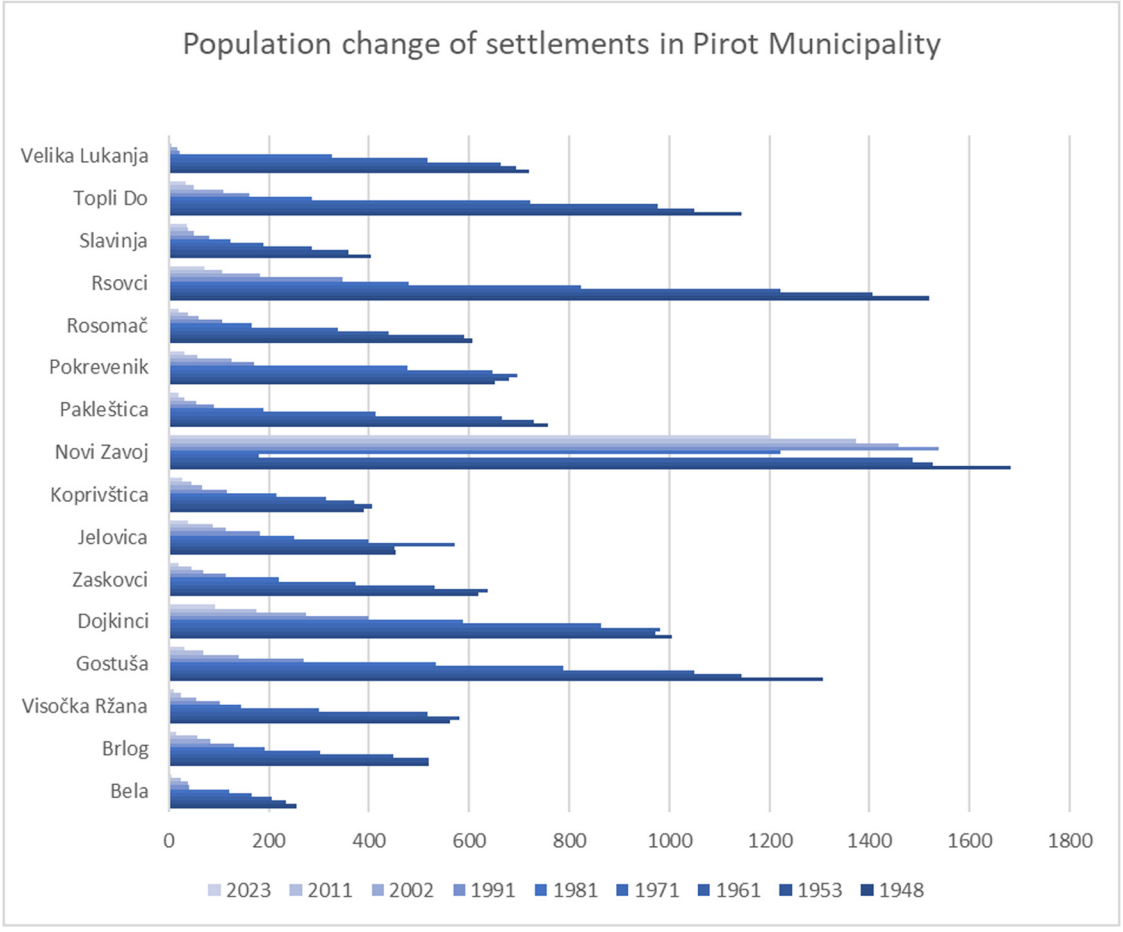

Figure 3: Population changes across census cycles in settlements of the Visok region 1948–2023 (Pirot municipality) [24].

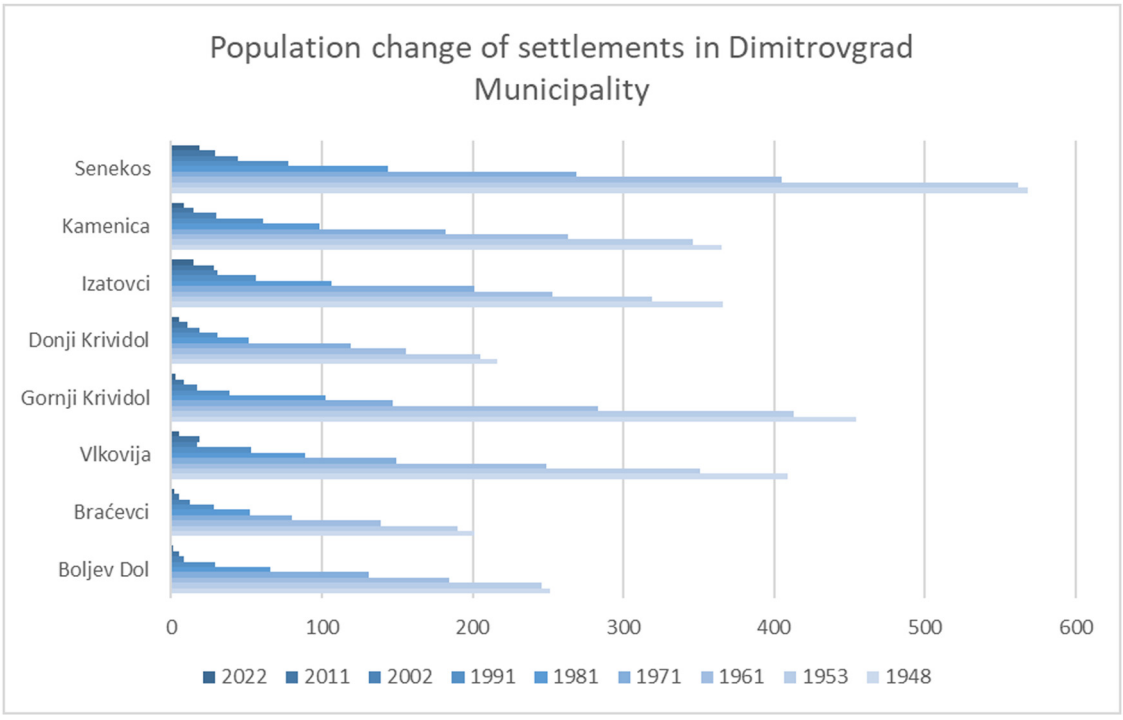

Figure 4: Population changes across census cycles in settlements of the Visok region 1948–2023 (Dimitrovgrad municipality) [24].

occurs in the census period between 1991 and 2002. The aging index in 2002 was 32, while in 1991, the index value was 10. In the subsequent census cycle, the difference in the aging index increased from 32 up to 39.94, while in the last census cycle, the aging index decreased compared to 2011 and has the same value as in 2002 – 32 (refer to Table 3).

The aging index of the Visok micro-region in the 1991 census was 10, which is 22 times higher compared to the aging index at the national level in Serbia (0.44) and over 12 times higher than the aging index in the Pirot city (0.79). The difference between the studied area and the national average raised in the 2002 census; the national aging index is 1.05, which is 30 times lower than the aging index of the Visok micro-region (32). A similar situation is recorded in the subsequent census cycle, with an increase in the aging index at both the national level (1.22) and the Visok micro-region (39.94). However, in the latest census, there is an increase in the aging index at the national level (1.54) and a decrease in the Visok micro-region on the same value as in 2002 (32). The difference in the aging index values between the Pirot district and the studied area is also very high. The aging index of the Pirot district in 2002 is 1.59 and it is 20 times lower than in the Visok area. The even bigger difference is if we compare Pirot city with Visok, Pirot city has 25 times lower value of the aging index than Visok. The aging index of Dimitrovgrad showed that there is also a big difference between the Visok area and this city, with almost 19 times lower value of the aging index than Visok. But still difference is smaller compared with Pirot and Pirot district, and this trend will continue in every next census (refer to Table 3). In the next census cycle, Pirot district

Table 2: Average age at the period: 2002–2022

	Average age		
Year of census	**2002**	**2011**	**2022**
Serbia	40.25	42.2	43.8
Pirot district	43.5	45.4	47.17
Pirot city	41.8	44.2	46.18
Visok	69.04	67.21	66.44

Table 3: Aging index at the period: 1991–2022

	Aging index			
Year of census	**1991**	**2002**	**2011**	**2022**
Serbia	0.44	1.05	1.22	1.54
Pirot district	—	1.59	1.87	2.26
Pirot city	0.79	1.28	1.60	2.00
Dimitrovgrad	1.3	1.7	2.11	3.0
Visok	10	32	39.94	32

had a value of 1.59 for 2002 and increased to 1.87 10 years later in comparison with the Visok area, which had more significant increases, from 32 in 2002 up to 39.94 in 2011. At the latest census, in the year 2022, we have the opposite situation, Pirot district is facing an increase of the aging index up to 2.26, the same is with the Pirot city up to 2.00, and Dimitrovgrad up to 3.0 and the Visok area has a decrease of the aging index up to 32 (refer to Table 3).

4.2 Survey

The sample consists of 70 respondents, 20 female and 50 male participants. Regarding age structure, we have a very similar age structure to the age structure of the population. If we look at the age structure of the sample, we can conclude that it roughly reflects that of the total population, with the note that the second group, which includes individuals aged 30–64 years, is overrepresented in the sample (refer to Table 1). The oldest participant was born in 1936 (88 years old), while the youngest participant was born in 2002 (22 years old).

4.2.1 Socio-demographic characteristics of the respondents

Residence: The sample includes participants from 10 different settlements, with 57 participants residing in the micro-region of Visok, and the remaining 13 participants residing in Belgrade, Niš, and Pirot.[4]

Level of education: The majority of respondents, 31 (44.3%), have high school degrees; 16 respondents (22.9%) have completed only primary school, while 12 respondents (17.1%) have indicated that they have completed college or have a university degree; 10 respondents (14.3%) stated that they had not completed primary school; and only one respondent (1.4%) reported having completed postgraduate studies.

Professions: Participants in the conducted sample mostly identified themselves as retirees, with 19 respondents (27.1%). Ten respondents (14.3%) stated that they are self-employed or independent entrepreneurs in all economic sectors except agriculture, while nine respondents (12.9%) indicated that they work as industrial production workers. Eight respondents (11.4%) reported working as white-color workers/clerks or farmers. A high percentage, 17.4%, chose "other" as their occupation, with 12 respondents selecting this option, while 4 respondents (5.7%) chose not to answer the question.

Marital status: The majority of respondents, 48 respondents (68.6%), stated that they are married. Twelve respondents (17.1%) stated that they are single, 6 respondents (8.5%) stated that they are widowed, and 4 respondents (5.7%) stated that they are divorced. None of the respondents indicated that they are living in a common-law marriage.

Monthly income: The majority of respondents, 19 respondents (27.14%), stated that their monthly income ranges from 12,000 RSD to 24,000 RSD. Thirteen respondents (18.6%) reported that their total monthly income ranges from 24,000 RSD to 32,000 RSD. Eight respondents (11.5%) indicated that their income ranges from 32,001 RSD to 48,000 RSD. An equal number of respondents, 7 (10%), stated that their income is between 48,001 RSD and 64,000 RSD or between 64,001 RSD and 80,000 RSD. Four respondents (5.7%) reported having no income. Three respondents (4.28%) stated that their monthly income is up to 12,000 RSD. Two respondents (2.86%) reported an income of over 120,000 RSD, while one respondent (1.43%) indicated that their income ranges from 80,001 RSD to 120,000 RSD. Six respondents (8.6%) chose not to answer the question (Table 4).

4.2.2 Perception of the causes of the depopulation – the attitudes of the respondents

Most of the respondents think that the main causes of emigration from Visok are connected with the economic development of the area. To be more precise, out of 70 respondents, 57 (81.4%) stated that the main causes of emigration are low wages and limited chances to earn an income sufficient for a "normal" life, while 54 respondents stated that the main reason why inhabitants are moving away from Visok is unemployment (Figure 5).

Unavailability or poor quality of healthcare facilities is the "third" main reason why people are moving away, taking into account the perception of the local community. Specifically, 38 respondents (54.3%) stated that they agreed with the statement, while 20 respondents (28.6%) disagreed. A similar perception exists regarding poor infrastructure and the low quality of public goods as the main reason for emigration. Thirty-eight respondents (54.3%) agreed that this could be the main cause, while 21 respondents (30%) disagreed with this statement (Figure 5).

Considering the challenging living conditions in a mountain area, 34 (48.5%) of the 70 respondents stated that this could be a reason why inhabitants are moving away from the Visok area, while 17 respondents (24.2%)

4 All of these respondents live in the Visok area for part of the year.

Table 4: Sociodemographic characteristics of the respondents

Gender	No of respondents	Age	No of respondents	Education	No of respondents	Residence	No of respondents	Profession	No of respondents	Marital Status	No of respondents	Monthly income[a]	No of respondents
Male	50	15-29	4	Incomplete primary school	10	Beograd	1	Pensioners	19	Married	48	Up to 12000RSD	3
Female	20	30-64	31	Primary school	16	Jelovica	3	Entrepreneurs/ Self-employed	10	Single	12	12.001-24.000	19
		65+	35	Completed secondary school	31	Dojkinci	8	Farmer	8	Divorced	4	24.001-32.000	13
				Completed higher education or university	12	Niš	2	Ind. production workers	9	Widow/ Widower	6	32.001-48.000	8
				Postgraduate studies (MA or PhD)	1	Pirot	10	White-collar worker/clerk	8			48.001-64.000	7
						Rsovci	14	Other/I prefer not to answer	16			64.001-80.000	7
						Temska	16					80.001-120.000	1
						Topli Do	9					Over 120.000	2
						Visočka Ržana	6					Without any income	4
						Vlkovija	1					Don't want to response	6
Total					**70**		**70**		**70**		**70**		**70**

[a]Monthly incomes are given in the national currency (RSD), where 1 EUR = 118 RSD.

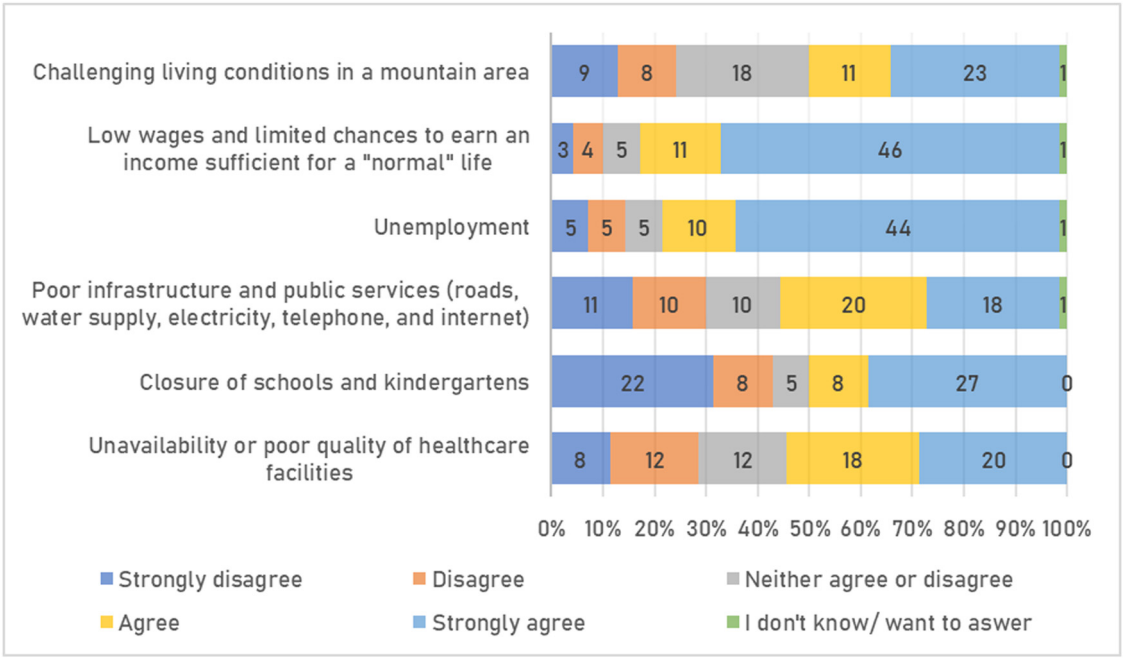

Figure 5: Perception of the main causes of the depopulation of the Visok area.

disagreed with this statement. Regarding the absence of schools and kindergartens, opinions are highly divided: 35 respondents (50%) believe that this has a significant influence on emigration in the Visok area, while 30 respondents think the opposite (Figure 5).

The third block of questions is dedicated to the measures needed for the revitalization of the Visok microregion, specifically what actions need to be taken, according to the estimates of the locals, to make the Visok area a more attractive place for living and investment. This block of

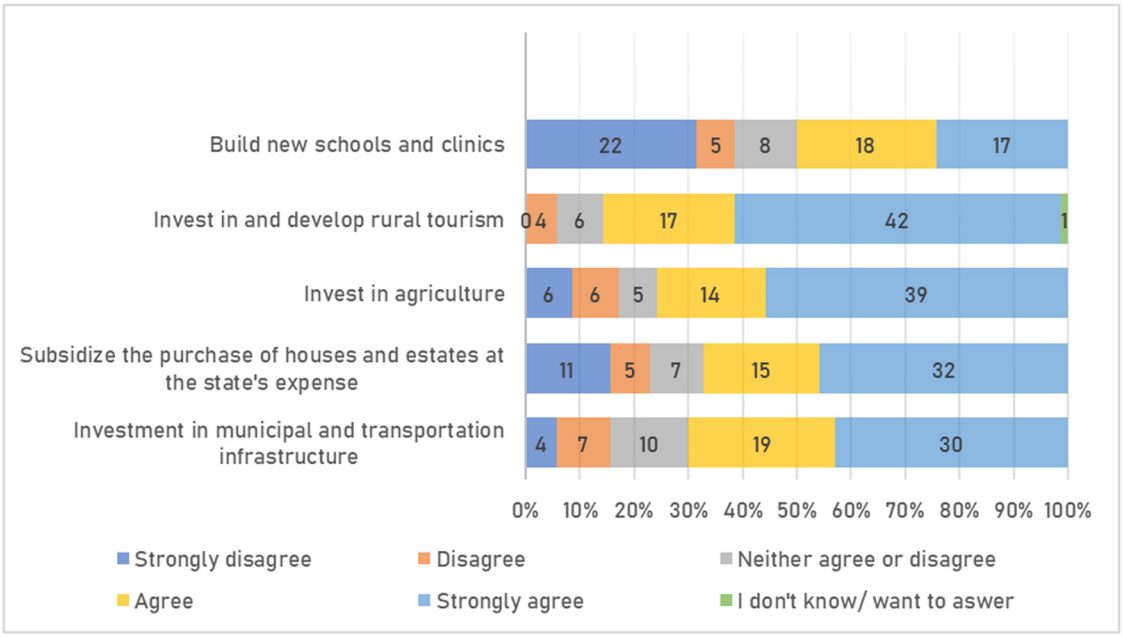

Figure 6: Perception of the measures that would contribute to immigration to the Visok region.

questions aims to identify the areas that need investment to create conditions for the immigration of residents and to examine the residents' perception of the tourism potential of the Visok micro-region. The further text will be dedicated to analyzing the respondents' answers to these questions.

Regarding immigration to the Visok area and which measures should be implemented, most of the respondents, more than 70%, believe that a good step forward would be to invest in rural tourism and agriculture. To be more precise, out of 70 respondents, 59 (84.3%) stated that they agree with the statement that investment in rural tourism would contribute to immigration to the Visok area, and only 4 (5.7%) of them disagree with this statement. The perception of the respondents regarding investments in agriculture is as follows: 53 respondents (75.7%) believe that these measures would have a positive influence on immigration, while 12 respondents (17.1%) stated that they disagree with this (Figure 6).

Over two-thirds of the respondents stated that they agree with the statement that investment in municipal and transportation infrastructure will contribute to immigration in the Visok area. Forty-nine respondents (70%) agree with this statement, while 11 respondents (15.7%) disagree. The fourth measure that we tested was the allocation of budget subsidies for the purchase of houses and estates. The majority of respondents, 47 or 67.1%, stated that they agree with the fact that this measure could contribute to immigration to the Visok area, while 16 of them (22.8%) disagree with this (Figure 6).

The measure that will have the lowest influence on immigration in the Visok area, considering the perception of the local community, is to build new schools and clinics. Fifty percent of the respondents (35) agree that this measure could have a positive influence on immigration, while 27 of the respondents (38.6%) disagree with this statement (Figure 6).

In this section, we also examined respondents' attitudes regarding which models are best to apply to attract and increase the number of tourists in the Visok area. We tested six statements; each statement represents one model. Most of the respondents, 63 or 90%, agreed with the proposed model, which includes the improvement of basic infrastructure, primarily roads, and accommodation capacity, and only 5 of them disagreed. Almost the same results are regarding the model, which includes investment in marketing and creating interactive maps and introduction of guided tours of the most famous sites in local tourist agencies; 63 respondents (90%) stated that this measure will increase the tourist number of Visok area; and 3 respondents disagree with the claim that investment in marketing and creating interactive maps can attract a larger number of tourists. Regarding the model that implies the introduction of guided tours of the most famous sites in local tourist agencies, over 90% or 63 of the respondents support this idea, while only 4 of them disagree with the claim that this model will increase the number of tourists in the Visok area (Figure 7).

Almost three-quarters of respondents, 59 of them (84.3%), agreed with the claim that regular maintenance of hiking

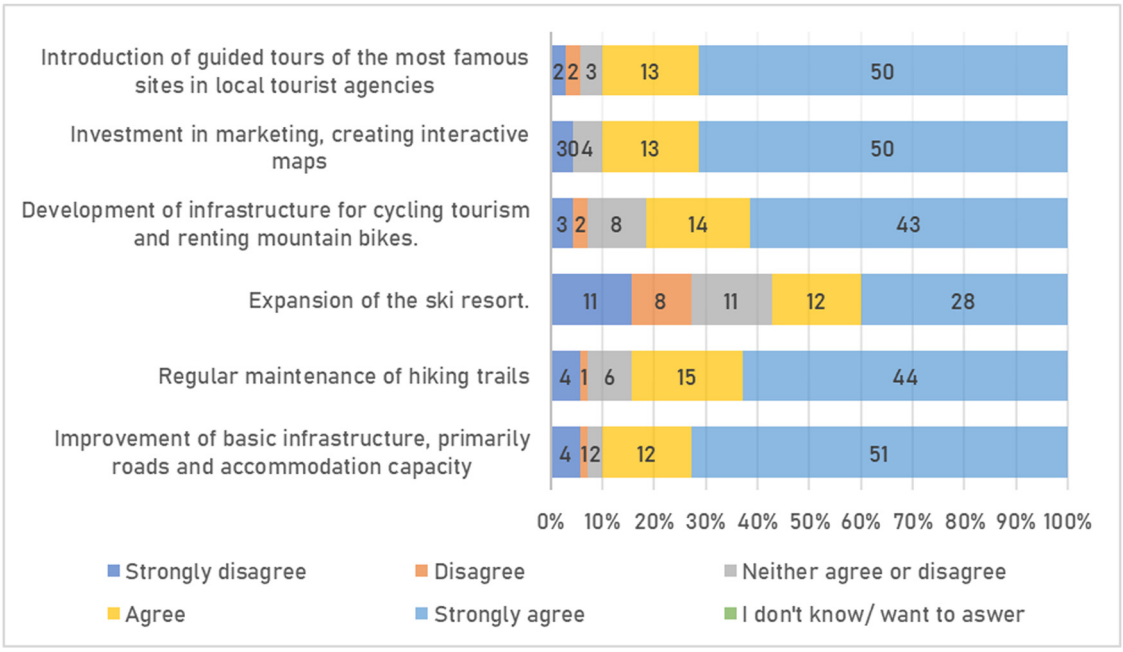

Figure 7: The best models for improving tourist potential.

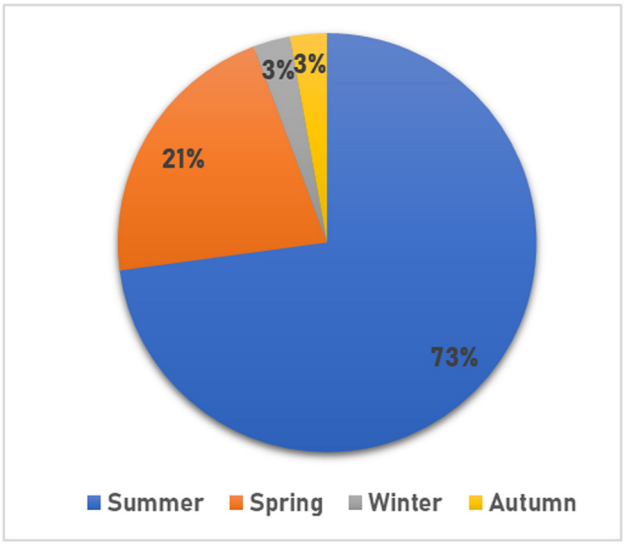

Figure 8: The best tourist season – attitudes of the respondents.

trails can increase the number of tourists in the Visok area, while 5 respondents (7.1%) disagreed with this. Almost the same distribution of answers is found with the claim that the development of infrastructure for cycling tourism and the possibility of renting mountain bikes: 57 respondents (81.4%) support this model, while 5 (7.1%) are against it. The smallest number of respondents agreed with the claim that the expansion of the ski resort would attract a greater number of tourists to visit the Visok area; 40 respondents (57.1%) agreed that this can be a suitable model for increasing the number of tourists, while 19 of them (27.1%) disagree with this (Figure 7).

Additionally, we examined the local population's assessment of which season is most suitable for tourism activities in the Visok micro-region. The majority of the respondents stated that they think that the best tourist season for the Visok area is summer, 51 respondents (73%) choose summer, 15 of them choose spring (21%), and only 2 (3%) of them think that winter is the best tourist season and the same number choose autumn (Figure 8).

When it comes to changing the purpose of existing state-owned buildings (schools, cooperatives, etc.), opinions are quite divided. Most respondents, 36 (52%), would support measures involving changes in the purpose of these buildings/facilities. However, 15 respondents (21%) stated that they would not change the purpose of the existing buildings/facilities. Additionally, the number of respondents who do not want or do not know how to answer this question is significantly higher compared to previous questions: 5 respondents (7%) stated that they do not know how to answer the question, and 4 respondents (6%) stated that they do not want to answer this question (Figure 9).

Respondents also had the option to choose "Other" among the provided answers if they disagreed with any of the suggestions presented. Ten participants chose the "other" option, and they were given the opportunity in the following question to express their opinion on a

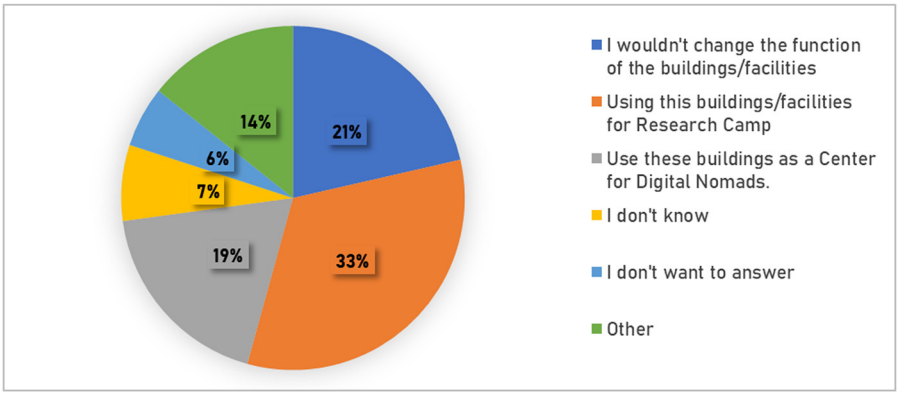

Figure 9: Changing the purpose of existing buildings that have no function.

desirable "other purpose" for the mentioned facilities. The largest number of participants suggested that a store/market should be opened in one of the settlements in the Visok area, and five participants had a concrete proposal that it should be in the settlement of Visočka Ržana.

5 Discussion

If we consider the assumption that settlements below 100 and 200 inhabitants do not have any chance for demographic revitalization [7], then we can conclude that the demographic potential of the settlements in the Visok micro-region was interrupted 40 years ago. Every census since 1981 shows that all the settlements in this area have been experiencing a population decrease, and half of the settlements had a population lower than 200 people [24]. Conversely, the municipalities to which these settlements belong exhibit a similar but less dramatic trend. The municipalities of Pirot and Dimitrovgrad have also experienced a decline in population during the same period.

The latest census results indicate that the municipality of Dimitrovgrad is one of the three municipalities in Serbia with the greatest population decrease, with the smallest settlements located there (21 out of 24 settlements have fewer than 100 inhabitants).[5] Conversely, the municipality of Pirot records the largest absolute decrease in population [7]. The latest census results show the same trend but manifest more dramatically in the Visok micro-region, which now consists of extremely small settlements, all with fewer than 100 inhabitants [24]. Figure 10 shows the number of inhabitants per village according to the latest census (2022).

Having all mentioned, we can conclude that the depopulation of the Visok micro-region can be largely attributed to its age structure. The average age has hardly changed in the last three decades. There are different values in each census cycle, but all of them have been more than 65 years for the last 30 years. For the last 30 years, the Visok micro-region had a much older population than the Pirot district, Pirot City, or Dimitrovgrad (Table 3). With a constant decrease in population and such a high average age, it is clear that migrations in the past three decades did not significantly influence the population of this area.

The inherited age structure and the emigration of young and reproductive-capable populations emerge as two main causes of depopulation in the Visok area. Analyzing the demographic characteristics of the Visok region, we conclude that the age structure has further intensified the impact of fundamental factors contributing to population decline, particularly the negative natural population growth. The inherited age structure has influenced the narrowing of the reproductive population base, and such implications are present throughout the southeastern Serbia region [10], as well as at the national level in Serbia [34].

If we look at the aging index, we can see a significant difference between the values for the Visok micro-region and the municipalities to which they belong (refer to Table 3). This difference is a consequence of the fact that in the Visok micro-region, we have settlements without a young population (ages between 0 and 15) in 12 settlements, according to the 2022 census. A similar situation was observed in 2011 and 2002. The difference in the aging index values between 2011 (39.64) and 2022 (32) is not a result of significant changes in the age structure. It is a consequence of the fact that 10 years ago, these settlements had few young people, but by 2022, they moved from one age cohort to another [24].

5 Dimitrovgrad, Babušnica, and Bela Palanka are three municipalities that have the least populated settlements in south-east Serbia [7].

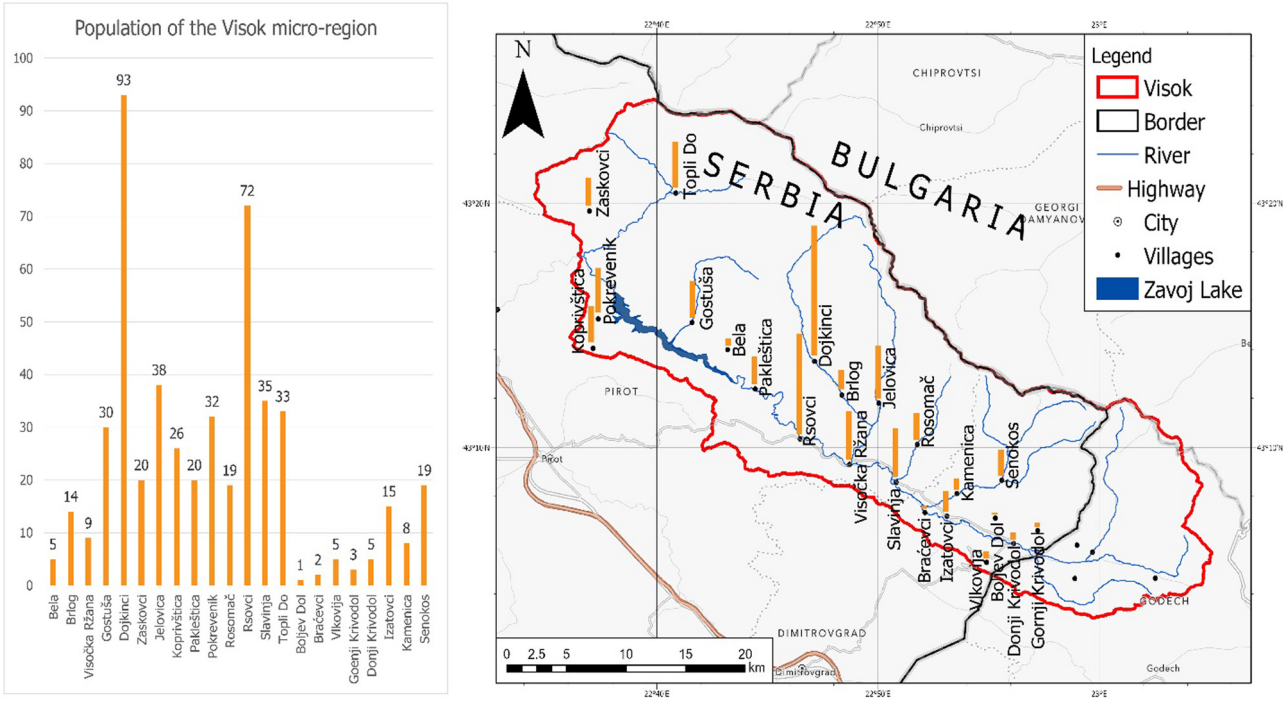

Figure 10: (Left) The population of the Visok micro-region and (right) distribution of the inhabitants.

Given the age structure of the population, there is no chance for these settlements to be revitalized through natural reproduction. If this trend continues, most of the settlements will be empty very soon.

The trend of an unfavorable age structure is observed in the municipalities of Pirot and Dimitrovgrad, to which the settlements of the Visok micro-region belong. The analysis of the age structure of southeast Serbia indicates that as early as 2002, Pirot was classified among cities that had experienced profound demographic aging, and Dimitrovgrad was already categorized as one of the municipalities that had reached the deepest demographic aging [33]. The calculated aging index from 2022 confirms the stated finding. The aging index for the city of Dimitrovgrad is one point higher than the aging index of the Pirot municipality, 3.00 compared to 2.00. Both values indicate that the age structure of the population in both cities suggests municipalities with an extremely endangered demographic potential. Results indicate that the demographic potential of the entire Pirot district is endangered due to the age structure of the population, which is a consequence of negative natural population growth, as well as the constant emigration of young people over the past 60 years. The age structure of the population and the absence of immigration also influence on economic development of the area. Southeastern Serbia is among the regions with the lowest economic activity, as evidenced by significant differences in incurred costs, turnover, and employment [35]. The above-mentioned finding has also been confirmed through our research. Members of the local community accurately perceive the area's economic underdevelopment (limited chances to earn enough for "normal life") as the main cause of depopulation. This primarily refers to the emigration of young and reproductively capable individuals, as well as the lack of conditions for people to come and settle in this area due to very limited opportunities for employment and leading a normal life over the past six decades (refer to Figure 5).

If we consider the first assumption, that a natural disaster and the subsequent consequences (forced population displacement due to the Zavoj lake catastrophe in 1963) have influenced depopulation, leading to a decrease in the demographic potential of the Visok, we can conclude that the main causes of depopulation of the micro-region Visok are its age structure and absence of the immigration. However, it is important to mention that the relocation of residents from Zavoj to Novi Zavoj, now a part of the Pirot City, accelerated the depopulation of the Visok micro-region, but it did not cause it. When we consider this hypothesis, we need to have in mind that Zavoj was the biggest settlement in the area, with 1,335 inhabitants in 1961 (2 years before catastrophe), so it was a settlement with the greatest demographic potential [24]. Relocation of the residents from Zavoj to Pirot city permanently jeopardized the chances of the micro-region Visok being revitalized through natural reproduction. It remains an open

question whether the settlement of Zavoj (now Novi Zavoj), if its inhabitants had not been relocated to Pirot city, would have shared the fate of other settlements and lost its demographic potential over time due to emigration, as happened with Gostuša, Rsovci, and Topli Do.

Even though it is clear that the Visok micro-region because of the inherited age structure and absence of immigration does not have a chance for natural revitalization without planned immigration, there is a chance for economic revitalization of the area. We have concluded that one of the main causes of depopulation is the area's economic underdevelopment. If we want to revive the area's economy, it is necessary to use the touristic potential of the micro-region. The outstanding geoheritage conditions in this region hold great potential for ecotourism [21,22], attracting more residents, especially during the warmer seasons. These findings have been confirmed by our research as well; the local population recognizes the summer season as the most suitable for tourism activities in the Visok micro-region. Additionally, there is substantial potential for ski tourism to establish a nature-oriented ski center, given the rapid urbanization of other ski centers in Serbia [36]. Survey data showed that Visok inhabitants do not feel like part of the ski resort Stara Planina, even though the ski resort is a part of this micro-region. The main reason for this is the poor condition of the road between Topli Do and Babin Zub, which is unusable by regular cars or buses, preventing the local community from experiencing the real benefits of the ski resort. Conversely, considering the main findings of the research, the local community recognizes the benefits of and supports ecotourism models focused on the summer season (refer to Figure 7). It is justifiable to assume that the local community largely recognizes that the summer season has greater potential for the economic and demographic revitalization of the Visok micro-region, as it involves activities that include the local community.

Based on surveys and fieldwork, it is observed that the majority of inhabitants are either engaged in farming or work in the construction, stone, and forestry industries. Among the animals, sheep are undoubtedly the symbol of this region, and from an ethnological standpoint, it is crucial to secure this tradition and ethnological heritage [13,16,28,37]. It is important to mention that this approach would have the support of the local community. Survey findings show that over two-thirds of respondents strongly believe that investment in rural tourism and agriculture would be a positive step forward (refer to Figure 6). Moreover, the local population demonstrates a strong ecological awareness, advocating for industries that harmonize with nature. This creates an ideal environment for nature enthusiasts and scientists to preserve this nearly untouched part of the world.

The data on age structure across all census periods indicate that the population of this area has surpassed the demographic aging threshold since the 1961 census and is now in the final stage of demographic transition. This age structure has led to the absence of children in these settlements, resulting in the closure of all schools in the micro-region. Until conditions allow for the reopening of schools, it is essential to repurpose these valuable buildings to preserve them.

Surveys have identified that the best ways to utilize existing resources include establishing permanent summer schools and camps. These would attract young people and have a significant impact on ecological awareness. Some of these facilities could also serve as hubs for digital nomads. Development of both models would have the support of the local community (refer to Figure 9). This approach would not only popularize the area but also increase the visibility of the entire micro-region. In addition to gaining a stable customer base for local products, residents would benefit from improved infrastructure, particularly in terms of internet and communication systems, as well as enhanced economic benefits for the local community.

Such measures would significantly contribute to the mutual education of both residents and new temporary visitors, potentially resulting in modern tourist products such as digital maps and overall improvement in the marketing of the Stara Planina mountain's tourist offerings. Additionally, it is necessary for the offerings of local tourist agencies to be systematically based on visits to the geohistorical heritage of this micro-region. Moreover, many residents expressed a need for a store and a gathering place during the survey. The solution to these issues potentially lies in relocating retail facilities near the most significant geolocations and increasing the availability of local products at these sites.

A positive example of repurposing existing buildings can be seen in the village of Temska, where the camp "Temska" has been active for 20 years. Every year, at least 100 students of biology, geography, and related sciences visit this camp. It has played a crucial role in educating locals about the negative effects of small hydropower plants on Stara Planina Mountain. The camp operates solely on the enthusiasm of its participants and local residents. There should be an organized plan for similar initiatives throughout the whole micro-region. Additionally, the local community center in Temska has been repurposed and now serves as a museum and educational center addressing the ecological challenges faced by the residents of Stara Planina.

6 Conclusion

Based on the presented data, it is evident that the Visok micro-region has undergone a dramatic demographic decline since 1948, leading to its near extinction. None of the observed settlements in this area have any potential for further biological reproduction. However, the region holds potential for the development of agriculture, forestry, and particularly sustainable tourism and related activities. Traditionally, agriculture and forestry have been the primary activities in this area. The well-preserved geoheritage, with its attractive attributes, presents an opportunity for the region to become a true tourist destination. As we mentioned, the tourism potential of the region is seen as an opportunity for the revitalization of the Visok micro-region, as it could revive the area's economy. In this context, tourism might be the only chance for the demographic revitalization of the Visok micro-region.

Surveys indicate that spring and summer are the best periods for visiting this area, while winter conditions make life challenging for the residents. Therefore, organized periodic migrations could create a multi-faceted economic benefit for the region by integrating agriculture, crafts, and forestry and forming a unique tourism brand. The preserved environment, diverse topography, favorable climate, and exceptional geoheritage provide opportunities for various types of tourism, including active leisure, sports, recreation, and mountain tourism. The local population recognizes the advantages of developing the summer season, as it provides opportunities for the involvement of residents from both Visok and the surrounding settlements in different ways, and that is why, in this article, we advocate for modes that imply the development of the summer season.

The development of tourism in the Visok micro-region should follow a polycentric approach. Current research and analysis have shown that the area's tourist values belong to the category of independent and complex tourist attractions with unique and aesthetic attributes. The main shortcomings in the current tourism development are the lack of tourism infrastructure and superstructure. Although the infrastructure of the region has been partially improved between 2019 and 2024, it remains below the optimal potential that the area offers.

Future development plans cannot rely solely on the capabilities of local governments but must be an integral part of national-level planning. The first step should be transforming the dominant functions of the region. Data analysis shows that all settlements are predominantly agrarian, whereas, for these plans to succeed, they should shift toward agrarian-service settlements. This redirection of economic investments would benefit both agriculture and tourism. We need to emphasize that this approach would have the support of the local community, which has shown great determination and perseverance in fighting for development models that will not disrupt the economic and ecological balance of the region.

Such development would allow certain settlements to gain new functions, attracting tourists and investors. Promoting the ecological aspects of these settlements and leveraging the popularity of Topli Do as a center for ecological activism, as well as valuing the exceptional hydrological geoheritage, can enhance the region's appeal. Notable villages like Rsovci, Dojkinci, and Slavinja in the Visok micro-region's watershed stand out for their tourist potential, with Visočka Ržana positioned as the central settlement due to its location, attractive attributes, and functional capacity. Future research and development plans should focus on establishing Visočka Ržana as the central hub for investment ideas and economic activities, with other settlements complementing the region's overall functions.

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