Georgi Zhelezov
Editor

Sustainable Development in Mountain Regions

Southeastern Europe

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Preface

The mountain regions in Southeastern Europe are unique natural regions of great beauty and ecological value, and home of the head waters of major rivers. They constitute a major ecological, economic, cultural, recreational and living environment in Europe, shared by numerous peoples and countries. The Southeastern European Mountain Regions are an important reservoir for biodiversity and habitats in Europe. A great number of protected areas – national parks, nature parks, reserves and nature monuments are located in these regions.

From a socio-economic point of view, the mountain regions are observed to be the poorest areas in the Southeastern European countries, but they have potential for the implementation of successful economic practices and activities. There is an opportunity to set measures for the development of the regions and, in particular, for trans-border integration and cooperation. Regional cooperation is of paramount importance as the EU integration differs among the countries and synchronization of this activity, originally triggered through the EU accession process, is needed to avoid future imbalance of developments in border regions.

Positive examples as the *Alpine Convention* or the *Carpathian Convention* do demonstrate the broad aspects and potential of local embedded processes contributing to the sustainable development of (also trans-border) regional cooperation and the high economical potential of mutual learning from each other. The development of these conventions provided the framework for cooperation and multi-sectoral policy coordination, a platform for joint strategies for sustainable development, and a forum for dialogue between all stakeholders involved. Both conventions were triggered or assisted by researchers in their development and implementation. The recent developments and the more stabilized peaceful neighbourhood opens up the chance for preparing a Balkan Convention on Mountainous regions.

The most important aspects of the problems in mountain regions in Southeastern Europe formulated as a result of the work at the International conference *Identifying the Research Basis for Sustainable Development of the Mountain Regions in Southeastern Europe* in Borovets (Bulgaria) – April 2009, supported by Austrian Science and Research Liaison Office – Ljubljana/Sofia and the Federal Ministry of Science and Research of the Republic of Austria in the framework of its SEE science cooperation initiative are as follows:

– Mountain environments are sensitive ecosystems. In Europe, they are among the most threatened landscape systems.
– Mountain regions must preserve their function as a living space.
– All mountain regions must be subject to a proper policy of planning, development and mountain population promotion.
– The development of tourism, transport and industry must be based on the efficient management of natural resources.
– Effective preventive measures must be taken against natural disasters such as avalanches, torrents in spate, landslides and falling rocks.
– Natural, semi-natural and cultural landscapes and environments must be preserved.
– A mountain network of biogenetic reserves must be established.
– Efficient measures must be taken to preserve the originality of rural mountain life indispensable for conserving the living mountain environment.
– Grazing strategies and management plans must be optimized.
– Lighting of fire in mountain regions must be prohibited.
– Native species in maintaining or restoring the forest cover must be used.
– The protection of fauna and flora and the reintroduction of extinct species wherever possible must be one of the priorities.
– Adequate ecological control of game is required.
– Conservation of the natural heritage of mountains and their ecosystems through scientific cooperation at all levels.
– Appropriate programmes are required for informing and educating the public, for shaping opinions and for training specialists.
– There should be set up of a distributed Spatial Data Infrastructure (SDI) adhering to relevant standards and conforming to the INSPIRE framework of the EU, as a foundation for monitoring, decision support and research activities.
– Human, ecological and economic problems arising in various mountain regions have the same basic characteristics irrespective of the country.

Understanding the importance of development of mountain regions in Southeastern Europe, the participants in the scientific forum decided:

1. to establish and develop a scientific network for the Mountain Regions of Southeastern Europe, to advance research efforts in the field of Global Change and to support sustainable development in the region.
2. to formulate recommendations to the national and international institutions and organizations for initiating the development of a Balkan Convention, based on the present experience of Alpine and Carpathian conventions.

Contents

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Part I
Global Problems and Mountain Regions

Chapter 1
Scientific Research Basis for Sustainable Development of the Mountain Regions: Main Concepts and Basic Theories

Mariyana Nikolova

Abstract European policy toward the mountain regions aims at achieving sustainability by using cohesion and integration policies, as well as multi-sectoral and regional approaches. Under the conditions of global change, the role of scientific research in the implementation of these policies acquires additional importance. Scientific understanding of the theoretical base and the concepts involved would best serve sustainable development policies in the mountain regions. This chapter provides an overview of definitions of fundamental concepts, like "sustainability" and "sustainable development," "multidisciplinarity," "interdisciplinarity," and "transdisciplinarity." Having in mind that the diversity and complexity are typical characteristics of mountain areas, both socially and environmentally, the chapter discusses advantages and drawbacks of the implementation of the DPSIR model and the concepts of "multidisciplinary," "interdisciplinary," and "transdisciplinary." This analysis is expected to support the following conclusions: (1) Sustainable development policies must be grounded in the basic concepts of economic theory, including "throughput," instead of "utility." (2) Mountain research necessitates transdisciplinary approaches.

Keywords Sustainable development · Mountains · Global change

1.1 Introduction

Thirty-five years after adoption of the idea of sustainability by IUCN, the Millennium Assessment (2005) provides evidences that the human capacity to destroy life-support systems grows and the rates of human transformations of the earth are increasing. Current relationships between humans and biosphere have reached a critical state without analog in the past centuries. The earth's capacity to provide resources and to support ecosystem services and human well-being is

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limited, and this put under question the need of development of new thinking about sustainability and new strategic approach to global sustainability because “business as usual” is no more an option. Mountains of the world need new knowledge-based approach in this process because of their high sensitivity to the global change on the one hand and because of the great diversity of goods and services which mountain regions provide to the society, on the other. About 36% of the territory European Union is a mountainous area that contains 18% of the Union population. Mountain regions within Europe are important for water capture, storage, and delayed release to downstream areas. These regions are centers of biological diversity and they are economically and socially important as sites for tourism. Research and innovation are crucial to addressing some of the major issues facing the European Union and upholding an EU-model based on economic growth, social responsibility, and sustainable development.

1.2 Research Base for Sustainable Development of Mountain Regions

There is no agreed way defining extend to which sustainability is being achieved or not in any policy program in spite of all sets of indicators developed during the years. It is already clear that we have to face the challenge and to shift the concept “sustainable development,” which is an oxymoron, in a new direction which would be expressed better by “sustainability, well-being and security.” At the same time, we have to seek for better solutions how to make trade-offs and synergy between different goals (between the interest of different social groups or different environmental outcomes, etc.). The three “pillars” of sustainability—environment, society, and economy—cannot be treated as if equivalent because economy emerges from society in difference of environment and because environment includes both society and economy.

Sustainable development definition is under critical analysis since it was proposed in Burndtlad Report (1987): “Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.” An important discussion on this definition was published by Herman Daly in 2001. He stresses on the significant role which utility plays in the abovementioned definition and on the expectation that utility of the future generations is to be sustained and non-declining. According to the author, physical throughput should be sustained. Natural capital (the capacity of the ecosystem to yield both a flow of natural resources and a flux of natural services) is to be kept intact. Sustainable development as a concept of throughput requires increasing reliance on the renewable part of the throughput, and willingness to share the non-renewable part over many generations. The concept of throughput forces the recognition of the constraints of physical law on economics and also it forces the recognition that “sustainable” cannot mean utility “forever.”

Under the conventional development model the “good life” is defined in terms of access to goods and utilities. This formulation seems to be inadequate anymore and replaced by a concept for "well-being" defined in terms of access to quality, diversity, healthy environment, solidarity, and security. Research development in field of ecosystem services and innovations in so-called "green" technologies are crucial for the successful implementation of any strategy aiming sustainability nowadays.

The EU Sustainable Development Strategy (SDS), which was renewed in June 2006, sets out a coherent approach to how the EU will more effectively live up to its long-standing commitment to meet the challenges of sustainable development. It reaffirms the overall aim of achieving continuous improvement of the quality of life and well-being on earth for present and future generations, through the creation of sustainable communities able to manage and use resources efficiently and to tap the ecological and social innovation potential of the economy, ensuring prosperity, environmental protection, and social cohesion.

The SDS requires the Commission to develop indicators at the appropriate level of details to monitor progress with regard to each particular challenge. A first set of indicators was adopted by the Commission in 2005 and further reviewed in 2007 in order to adjust to the SDS. Sustainable Development Indicators (SDIs) are used to monitor the EU SDS in a report to be published by Eurostat every 2 years.

The SDI framework is based on ten themes, reflecting the seven key challenges of the strategy, as well as the key objective of economic prosperity, and guiding principles related to good governance. The themes follow a general gradient from the economic, to the social, and then to the environmental and institutional dimensions. They are further divided into sub-themes to organize the set in a way that reflects the operational objectives and actions of the sustainable development strategy.

In order to facilitate communication, the indicator set is built as a three-level pyramid. This distinction between the three levels of indicators reflects the structure of the renewed strategy (overall objectives, operational objectives, actions) and also responds to different kinds of user needs, with the headline indicators having the highest communication value.

The three-levels are complemented with contextual indicators, which provide valuable background information but which do not monitor directly the strategy's objectives. The typology indicators, proposed by the European Environmental Agency are divided in four types:

- Type A: *descriptive indicators* of what is happening to the environment or human health, e.g., emissions and concentrations of pollutants (nearly 60 of this type);
- Type B: *performance indicators* linked to a reference value or policy target, illustrating how far the indicator is from a desired level (over 40 of this type);
- Type C: *efficiency indicators* illustrating the efficiency of production and consumption processes, e.g., energy consumption per unit of output (only 8 individual indicators);
- Type D: *total welfare indicators* which aggregate together economic, social, and environmental dimensions to illustrate whether, overall, welfare is increasing (no one).

The remaining indicators are either contextual indicators or those “to be developed” in the future (Eurostat, 2007).

Sustainable development policy indicators should be based on the principles and objectives of the EU SDS aiming at development of a clear understanding of the additional headings of governance and global partnership directed to the policy priorities and organized within a thematic structure that would be readily understood by policymakers. The scientific basis on which sustainable development indicators are build needs to be also regionally tested and relevant to the specific environmental features of a given territory, like mountain, coastal or urban regions.

1.3 PSR and DPSIR Models Require Transdisciplinarity

A number of models have been proposed for developing indicators, and illustrating the links between issues, particularly for environmental indicators. The best known of these is the “pressure, state, response” model developed originally by OECD. This is also the basis of the United Nations Commission for Sustainable Development (UNCSD) framework of sustainable development indicators. It has been adapted by the European Environment Agency into the “DPSIR” model (Driving forces, Pressures, State, Impact, Responses).

These models were developed primarily to help in understanding the interactions between the economy and the environment so they are not entirely appropriate for dealing with sustainable development. However, the concept of “ecosystem services (ESS)” essentially examines the link between biodiversity, ecosystems, and human well-being and plays important role in implementation of the DPRIR model in the studies on sustainability.

According to DPSIR terminology, human developments (drivers, D) exert pressures (P) on the environment and, as a consequence, the state (S) of the environment changes (changes of ecosystems). This has impacts (I) on humans and the society (by less or changed provision of ecosystems services), which may elicit a societal response (R). This response may either target the drivers, the pressures, the state or the impacts on society via various mitigation, adaptation or curative actions (Odermatt, 2004).

The research basis for sustainable development requires implementation of methods and knowledge from different scientific disciplines incorporated into a multidisciplinary account. The uniform understanding about the concepts we use in the research process of a given ecological target category, like mountains, is of crucial importance for the successful integration of knowledge and achievement of scientific results.

However, what we are going to do in the process of this integration? The answers are given in many publications from different authors:

- *Multidisciplinary* studies joining together two or more disciplines without integration. It is a wide range of subject matter and of conceptual frameworks, exploring the current state of mountain areas (Messerli and Ives, 1997);

- *Interdisciplinary* study is an academic process seeking to synthesize broad perspectives, knowledge, skills, interconnections, and epistemology in order to facilitate the study of subjects which have some coherence, but which cannot be adequately understood from a single disciplinary perspective. Interdisciplinary is by now a stand-alone discipline (Jones and Macdonald, 2007)
- *Transdisciplinarity* implies the interrelation of disciplinary generated knowledge and non-disciplinary generated knowledge and its application to complex problems and issues (Webster, 2009).

The close relation between sustainable development and transdisciplinarity is due to the fact that research for sustainable development has to be issue-oriented and reflect the diversity, complexity, and dynamics of the processes involved. It is possible therefore to examine complexity on a discipline-by-discipline basis.

1.4 Conclusions

The studies on sustainable development if mountain regions must be directed to successful implementation of the EU Sustainable Development Strategy but also they have to find implementation in the policies for sustainable development grounded in an economic theory that includes throughput, "green" technologies innovations, and ecosystem services as its most basic concepts. Implementation of the DPSIR in the studies on sustainability in mountain regions provides good research basis for integration of the abovementioned goals and for knowledge generation.

Transdisciplinarity is most relevant to the current dynamic processes under conditions of global change and to the study of the sustainable development in mountain regions using DPSIR model and SDI.

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Chapter 2
Solar Activity – Climate Change and Natural Disasters in Mountain Regions

Milan Radovanovic

Abstract Contemporary science is burdened with contradictory, i.e. severely opposed attitudes relating to climate changes issue, i.e. global warming. What is undisputable is that if climate changes are more intensive, the changes relating to stand of plants are also more intensive. Forest fires are one of the most drastic factors that influence changes of stand of plants on mountain terrains. Damages caused by destroying forests in that way vary from case to case, but the significant problem occurs in irretrievable losses in soil due to additional erosion, as well as disturbances in underground water circulation. In contrast to plain terrains, mountains are far more sensitive to such disasters especially when we have in mind losses in agricultural soil, as well as in wild animals. The fact that direct connection between any of climate elements and the initial phase of fire has not been established so far represents a special challenge to science. New hypothesis is presented in this chapter, which tries to link the processes on the Sun, i.e. charged particles (protons) as the potential causes of forest fires the origin of which is not known.

Keywords Solar activity · Forest fires · Natural disasters

2.1 Background

According to the official FAO data (2001, 2002), the number of forest fires of unknown origin (1999–2001) is over 20,000 in some European countries. For the period from 1950 to 1991, 40% of fires with unknown cause were registered in Europe (http://www.feudeforet.org/english/forets_europe.htm#haut). Nikolov (2006) points out that Bulgaria had the highest percentage of fires of unknown cause (67.9%) on the Balkans in the period from 1988 to 2004, whereas the Balkan countries had 37.9% in the same period. Disregarding whether it is about fires at mountain terrains, foothill or plains, the connection between the meteorological, i.e.

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climate conditions and the initial phase of fire is unclear. Every attempt of more complex research of this problem unavoidably leads to contradictory results which have been noticed about climate changes.

In the last few decades many scientific papers were published with several opposed attitudes towards climate changes. Girardin et al. (2006) say: "Human-induced climate change could lead to an increase in forest fire activity in Ontario, owing to the increased frequency and severity of drought years, increased climatic variability and incidence of extreme climatic events, and increased spring and fall temperatures. Climate change therefore could cause longer fire seasons, with greater fire activity and greater incidence of extreme fire activity years." The news are becoming worse as they note "Fire has also been recognized as a significant source of greenhouse gas emissions into the atmosphere. Most of this is in the form of carbon dioxide (CO_2), but quantities of carbon monoxide, methane, long-chain hydrocarbons, and carbon particulate matter are also emitted."

Contrary to the euphoria on global warming, which especially has been supported in the media during the last years, there are more and more papers in which regional climate changes are emphasized (Michaels, 1998; Gray, 2000; Landscheidt, 2003; Komitov, 2005; Radovanović et al., 2006, and many others). In that sense, the results that came out are commented as follows: "Just when you are starting to believe that variations in the amount of energy, which is coming from the sun, are not responsible for much of the observed surface warming during the past 20 years, Scafetta and West (2006) conclude otherwise: 'We estimate that the sun contributed as much as 45–50% of the 1900–2000 global warming, and 25–35% of the 1980–2000 global warming. These results, while confirming that anthropogenic-added climate forcing might have progressively played a dominant role in climate change during the last century, also suggest that the solar impact on climate change during the same period is significantly stronger than what some theoretical models have predicted' " (http://www.worldclimatereport.com/index.php/category/climate-forcings/).

In situations when a number of localities appear, burning in several states, the question of intentionally or unintentionally caused fires simply cannot be taken into discussion. Due to the limited scope of the chapter only two figures will be presented, illustrating the non-justification of taking into consideration the anthropogenic affect on the phenomenon of the initial phase of fire in similar situations.

Speaking about Fig. 2.1, it is necessary to emphasize that 2 days earlier many fires appeared on the southern banks of the Baltic Sea. It has come out that at the end of March the destructive power of fires was spreading from the north of the Central Europe towards the south of the Balkans and even on the south of the Apennines (Radovanovic and Gomes, 2009).

It is also necessary to mention that such images can be taken only when fire is already in its developed phase. In other words, the moment of the ignition certainly appears a little earlier. Nevertheless, satellites cannot detect fires which seize smaller surfaces (less than 1 km^2). Csiszar et al. (2005) wrote about the limitations of using satellites for the spatial detection of forest fires.

Fire seized locations throughout the Balkans can be seen from Fig. 2.2. Forests burned in the following mountains: Prokletije (Serbia, Albania), Sara (Macedonia),

Fig. 2.1 Large number of fires was spreading from Italy over the Balkans, Hungary, Romania, Ukraine, Slovakia and Poland on March 26, 2003. (http://earthobservatory.nasa.gov/NaturalHazards/natural_hazards_v2.php3?img_id=8620)

Pindus Mts. (Greece), the Carpathians (Romania), Stara planina (Serbia, Bulgaria), the Dinaric Alps (Montenegro, Croatia), but also at the lower terrains of the Mediterranean and the Black Sea coasts. The following quotation gives the concise description of the events in Bulgaria: "Emergency services were inundated with hundreds of calls from people suffering from heat stroke, dehydration and headache. Only in Sofia 140 people fainted in the streets on Saturday. At least eight deaths were directly attributed to the extreme temperatures. Most of the victims were elderly people suffering from chronic diseases. Six people were killed in the fires that started on Saturday and that continued well into the next week. There were an estimated 1,530 cases of fire in just 4 days (Friday 20 to Tuesday 24 July, 2007). That's three times the yearly average. Fires raged in almost every corner of the country but the largest fire was near Stara Zagora where 20 square miles (50 km^2) of pine forest burned uncontrollably for 3 days. Firefighters were unable to put out the fire by conventional means. Strong winds and the extremely dry air quickly sparked new fires and by Sunday the situation was out of control. The government turned for help to Russia and Be-200 amphibious water bomber flew in on Saturday to help fight the blaze near Stara Zagora. On Monday, more fires broke

Fig. 2.2 Fires and smoke across the Balkan Peninsula Satellite: Aqua – Pixel size: 1 km – Alternate pixel size: 500 m | 250 m 2007/206 – 07/25 at 11:15 UTC

out but the one near Stara Zagora was contained. The fire caused extensive damage to the forest and wild life. Estimates vary but this fire alone caused at least two million euros worth of damage. Temperatures in excess of 45°C had never previously been recorded in Bulgaria. The country generally has a temperate climate. Although temperatures reach around 40°C every summer this usually lasts for just a few days whereas this heat wave lasted for more than a week. Meteorologists from the national Institute of Meteorology and Hydrology announced 2007 to be the hottest year on record. However, they were careful to say that no clear link between global warming and the 2007 Bulgarian heatwave could be established" (http://en.wikipedia.org/wiki/2007_Bulgarian_heat_wave).

When it is about the eventual link of the climate elements and fires, it is necessary to emphasize clearly that such connection has never been proved concretely. Namely, the minimum of 300°C is necessary for the flame to appear (Viegas, 1998). As it is well known, the temperature of the ground surface that has ever been measured is not anything like this one, not to mention the air temperature. In the meantime an idea appears that lightning can represent frequent potential cause of forest fires. Somehow there is a conviction that it is easily paid no attention to the fact that, almost by the rule, rainfalls appear with lightning that should control fire spreading. It was established that: "From 1990 to 1998, over 17,000 naturally ignited wildfires were observed in Arizona and New Mexico on US federal land during the fire season of April through October. Lightning strikes associated with these fires accounted for less than 0.35% of all recorded cloud-to-ground lightning strikes that occurred during the fire season during that time" (Hall, 2007).

2.2 Heliocentric Hypothesis on Forest Fires

As far as it is known, Stevancevic (2004, 2006) for the first time gives the hypothesis on the possible connection between charged particles and forest fires. The author offers in his papers the explanation of the mechanism of the Solar wind (SW) penetration through the magnetosphere and atmosphere of the Earth, concluding that protons can reach the topographic surface only in the conditions of reduced air humidity and cloudiness. In the contact with plant mass, the conditions are made for the initial phase of the fire to occur. Gomes and Radovanovic (2008) and Radovanović and Gomes (2009) have decided to confirm the justification of the presented hypothesis in ten, i.e. 11 cases. Besides the fact that it was about a test research, it came out that a few days before the forest fires occurred, the coronary holes and/or energetic regions had been in geo-effective position on the Sun in all examined cases. Strong corpuscular energy was emitted out of them towards the Earth, the speeds of which in some cases exceeded 800 km/s, the particle temperature was over 1,000,000°C, while the particle density ranged even over 50 p/cm^3. Having in mind that the number of samples is statistically insufficient (due to problems on data gathering), Todorovic et al. (2007) and Radovanović et al. (2007) have also confirmed the justification of such approach through some separate examples. Regional-geographically observed, it can be said that where there are vegetation on our planet there are fires, too. Besides the reconnection (Radovanovic et al., 2003; Stevancevic et al., 2006), especially intriguing explanation was offered on the SW penetration mechanism through the atmosphere in tropical areas over geomagnetic anomaly, i.e. over the areas where the Earth's magnetic field is the weakest. At the same time, when fires occurred in the Balkans, numerous locations were also burning in Canada (Radovanović et al., 2009). The SW stream which is directed towards the tropics due to the kinetic energy influence, in dependence on the existing situation in the atmosphere and angle under which it comes, moves towards certain parts of our planet, also including mountain regions. According to Stevancevic (2006), in each concrete situation under the penetration deeply through the atmosphere, the SW stream disperses into several smaller sheaves due to increase of geomagnetic induction B and decrease of radius of the SW particle circulation in accordance with the relation: $r = mV/qB$. The radius of the SW motion is proportional to mass m and speed V, while it is inversely proportional to the electric load of particles q and the value of the magnetic induction B. Approximately, 80% of total burned biomass relates to tropical countries (http://earthobservatory.nasa.gov/Study/Fire/). The abundance of plant mass certainly influenced the previously mentioned extremely high value in this region.

However, rarely inhabited terrains, as well as the presence of extremely high values of humidity in the air should not be disregarded.

Which areas are going to be under the effect of the SW stream will depend on the angle (as well as other physical–chemical characteristics) under which the SW stream penetrates towards the surface over the tropics. From the previously mentioned case, there has also been the time coincidence of air mass moving from the southwest towards the Balkans. It is very important to emphasize that before the destructive power of fires occurred in the southeastern Europe, a series of fires had occurred in the northwestern Africa, as well as on many locations of the European Mediterranean (Gomes et al., 2009).

Figure 2.3 shows mean wind speeds, approximately from the upper border of the troposphere to some mountain peaks. Yellow lines mark wind speeds, so that by following their location we can make some conclusions on dominant directions of air mass moving. The upper part of the 3 relates to July 21, while the lower one to July 22, 2007. The same day when satellite measured the sudden rise, i.e. IMF approaching towards Earth, the isoclines of the increased mean wind speed (70 knt) were recorded in the area of the Mediterranean. According to heliocentric hypothesis, the penetration occurred over the Atlantic geomagnetic anomaly, so that a part of stream was directed towards Europe. Gomes and Radovanovic (2008) for the first time, in the case of Portugal, explained the idea according to which the air masses took hold due to SW penetration over the Atlantic anomaly. Based on the available literature, it seems that the research of the links between processes on

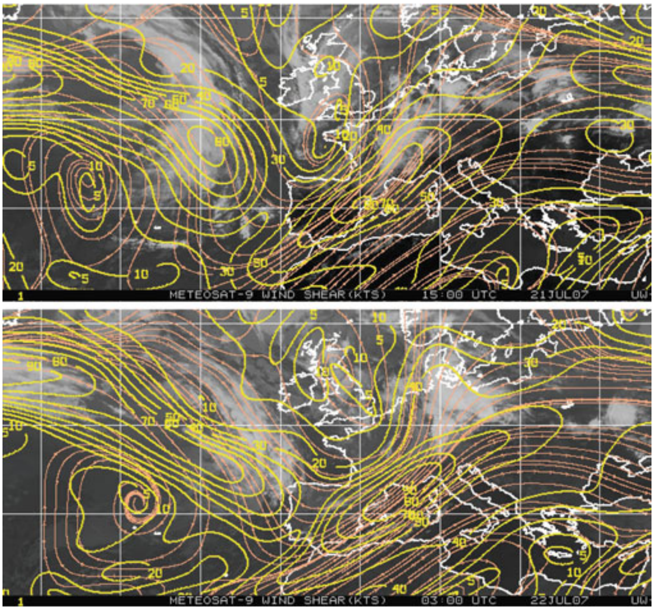

Fig. 2.3 Wind Shear 150–300 mb layer mean minus 700–925 mb layer mean (http://cimss.ssec.wisc.edu/tropic/real-time/europe/winds/wm7shr.html)

Table 2.1 Number of protons of certain energies during and after fires in Canada and the Mediterranean (http://umtof.umd.edu/pm/crn/)

(protons/cm^2-day-sr)			
Date	>1 MeV	>10 MeV	>100 MeV
2007 07 21	3.5e+05	1.7e+04	3.7e+03
2007 07 22	4.3e+05	1.7e+04	3.8e+03
2007 07 23	4.7e+05	1.7e+04	3.8e+03
2007 07 24	6.4e+05	1.7e+04	3.8e+03
2007 07 25	7.6e+05	1.7e+04	4.1e+03
2007 07 26	1.6e+06	1.8e+04	4.0e+03
2007 07 27	4.3e+05	1.7e+04	3.9e+03
2007 07 28	5.6e+05	1.8e+04	3.9e+03
2007 07 29	7.1e+05	1.7e+04	3.8e+03
2007 07 30	8.7e+05	1.6e+04	3.6e+03

the Sun and physical–geographic processes on Earth indicates to synchronized phenomenon of the SW particles and geomagnetic anomalies. "Therefore, we conclude that geomagnetic activity plays an important role in recent climate change, but that the mechanism behind this relationship needs further clarification" (Palamara and Bryant, 2004, Table 2.1).

On the basis of the data from the previous table, it can be seen that the number of protons in range of over 100 MeV practically did not decrease in the period from July 21 to 25, 2007. Until July 29, 2007 the number of protons of mentioned range was decreasing but only on July 30, 2007, it was below the level in comparison with July 21, 2007.

On the basis of the available literature, it seems that the cosmic radiation has also its pulsations, i.e. it is not constant. It has been noticed that when the Sun is more active the electromagnetic waves coming out of the solar system penetrate harder towards the Earth and vice versa. However, in some cases, except the strengthened activity of the Sun, the striking fronts of the cosmic particles are still coming towards us at certain moments. "Cosmic rays are different – and worse. Cosmic rays are super-charged subatomic particles coming mainly from outside our solar system. Sources include exploding stars, black holes and other characters that dwarf the sun in violence. Unlike solar protons, which are relatively easy to stop with materials such as aluminum or plastic, cosmic rays cannot be completely stopped by any known shielding technology" (http://science.nasa.gov/headlines/y2005/07oct_afraid.htm).

2.3 Conclusion

The hypothesis by which the charged particles from the Sun and forest fires (of unknown origin) are taken into the connection needs the experimental confirmation that would approximately simulate the contact between the plant mass and protons in laboratory conditions. It is also necessary to confirm the eventual causality on far larger number of cases. That means, more concretely, that there are certain possibilities of prognostic modelling under the existing notions. Therefore, at this moment it seems far simple to prognosticate when forest fires are going to happen, but considerably greater problem is to define where they are going to appear concretely. "... I think that these problems can only be solved by a joint interdisciplinary effort of open-minded scientists" (Landschieidt, 2000).

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Chapter 3
Mass Movement Processes Under Changing Climatic and Socioeconomic Conditions

Karl Hagen and Peter Andrecs

Abstract In recent years, natural hazards have caused increasingly damages to infrastructure and human beings in the alpine regions. At the same time, the global mean temperature is rising but in case of mass movement processes, there exists no direct connection between these two facts. It is not evident, that global rising temperatures will intensify the triggering effect of extreme precipitation everywhere. This will probably vary spatially. Adverse socioeconomic development has brought about the increase of real values. The impact of unsustainable land use has often caused higher susceptibilities. Even without adverse "Climate Change Effects", the risks due to natural hazards will increase in the future as a consequence of socioeconomic development. Hence, databases and methods of hazard and risk assessment have to be updated and improved.

Keywords Landslides · Climate change · Socioeconomic change · Hazard assessment · Risk assessment

3.1 Introduction

In recent years, in Austria and in adjacent countries, natural hazards such as mass movement processes have increasingly caused damages to infrastructure, settlements and human beings. Is this caused by an increase in extreme precipitation events or is socioeconomic development responsible for this phenomenon? Which measures on the international, national, regional and local level are required to reduce these adverse effects? Based on local investigations in Austria, some

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recommendations with emphasis on spontaneous landslides and debris flows are given below.

3.2 The Matrix of Mass Movement Processes and Triggering Parameters

3.2.1 Basics

In mountainous regions several processes of mass movements appear, reaching from sediment transport in rivers over debris and mud flows to landslides, rock falls and avalanches. All these processes are triggered by varying combinations of parameters in different ways. For instance, rising temperatures mean rising snow lines which probably increase the danger of flooding especially during the winter season but also may decrease the hazards of avalanches at lower altitudes. This chapter focuses on the processes of spontaneous landslides and resulting debris and mud flows, but a lot of the conclusions may be figuratively valid also for other mass transport processes.

The *basic disposition* (Fig. 3.1) against sediment transport processes, especially landslides and debris or mud flows in young fold mountains (e.g. the Alps) is comparatively high in this stage of "Mountain-development". Due to topographic attributes (high gradients) erosion is a natural phenomenon. In the case of spontaneous, more or less shallow landslides and mud flows, basically tasks like

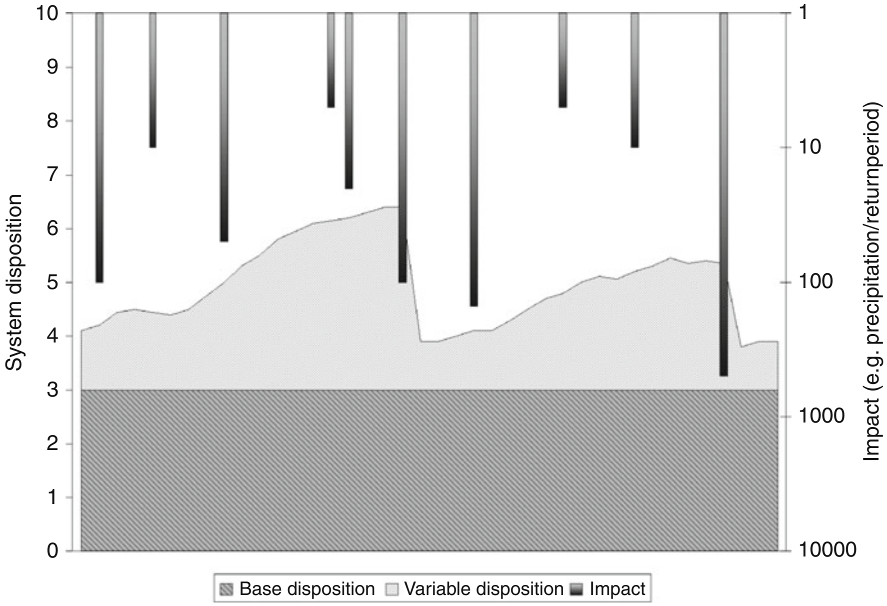

Fig. 3.1 Scheme: Frequency of mass transport processes (especially spontaneous landslides and debris flows). The amount and intensity of precipitations (shown by the return period) is only one triggering factor. The basic and the variable susceptibility of the area, reflected by selected parameters, have to be considered in this matter

topography, parent rock material, the genesis of loose material and soil are relevant. They assign the effects of gravitation (slope angle) and the countering forces (friction angle). They also affect the water regime (infiltration, water storage capacity).

The varying availability of material in the circle of soil generation, erosion and transport on slopes and in channels may be appointed as *variable disposition* (Fig. 3.1) as well as the complex of land use and vegetation, which is often subjected to the turn of seasons. Also road constructions and other building projects as well as protective measures like drainages or constructions in varying conditions are important factors.

Triggering effects of spontaneous, shallow landslides are predominantly heavy precipitation and earthquakes in seismic active zones. Depending on soil properties, the role of precipitation differs in amount and period. Debris or mud flows may be triggered by several factor combinations; the role of precipitation intensity and amount vary accordingly. Usually, they are not directly caused by earthquakes but they may emerge from seismic triggered landslides.

Except for the factor precipitation, none of these factors includes a time component. For this reason, it is hardly feasible to determine the *frequency* of occurrence and even less the changes in the frequency-magnitude function caused by climate change.

3.2.2 The Event of 2005 (Communities of Gasen and Haslau, Austria)

Between the 20th and 22nd of August 2005, an extreme precipitation event producing about 200 mm of rainfall within 36 h (>100 years return period) triggered off several shallow landslides and mud flows (Fig. 3.2).

As an additional triggering factor, a high soil moisture content acting as a critical pre-condition was considered. The conjunction of these adverse climatic conditions can be assessed as very rare (>>100 years return period, Andrecs et al., 2007).

The variable disposition for spontaneous landslides of the area may be considered all in all as high because of extensive road construction especially for forestry measures. About 2/3 of the surveyed landslides were triggered (or increased in magnitude) because of improper road slopes. Debris- or mud-flow events were not affected that adversely by road construction – in some cases, material deposition on the roads could even stop or attenuate small debris flows.

In relation to the part of the surface, agricultural areas were affected more seriously by landslides than forestry areas although forestry areas are to be found predominantly in the steeper parts of the region.

If they are affected, the woody debris will cause quite often problems by impairing protection measures (Fig. 3.3) and jamming channels.

The basic deposition of the area is high due to the lack of glaciation during the last ice age. Therefore, thick soil and loose material horizons could develop.

Considering long periods, it seems that socioeconomic changes in the area have led to damages and to an increase of vulnerability, the extent of which had never been possible before.

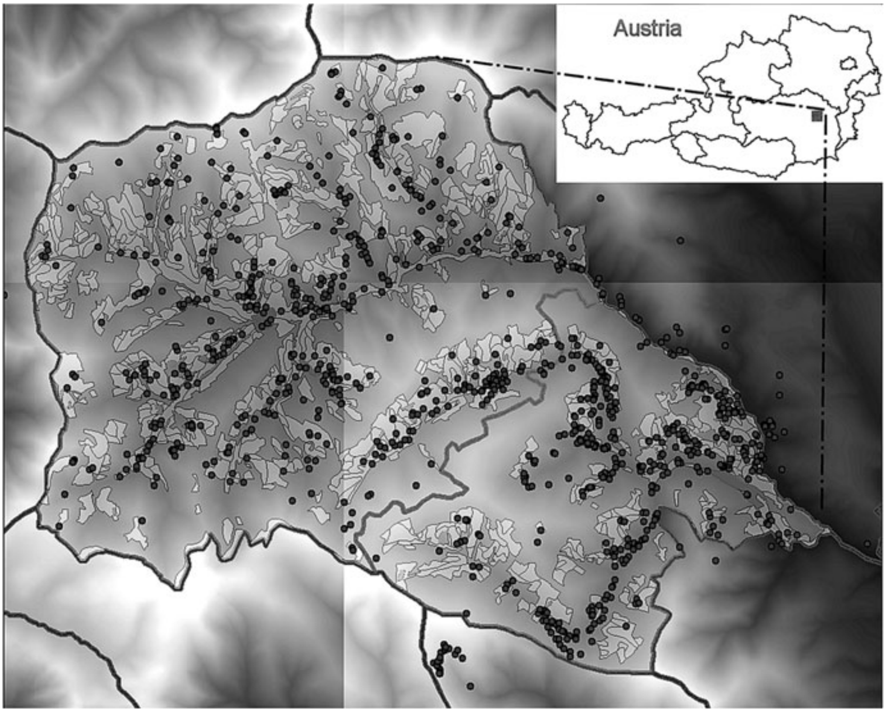

Fig. 3.2 In and around the Communities of Gasen and Haslau about 400 predominantly shallow landslides often with ongoing debris flow were documented (red points) occurring during and shortly after the precipitation event of August 20 and 21, 2005 (Hagen and Andrecs, 2009)

3.3 Climate Change – Facts and Assumptions

Looking back to earth temperature history, we can take it as a fact that climate is not constant. Knowledge about other climate parameters like precipitation is fragmentary. There have always been climate changes driven by, e.g. continental drift, earth orbit parameters and even greenhouse gas concentrations; built up by feedback effects of the glacial stage which influences earth albedo. The main task is to find out the intensity of change and its impact on society, which must not be necessarily negative. Climate history can probably help us to understand and predict ongoing and further climatic development.

The Fourth Assessment Report of IPCC (2007) found out that global warming is already a fact and will continue (virtually certain) in the 21st century, depending on the development of greenhouse gas emissions. According to the IPCC report, it is very likely that heavy precipitation events have already increased over most areas, and this trend is likely to continue. For Central Europe (Christensen et al., 2007), summer precipitation will decrease with drought but extreme precipitation events are likely to increase (prediction highly model-dependent). Winter precipitation will increase as well as extreme precipitation events (in magnitude and frequency) while snow cover will decrease.

Fig. 3.3 Debris-sorting dam in the "Rauschergraben" (Community of Gasen, Austria). Impaired function and overload because of "Woody Debris". Anyway, the measure could avoid heavy losses in the settlement (Photo: WLV Styria, Ellmer)

Global warming is an established fact, regional and local effects of climate change are not that clear. To run AOGCMs (*Atmosphere-Ocean General Circulation Models*), it is necessary to use low spatial and temporal solutions and to reduce physical correlations. While this is an appropriate method for global pattern, conclusions for higher solutions have become increasingly unreliable. Problems with simulating the hydrologic circle, especially convective processes at a small scale, make these simulations extremely difficult. Furthermore, existing datasets are improper for analysing changes in short duration extreme precipitation events (Böhm, 2008). Considering this, we have to ask how we can predict future developments, if we are hardly able to detect ongoing trends in this matter.

Reinhard Böhm (2009), an Austrian climate scientist, compared the "Climate Change Situation" with the turbulent runoff in a torrent channel: ". . . it is currently clear, that the water altogether flows downhill as it is clear that we are living in a time with global rising temperatures. But looking at all the details, we will detect places with still waters or with whirls witch even cause 'uphill flow' close to torrent flow . . .". The fact of global warming and connected changes of precipitation behaviour cannot be adopted one to one at a regional or local scale (Fig. 3.4).

For the region of Gasen and Haslau, the precipitation event (including the high pre-precipitation amount) must be considered as not having been measured before, which means a period of about 120 years. Although this was an extreme event, it is

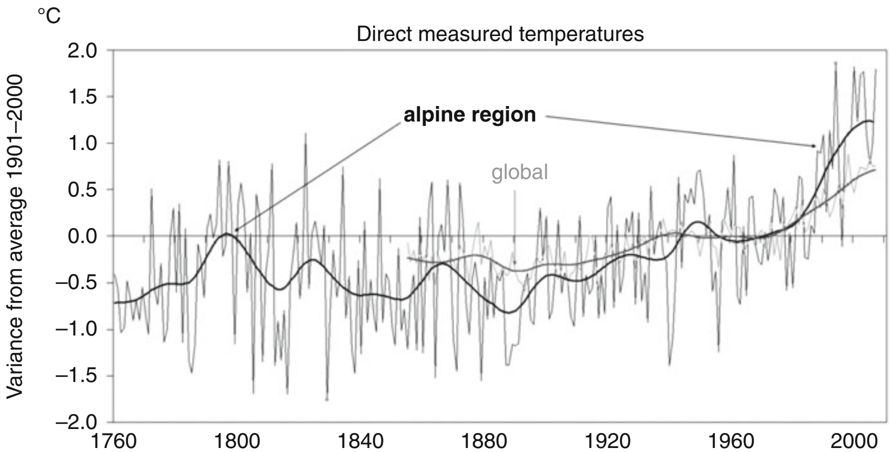

Fig. 3.4 The region of the Alps seems to be particularly susceptible to climatic impacts; the variance of temperature is more visible in this region than in the global trend. HISTALP (Auer et al., 2007; Böhm et al., 2010)

not serious to draw conclusions from this single event to an ongoing climate change. Linked with other extreme events it might be a small part of the "Global Puzzle".

The damages and losses caused by extreme precipitation events will oblige responsible authorities to take action so that future events will be less harmful.

3.4 Socioeconomic Development and Rising Disadvantages

We cannot get rid of the feeling that losses caused by natural hazards reaching from storms to flood events and mass movements are increasing. And yes, it is not just the nowadays excessive reporting in our "Global Village", or psychological reasoned influences. Looking at world-wide statistics, there is no doubt that there is an increasing number of natural catastrophes, defined as the region's ability to help itself clearly overstretched, etc. (Munich Re, 2008). In 2007, there have been 960 natural catastrophes following this definition, whereas 400 events occurred on average in the 1980s, 630 in the 1990s, and 730 in the last 10 years. Depending on the rising number, also the losses of natural catastrophes have increased to US$ 82 billion (Munich Re, 2008).

The definition of natural catastrophes shown above indicates that socioeconomic factors are the crucial tasks between hazard and risk (risk = hazard × vulnerability), although these two terms are often used synonymously. Increasing losses can be caused by increasing hazards as well as by increasing society's vulnerability (Fig. 3.5).

Calculating vulnerability means to determine the number of affected objects and their resistance against the potential damage. Figure 3.6 shows the increase of buildings in Austria, from 1951 to 2001 (from 916.448 to 2.047.712 buildings).

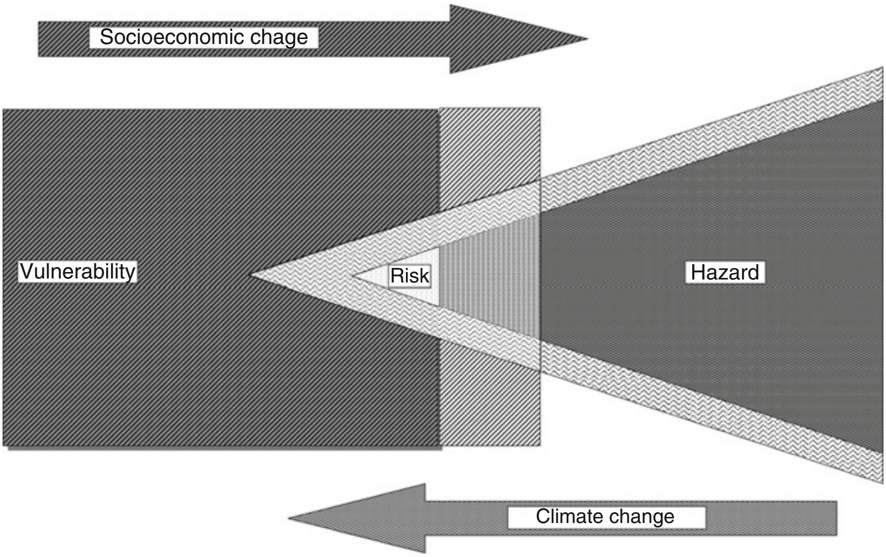

Fig. 3.5 Schematic relation between risk, hazard and vulnerability. Changes of hazard as well as vulnerability (caused by socioeconomic development) may abate or boost the risk

It indicates that, in Austria, the socioeconomic development is probably more responsible for increasing losses than effects of climate change.

In terms of sustainability and risk management strategies, it is necessary to quantify not only the absolute monetary losses, but also the consequences of these losses for the community, which are strongly related to the stage of development of the community. An example is given below.

As a consequence of the ruined potato crop in Ireland 1845–1848, more than one million persons starved and nearly two million persons were forced by their government to emigrate to America or Australia. These extreme effects on a community came along with comparatively marginal monetary losses (loss of potato crop). Nowadays, highly developed countries are able to overcome enormous monetary losses caused by natural disasters: e.g. Hurricane Katrina caused damages of US$138.000 million in total. Nearly 50% of this sum was covered by insurances (Munich Re, 2008), so detrimental effects on the society have been comparatively low.

The GDP (gross domestic product) is a very common parameter of describing effects of losses caused by natural disasters for countries. Investigations of the WIFO (2008) have shown that the big flood disasters in Austria in 2005 (monetary losses of about €500 million) have not influenced the GDP importantly. Two facts are responsible for this – in the first moment – incomprehensible result: Soon after the disaster, positive (!) effects to the GDP activated by capital investments for rebuilding projects became operative. These positive effects have been more than balanced out by decreasing private consumption in the following years. The other important factor leading to the WIFO result is that the GDP contains current

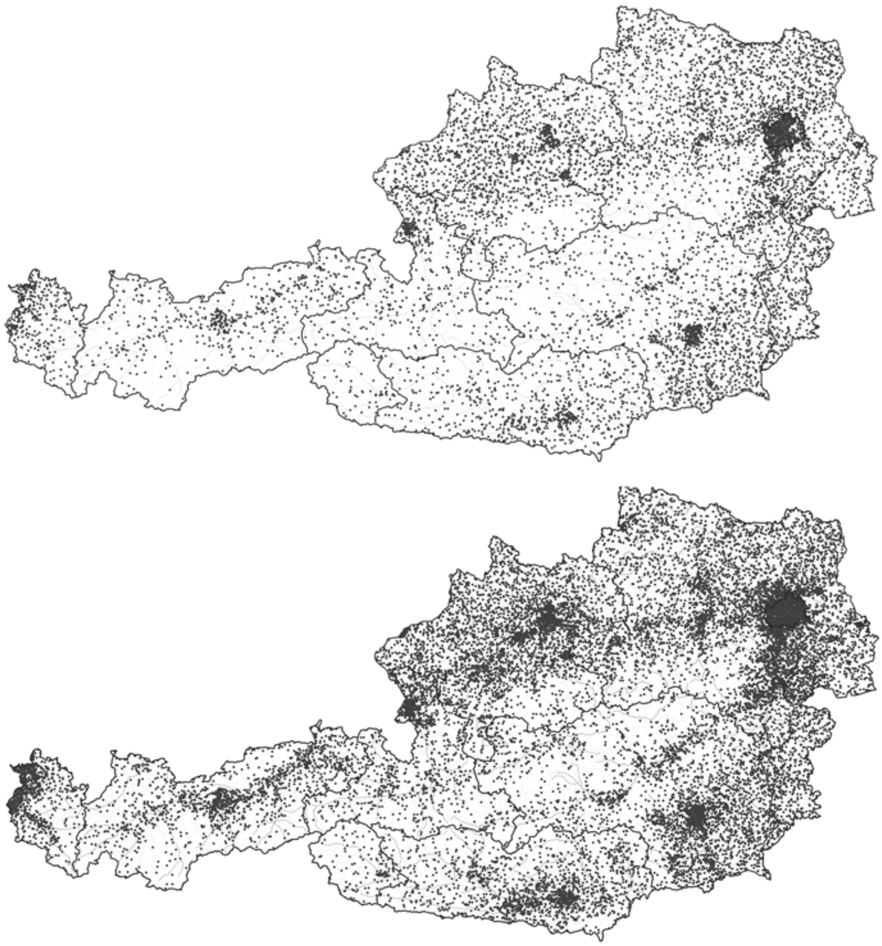

Fig. 3.6 Building census, Austria 1951–2001, every red point is representing 100 buildings. (WIFO, 2008 based on Statistics Austria)

values (rebuilding investigations after a disaster are part of the GDP account) but not inventory values.

Summing up these recommendations, it is evident that defining measured values to describe the magnitude of natural disasters related to socioeconomic effects is problematic. Natural catastrophes have to be considered not as a whole but separated into relevant processes. Events have to be analysed in terms of "Climate Change Tasks" as well as in terms of different vulnerability factors and different approaches of rating their effects. Considering the supposed adverse effects of climate change, emphasis should be placed on documenting and analysing the different triggering effects.

Scaling down these general conclusions to the regional scale of the communities of Gasen and Haslau, no comparable losses are documented, although in the last centuries the area was populated more densely than nowadays. Despite the moderate development in this region, there is additional demand for infrastructure and settlements with increasing property values. Whatever the conclusion, it is not serious to claim that there have not been similar precipitation events in the area before. They simply do not cause that much damage. Maybe because there have been less roads (impact of road constructions to landslide susceptibility, compare Chapter 3.2.2), people had a better understanding of natural contexts and inherent hazards and there were much less property values. Also, one cannot exclude historic documents describing such events got lost in the course of time.

The landslides that occurred 2005 in the communities of Gasen and Haslau are well documented and allow the analysis in varying terms whereas already results like first hazard index maps are available (Fig. 3.7). Further activities will focus on determining the sphere of action and how objects are affected (vulnerability), developing a transparent methodology for risk assessment, especially in the case of landslides and resulting debris flow.

3.5 Working with Scenarios – An Approach

As the further increase of frequency and magnitude of extreme precipitation events at a regional or local scale is insecure, scenario techniques will help to describe the frame of assumed developments. These scenarios should not cover only climate but also socioeconomic changes. Land use planning, agriculture and forestry should be involved in the design as well as damage limitation and preventative measures. In order to be able to calculate the further impact of events on economy and society, it is necessary that the vulnerability of communities be assessed.

As a first step, scenarios should be developed separated for each process, showing the effects of changing frame conditions to triggering, transport and deposition processes. As a second step, interaction between the processes should be considered as it can build up or mitigate adverse effects.

Scenario modelling is a common approach operating with insecure further developments. In the case of natural hazards and especially in the case of mass movement transport processes there are some hurdles to clear. The crucial point is the fragmentary database covering nowadays hazards and risks. There are hardly any practical hazard maps available and risk maps even less. Area information is often inadequate to generate even hazard index maps like, for example, the susceptibility map of the region Gasen and Haslau (Fig. 3.7).

While knowledge about triggering factors and processes is already on a rather satisfying level, the issue of frequency and magnitude of spontaneous, shallow landslides and debris flow has not been solved so far.

Classical frequency functions are based on series of measurements using statistical approaches. The assumption is that the extreme events are independent from each other, which means one event does not influence the other. This is true for precipitation and nearly always for flood events. Triggered landslides lead to changed slope conditions, which affect the sliding disposition. Therefore, the assumption is

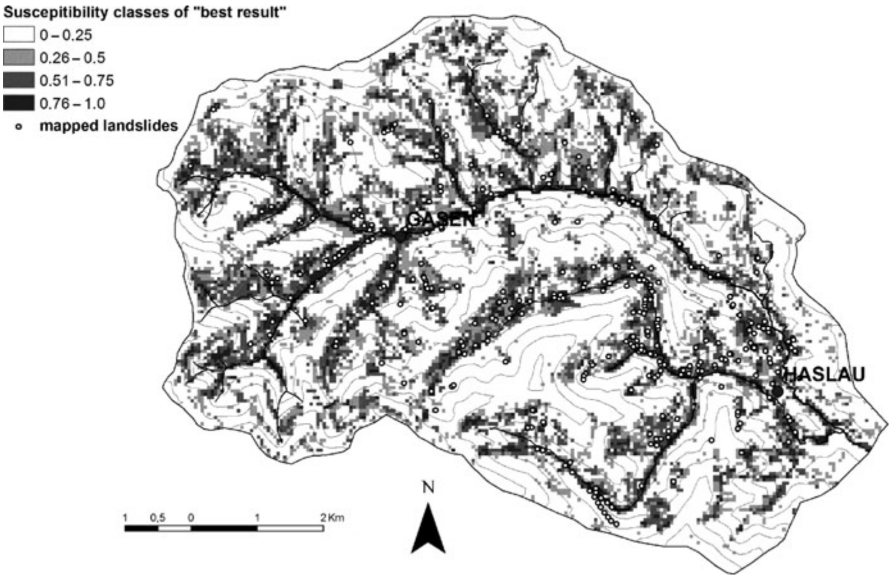

Fig. 3.7 Example of an area-wide assessment of susceptibility (hazard index map) as a basis for land use planning (Schwarz and Tilch, 2008)

not affirmed, autocorrelations are the consequence. Due to this fact, new approaches have to be found in this manner, because frequency and magnitude are the key points for the evaluation of current vulnerability as well as for the prognosis and evidence of changes!

3.6 Conclusions

Climate change is a reality; the direct effects concerning an increase or decrease of natural hazards especially on landslides and debris flow are doubtful. The strategy to deal with this situation is to be prepared for different scenarios of assumed further climatic development and its supposed impacts. This can be achieved on the one hand by designing scenarios including analysis and evaluations of their impacts and on the other hand by adapting monitoring of the ongoing developments.

It is evident that the impacts of changes are closely related to societies and economic development. Therefore, the needed basic data sets (e.g. event documentation) and existing hazard assessment tools should be adapted and improved to risk assessment tools. The everlasting conflict between decreasing quality and availability of data by increasing expanse can be met by applying a "Top Down Strategy" with different scales (levels of accuracy), ranging from pan-European summary maps and regional land use planning to detailed planning of preventive measures.

Considering the effects of climate change on hazards means that existing hazard maps get incorrect with the time. This problem is not new and not only arising in terms of climate change but also with socioeconomic development such as land use, construction measures, etc. There is a strong need to increase resources to keep them on an updated level with or without impacts of climate change on natural hazards.

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Part II
Nature Resources and Land Use in Mountain Regions

Chapter 4
Mountains and Mountain Regions in Bulgaria

Yulia Kroumova

Abstract The mountains in Bulgaria occupy almost half of its area (47.54%). The geographical situation of the country, the present-day differentiation and variety of the relief and its combination with the other natural components affect the economic management of the mountain regions. This chapter provides a comparative analysis of the changes in the mountain regions' territorial extension according to the criteria, approved in recent years (before and after Bulgaria's accession to the EU). According to the EU Regulations, the mountain regions are defined as unfavourable, with limited capacities for land use and with higher costs for performing agricultural activities. Among the groups of criteria, set in different normative documents and projects, special attention is paid to the criterion *above sea altitude*. The mosaic nature of relief and the great number of landscape types in Bulgaria require that the complex impact of the physical–geographical factors should be taken into consideration while determining the lower boundary of the mountain regions. In the research work, however, in order to be in compliance with the aims of each investigation and to achieve unbiased scientific results, we have to observe either the boundaries, already specified in the normative documents, or the physical–geographical borders.

Keywords Mountain · Mountain regions · Morphometry · Sustainable development

4.1 Introduction

The mountain regions as areas with natural limitations for economic activities have become the focus of research, aiming at efficient land use, sustainable economic development and preservation of the ecosystems. The identification of their borders

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and of the whole set of relief features enables the development of efficient regional development strategies.

We recognize 38 mountains in Bulgaria. They occupy an area of 52,774.6 km^2 (Mihailov, 1989) or 47.54% of the country's area. Eight of the mountains are over 2,000 m high, 19 are from 1,000 to 2,000 m high and only two are lower than 1,000 m. The highest mountain both in Bulgaria and on the Balkan Peninsula is Rila Mt. (Musala peak, 2,925 m), while the lowest one is Strandzha (Gradishte peak, 710 m) (Fig. 4.1). The vide variety of relief forms has an impact on the economic development of the mountain areas.

These areas are among the least developed in the country, but nevertheless, they possess a huge biological and natural potential, capable of sustaining a long-term growth. Bulgaria combines three biogeographical regions: the mid-European forests, the Eurasian plains and the Mediterranean, which overlap and favour the climatological and biological diversity. For example, the Bulgarian flora accounts for 3,550 species, of which 2,137 are found at altitudes between 500 and 1,000 m. Three hundred and eighty-nine plants of the latter and 437 animal species are protected, and the preservation area has increased by 2.5% after 1991 and reached 4.5% of the area of the country in 2001 (Nikolova, 2001).

The governmental policy of mountain regions' management has always tried to take into consideration these natural-geographical peculiarities, but, at the same time, is based upon their demographic and economic-geographical potential. Different indicators and criteria have been accepted to determine the mountain regions in which a specific policy is needed to guarantee their sustainable development. The mountain regions, delineated on the basis of these criteria, not always coincide with their physical-geographical boundaries. Therefore, different statistical figures are published about the area of the mountain regions in Bulgaria, about their share of the country's area as well as about the number of the mountain municipalities.

This research provides a comparative analysis of the changes in the mountain regions territorial extension according to the criteria, approved in recent years (before and after Bulgaria's accession to the EU). We would like to stress that, in order to achieve unbiased scientific results, we have to consider either the new boundaries or the physical-geographical ones, depending on the research goals.

4.2 Arguments

The policy of mountain regions development in Bulgaria after 2007 is carried out in accordance with the relevant policy of the EU.

Chapter Five of Regulations 1257/99 of the EU focuses the attention on the unfavourable regions and the regions with ecological restrictions, divided in three groups, which every country has the right to define. The mountain territories represent one of these groups. Article 18 specifies the factors according to which these territories are not favoured from the viewpoint of restrictions in land use and growth of production costs:

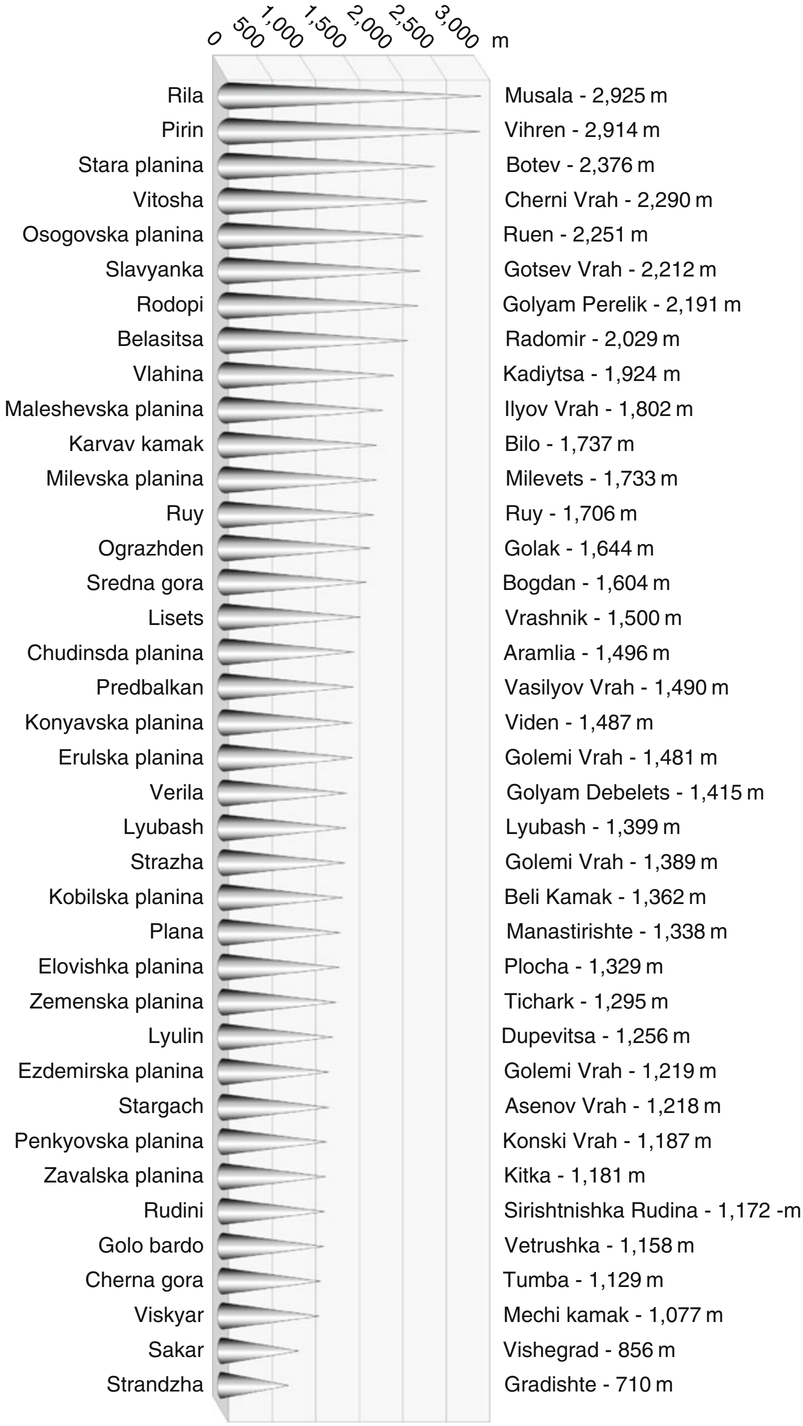

Fig. 4.1 The highest peaks of Bulgarian mountains

- *the altitude* as a factor for unfavourable climatic conditions leading to shortening the vegetation period of agricultural crops;
- *steep terrains* (regardless of the lower altitude), hampering the use of agricultural machinery and requiring more expenses for specialized equipment;
- combination of the above-mentioned two factors, which individually do not provoke any difficulties;
- regions to the north of the 62nd parallel.

The European legislation has issued guidelines for selection of criteria which are to help in defining the mountain regions. The aim is to achieve a better synchronization of the joint research, carried out by different European countries, which concerns these categories of unfavourable regions. They underlie the Bulgarian normative documents and projects.

- Regulation 14 from 1 April (2003, on determination of the settlements within the rural and mountain regions, issued by the Ministry of Agriculture and Forests and the Ministry of Regional Development and Public Works;
- A scientific project of Regulation on defining the unfavourable regions in Bulgaria (joint research, conducted by the Institute of Agricultural Economics, the Ministry of Agriculture and Forests, the Bulgarian Academy of Sciences, etc., 2006;
- Decree 30 from 15 February, 2008, on adoption of a Regulation, dealing with the identification of the criteria about the unfavourable regions and their boundaries.

4.3 Criteria

Although the criteria in these normative documents for defining the mountain regions are scientifically substantiated, they are too diverse which implies that mechanisms have been suggested for selection of certain areas rather than scientifically grounded criteria for their determination.

Thus for example, the criteria for identification of the mountain regions in compliance with Regulation 14 from 14 April, 2003, on determination of the settlements in the rural and mountain regions, are as follows:

- altitude over 600 m;
- altitude below 600 m with vertical dissection of relief over 200 m/km^2, drainage density over 2 km/km^2 and slope of the terrain over 12°;
- The municipalities are defined as mountainous if more than half of the settlements' adjacent areas in them belong to mountain regions.

According to a scientific project on the Regulation specifying the identification of the unfavourable regions in Bulgaria, the *criteria for defining the mountain regions in the country* are as follows (Yanakieva and Velev, 2006):

- average weighted altitude of the municipality territory not less than 600 m;
- average weighted slope of the terrain 10° (17.6%), average altitude for the territory of the municipality not less than 600 m;
- average altitude for the territory of the municipality within the range from 500 to 600 m, combined with an average slope of the terrain of 7° (12.3%);
- in the attempt to homogenize the region, municipalities may be included, in which at least one of the first two criteria shows significant height differences.

In the process of determination of the unfavourable regions (2005) the lowest level of administrative division of the country is the municipality. The major arguments in the selection of the groups of criteria for mountain region definition are:

- achievement of maximum range for the country;
- compatibility of the criteria with the respective ones of the EU countries;
- dependence of criteria selection on the databases, available for the country.

On the basis of this group of criteria, the mountain regions occupy 49% of the country's territory and 43% of the agricultural fund. They embrace about 95% of the forest fund and cover the territory of 130; of which 88 are at an altitude exceeding 600 m, 25 – with a slope exceeding 10°, 1 – meets the requirements of a combined criterion and 16 – correspond to the principle of homogenization of the mountain regions.

All these documents take into account the natural characteristics of the country and accept the altitude of 600 m as the mountain regions' lower boundary. Nevertheless, according to *Regulation No 30 of the Council of Ministers from February 15,* 2008, the mountain territories, defined as unfavourable territories, include the lands of the settlements that meet at least one of the following criteria:

- average altitude of minimum 700 m;
- average slope of the terrain of minimum 20%;
- average altitude of minimum 500 m in combination with an average terrain slope of minimum 15%.

4.4 Results

By comparing the two divisions – the one from 2003 (2172 settlement areas incorporated in 138 municipalities) and the one from 2008 (1714 settlement areas belonging to 144 municipalities), it became possible to draw an analytical map of the mountain municipalities (Fig. 4.2). The comparison clearly shows the newly established municipalities (13) in the 2008-division and those (7) which dropped out of the 2003 division. They all are presented with a limited number of adjacent mountain land plots (1 or 2).

Fig. 4.2 Municipalities in the mountain regions in Bulgaria

4.5 Conclusion

According to the criteria accepted in 2008, the mountain regions in Bulgaria include 41% of the settlement network and 25% of the population. Out of the 264 municipalities in Bulgaria, 144 incorporate the adjacent areas of settlements which belong to mountain regions.

The question about the lower boundary of the mountain regions in Bulgaria is still debatable. From physical–geographical point of view the mosaic relief, dominated by mountain and basin landscapes, which reach to the southern state border, and the restricted Mediterranean influence only in the lowest parts, are the main reasons to define the altitude of 600 m as a boundary above which there are relatively poor potentials for utilization of the territory.

As a member of EU, Bulgaria needs a unified national policy that will regulate the development of mountain regions and that will be tailored to local resources, potentials and limitations. The investments will facilitate the solution of some serious infrastructural, communication and organizational problems, in conformity with the principles of sustainable development and environmental protection. Such a balanced approach to mountain region management will ensure the long-term prosperity of these areas and therefore needs a solid legislative basis.

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Chapter 5
The Natural Potential of Mountains in Bulgaria and Its Sustainable Use

Marina Yordanova and Zoya Mateeva

Abstract Mountain territories and their inherent various and rich natural conditions and resources, have always been the subject not only of scientific, but especially of economic interest. They are a subject of attention also from the legal-normative point of view, from both national and international aspects, especially regarding the possibilities for their sustainable development. Their natural potential is determined as a quantitative expression of the combination of conditions and resources which are favorable for the all-round activity of society. Their importance for Bulgaria results not only from their significant areal distribution in relation to the whole territory – over 40% or even 50% according to the boundaries outlined in investigations by different authors, but also from their significant natural potential. In relation to the whole territory various natural resources are predominantly found in the mountains of Bulgaria, for example: mineral resources (fuel, metal, and non-metalliferous) – over 80%; water resources – over 80%, as well as 70% of the storage water capacity with in total 700 large, medium and small dams, and over 70% of the mineral water fields; forest resources – over 70%, as well as two-thirds of the plants growing in Bulgaria, and also considerable resources of game, wild fruits, herbs, mushrooms, etc. A significant percentage of demographic settlements and economic land structures also occur in the mountainous areas of Bulgaria, for instance: about 30% of the population and over 55% of the settlements (the number of municipalities in the mountainous regions is over 140, from in total 260 in Bulgaria); about 65% of the areas for cultivation of tobacco and potatoes; over 85% of areas under meadow, and over 70% of the pasture grounds in the country, etc. The evaluation of the natural potential of the mountains is related to the quantitative and qualitative characteristics of the basic natural components (relief&texture, climate, waters, soils, flora, and fauna), and this evaluation is concerned with two aspects – resources and conditions. In this respect climatic characteristics usually represent identification of the conditions of the surroundings but their assessment as a resource, especially as a renewable one, is becoming more and more important.

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The total, integral natural potential is subdivided into so-called partial potentials which are specific to the corresponding economic activity for which purposes they are intended, for instance: industry-, mineral-, water-, forest-, energy-potential, building potential, recreational potential, etc. Especially important is the assessment of aspects of the partial potentials that are related to the state and tendencies of change of natural components' characteristics under conditions of anthropogenic pressure, such as: self-clearing, regeneration, changeability, steadiness, etc. At the same time attention is paid to revealing degradation processes provoked by anthropogenic activity, by so-called physiognomic landscape components, grounding on the specific mountain landscape spectra typical for large morphographic units. On the basis of these analyses a concept is discussed for optimization of interactions in the system "Nature–Society–Economy," with accents placed on priority economic activities with emphasis on environmental protection, in mountain territories, according to the principals of sustainable development.

Keywords Nature potential · Bulgarian mountains · Assessment of the: relief, climate, waters, soils, vegetation, animals, landscapes · Sustainable usage of mountin resources

5.1 Former Studies on the Natural Potential of the Mountains in Bulgaria

The natural potential of the mountains in Bulgaria was the aim and subject of a specialized complex inter-disciplinary investigation that took place in the 1980s involving different institutes from the natural sciences group of the Bulgarian Academy of Sciences (BAS) under the leadership of the Institute of Geography. It was realized within the framework of the national plan for fundamental research in Bulgaria in the scientific sphere "Scientific bases of preserving and reproducing the environment," including in total 14 scientific problems (at governmental level). The results of this investigation were summarized in one of the two volumes of the monograph "Natural and Economic Potential of the Mountains in Bulgaria," volume I, "Nature and Resources."

A specialized study aimed at determining the boundaries of the mountain regions in connection with the preparation of a law for these regions was carried out in the mid-1990s also in the Institute of Geography of BAS and the results were presented in several scientific publications, one of them being of fundamental principle-methodological and information-empirical importance – "The Mountain Regions in the Legislation Policy of Bulgaria" (Geshev et al., 1995). The morphometric characteristics of relief were used as defining criteria: altitude – above 600 m, and for the low mountains (Fore-Balkan, East Stara Planina, Strandzha, Sakar, Sarnena Gora and East Rhodopes) – above 250–300 m; depth of dismemberment – above 200 m/km^2; slope inclination – above 12°, etc. On the basis of this empirical work, together with NCTDRP (the former National Centre on Territorial Development and Residential Policy of the Ministry of Regional Development and Public Works), a methodological approach was substantiated for classification of the mountain settlements in Bulgaria (Methodological approach to determining mountain regions and settlements, 1996), according to which about 2,200 settlements in the country correspond to the adopted criteria for mountain settlements (Kopralev, In: Geography of Bulgaria, 2002).

The mountain territories are also the subject of consideration from a legal-normative viewpoint by a number of national and international documents – Law for Mountain Regions in the Republic of Bulgaria, developed and discussed at its first reading in the National Assembly in the middle of the 1990s, but still not approved; European Chart for the Mountain Regions, developed also in the 1990s; Guiding Principles for Sustainable Spatial Development of the European Continent (including also mountain regions), accepted at the 12th session of CEMAT, Hannover, September 7–8, 2000, etc. According to these principles the mountain regions, with their ecological, economic and socio-cultural functions, are accepted to have exceptional national and European potential and it is respectively considered that they should be an especially important part of the integrated European territorial-arrangement (spatial planning) policy. Taking into account that the state borders of Bulgaria are almost entirely in mountain territories (with the exception of the north-eastern one with Romania), the formulated principles for the boundary regions are also valid for them, including those for trans-boundary, trans-national and inter-regional cooperation. These concern also the region of the Black Sea and the Caucasus countries, relating to the so-called Pan-European transport corridors and zones, crossing and respectively including parts of our mountain borders.

Themes concerning the boundary mountain space occupy a special place within the geographic investigations on the territory of Bulgaria. Complex scientific studies of this type were carried out as early as the end of the 19th century. Initially these studies were carried out by west European scientists and some scientists from the Balkan countries (Ami Boué, Auguste Viquesnel, Jovan Zvijić), and later, also by a number of Bulgarian scientists/geographers (Anastas Ishirkov, Yordan Zahariev, Ivan Batakliev, Dimitar Yaranov, Ilia Ivanov, Zhivko Galabov and others). The studies had a predominantly geomorphologic and landscape character, in the spirit of the German school at that time, or had an ethnographic emphasis. In more recent times complex geographic research has been carried out both within the framework of general studies of the country, for example "The Natural and Economic Potential of the Mountains in Bulgaria," and in regional studies – "Sakar–Strandzha," "Rhodopes," "Blagoevgrad District," etc. Specialized complex geographic investigations of the mountain territories along the southern and western borders of Bulgaria were realized in the 1990s within the scope of two scientific projects, financially supported by the National Science Fund of the Ministry of Education and Science (NSF-MES) – H3-38/91 and H3-502/95. They were directed towards revealing and evaluating not only the particular and general natural resource potential, but also the demographic, socio-economic and recreational-tourist potential. The aim was to intensify the healthy development of these regions which are boundary and at the same time peripheral for the country, in the context of the "opening" of the national space, both within the frames of the Balkan neighborhood and at the Pan-European and global scale. A number of scientific publications relating to the different physical- and economic-geographic aspects were issued on the basis of the results of these investigations. A substantial contribution in this respect was made by publications concerning the trans-boundary communication systems with neighboring countries (Nikolov and Yordanova, 1996) and the broader range of the Black Sea region with an accent on transport corridor VIII (Terziiska and Tarakanov, 2000).

The various types of natural potential (mineral / raw material, forest, water, etc.) in every territory, and especially those with a mountain character, are a regular consequence of the conditions of its formation in connection first of all with the location in spatial-territorial structures with a broader range. It bears the specific features of common morphotectonic evolution of the foundation and common planetary zonal determined belt peculiarities of the dynamic components. The individual specificity of this general background is related to the local manifestation of regularities of the so-called exchange of substances, energy and information between the basic natural components during their continuous interaction and mutual penetration (e.g. water/air – in rocks, soils, biota, etc.). In the context of the above mentioned, the mountain territories in Bulgaria, bearing in mind the position of the country in the South European mountain space, represent a part of two first-order mountain macrostructures entering the territory – large parts of the strongly faulted Macedonian-Thracian massif and the whole fold-chain Balkanide system of the Alpine orogen. From the hydroclimatic aspect, it is situated in the transition zone between the moderate and the sub-tropical belt – from the typically expressed moderate-continental features in the Stara Planina Mt. part, through the transition-continental features in the East Stara Planina, Kraishte–Sredna Gora and Rila–West Rhodopes part to the typically expressed continental-Mediterranean features in the Pirin–Slavyanka part, the East Rhodopes, Sakar and Strandzha. This determines also the expressed transition features of the soil-vegetation characteristics – between the typical Middle European and the typical South European ones. With increasing altitude the hydroclimatic differences are gradually smoothed out but the soil-vegetation differences increase and corresponding height zones are formed. In turn, this is important for the creation of the typical height-variable mountain altitude spectra of landscape belts, with their intrinsic characteristics of natural resource potential and specific conditions for their reclamation.

When treating the problem of evaluating the natural potential, renewable resources are usually implied, which are related first of all to the dynamic natural components (climate, water, biota, and partially – soil). But evaluation is also made of the relief as a natural foundation of the geographic space (Mishev and Vaptsarov, 1996). Such an approach was adopted in the monograph "The Natural and Economic Potential of the Mountains in Bulgaria," vol. I, "Nature and Resources."

5.2 Assessment of Natural Potential by Components for Various Economic Purposes

5.2.1 Assessment of Relief

Relief, representing the basic material surface (foundation) of the territory, is assumed to be the basic natural component. It forms on the one hand its morphographic features via characteristics of the Earth's surface, composed of heterogeneous rock substrate (mountains, plains, plateaus, valleys, etc.). On the other hand it determines the features of the whole natural complex by the specificities of interaction between other components – both more strongly or weakly dynamic natural as well as anthropogenic ones. They depend on its morphometric characteristics (altitude, vertical and horizontal dismemberment, exposition, slopes) (Alexiev et al., 2005). It follows therefore that its leading role as a natural component and as a natural factor is expressed mainly with respect to the conditions of the environment for existence and economic activity of man, with a lesser impact on the resource aspect. Evaluated from this viewpoint, the mountains occupy a very important part of Bulgarian territory in relation to the "height change of the climatic conditions, the landscape diversity and the lower anthropogenic impact on nature, compared to that in the plains" (Danilova, 1980).

In Bulgaria there is an almost zonal pattern to territories differing with respect to height of mountain relief in the central and southern parts of the country. Hypsometric analysis distinguishes six altitude belts as shown in Fig. 5.1 and Table 5.1.

The extension in the middle of the country (and along the parallel) of the Stara Planina Mt. chain plays the role of a natural barrier to the invasion of cold continental air masses from the North in winter and is accepted as a climatic boundary between the moderate-continental climate to the north and the transitional-continental climate to the south, whilst the high mountains of the

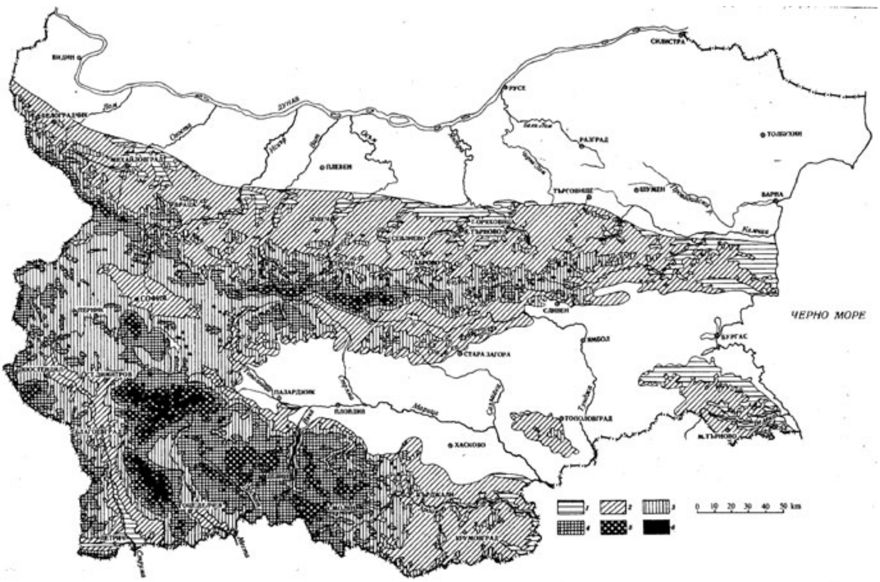

Fig. 5.1 Altitude belts (by Mihailov, in: The natural and economic potential of the mountains in Bulgaria, 1989). 1 – lowlands (<200 m); 2 – hilly lands (200–600 m); 3 – low-mountains (600–1,000 m); 4 – mid-mountains (1,000–1,600 m); 5 –high-mountains (1,600–2,200); 6 – alpine (>2,200 m)

Table 5.1 Area (%) of altitude belts[a] (by Mihailov, in: The natural and economic potential of the mountains in Bulgaria, 1989)

Altitude belts (m)	Mountain region: Rila and Rodopy	Kraishte-Sredna Gora	Stara Planina	Total for all mountain regions
Lowlands (0–200)	1.3	4.8	8.5	5.3
Hilly lands (200–600)	27.7	39.4	57.0	43.3
Low-mountain (600–1,000)	23.2	39.1	23.4	26.5
Mid-mountain (1,000–1,600)	35.1	15.9	9.7	19.8
High-mountain (1,600–2,200)	9.4	0.7	1.3	4.0
Alpine (> 2,200)	3.3	0.1	0.1	1.1
Total	100	100	100	100

[a]Percentages express the ratio to the total area of the mountain regions

Osogovo-Rhodopes massif represent a barrier to the invasion of warm air masses of marine origin from the South, their influence being more noticeable only along the meridional valleys of the Struma, Mesta and Maritsa Rivers, as well as in the adjacent mountain slopes, especially in the Pirin, Slavyanka, East Rhodopes, Sakar and Strandzha mountains.

The evaluation of the direct role of relief in formation of the natural environment is related first of all to favorable or restricting conditions for construction and agriculture from the viewpoint of terrain stability in the tectonic-seismic and lithological-petrographic respect and the sustainability/susceptibility of the soil cover to destruction-erosion processes in the case of bigger dismemberment and slopes. The results from relief assessment in relation to these two aspects with the use of rating estimates categorize the mountain territories as follows (Mihailov and Vaptsarov, 1975):

- with unfavorable conditions for construction and agriculture – the main Stara Planina Mt. chain in the middle and western part and the Osogovo–Rhodopes massif without the Middle Struma valley, the Gorna Arda basin and the Haskovo hilly district;
- with medium favorable conditions – the Fore Balkan, Kraishte–Sredna Gora, Sakar–Strandzha and Middle Struma valley and the Gorna Arda basin;
- with favorable conditions – Haskovo hilly area.

The coincidence in the gradation of the single mountain units and whole areas with respect to their suitability for construction and agriculture is due to the specificities of the broadly developed height belts in them, with their inherent morphometric characteristics, especially altitude, dismemberment and slopes. They are equally determinative both as prerequisites and constraints for these types of economic activities.

The assessments of the direct role of relief from the resource viewpoint are more specific mainly from the recreational-tourist and partially from the medical-geographic aspect.

The recreational-tourist aspect of relief ensues from the necessity for available geomorphologic objects with suitable properties for generating certain tourist demand and realization of respective tourist products for the different forms of tourism (Alexiev et al., 2005). Usually these are objects of high attractiveness, related to the specificity of the respective morphosculptural genetic type of relief, for example: karst – caves, dolines, backsets, canyons, abysses, ledges, crowns, travertine terraces, sinter pans, etc. (represented mainly in the Fore Balkan and the Rhodopes); erosion – gorges, doughs, canyons, meanders, waterfalls, erosion cauldrons, etc. (represented mainly in Stara Planina, Kraishte, the Rhodopes); glacial – cirques, carlings, trough valleys, moraines, stone fields and others (Rila and Pirin) etc. The so-called rock phenomena occupy a special place as products from specific morphogenetic processes. They depend on the stability of the bedrock and its selective destruction, provisionally typified in the following three groups:

- erosion-deflation – earth pyramids, rock mushrooms, etc. (Katina, Stob, Melnik, Zimzelen, etc.);
- karst-erosion – rock arcs, bridges, windows, pits, etc. (Chudnite Mostove (the Wonder Bridges) in the Rhodopes, Chudnite Skali (Wonder Rocks) in Stara Planina, etc.);
- lithological-destructive – prismatic basalt pillars (near the Studen Kladenets dam on the Arda River), vertical riolite walls and needles (in the region of Smolyan), spherical moraine-like blocks of massive rocks (in Vitosha), figures with outlines of rock castles, obelisks, people, animals (Belogradchik rocks), etc.

Deposits of interesting natural specimens of the so-called Geological Heritage (rocks, minerals, crystals, fossils, etc.) may also be connected to a significant extent with the rock phenomena. Relief forms like ridges and peaks with panoramic views, slope steps, river terraces, structural platforms, etc., may also possess certain tourist attractiveness. It has to be mentioned that for the specialized types of tourism, for example, for many types of sport tourism related to relief characteristics (climbing, ski slopes, cycling routes, rafting, etc.), the evaluation parameters are to a great extent measurable by concrete parameters, while for the mass forms of tourism the attractiveness parameters are to a great extent subjective and are defined by the criteria for diversity, picturesqueness, uniqueness, exoticness, etc.

The tourist attractiveness of the different sites related to relief is enhanced also by the presence of other, so-called physiognomic natural components such as vegetation, water, animals – for example, steep bare rocks, inhabited by eagles or with Edelweiss habitats, deeply incised river valleys with thick forests or waterfalls, etc. In the Bulgarian mountains there are many concentrations of resources of geomorphologic nature that are significant for recreation and tourism, which makes them attractive destinations not only at the national but especially recently at the international scale too. The rich resource potential of Rila, Pirin, the West Rhodopes has been used for the creation of sport bases (Belmeken, Malyovitsa and others), as well as of whole mountain complexes (Bansko, Borovets, Pamporovo). Naturally, parallel to the advantages of relief, the entire landscape diversity, and especially the favorable climatic conditions for the formation of a thick and durable snow cover have to be taken into account for the winter sport specialization.

The medical-geographic aspect of the resource assessment of relief is connected first of all with its individual properties (altitude, exposition, dismemberment, slopes), but also with the effect of the properties of the other natural components that are indirectly influenced by it, on the psycho-emotional state of man, especially in the case of moving along routes and encountering new and interesting sites.

At a greater height in the mountains the human organism is also favorably affected by clean air due to the lower general and bacterial pollution as well as due to higher ionization, especially noticeable around swift-flowing rivers and waterfalls (Danilova, 1980).

The rugged terrain exerts definite health recovery and strengthening impacts during movement along routes on the so-called "health-paths," naturally taking under consideration certain norms for personal physiological loading.

In summary, as already pointed out, the assessment of mountain relief is expressed in two ways: on the one hand, with its role as a decisive factor for the hydroclimatic and soil-vegetation conditions of a territory and via these factors – for a number of economic activities, and on the other hand – with its role directly influencing recreational-tourist resources for man, including those with curative effects.

5.2.2 Assessment of Climate

The thermal conditions of the mountains of Bulgarian territory with different situations and heights vary within a broad range but in general according to altitude belts the differences are of the order of 10–20°C, for each belt, both for the minimum average monthly temperatures in January and for the maximum average monthly temperatures in July. The average temperatures naturally decrease with height – in winter from 0–2°C in the lowest belts to –8 to –10°C in the highest, and in summer – respectively from more than 22° to less than 10°C, the annual temperature amplitude being almost unchanged (on the average 19–21°C) (Table 5.2). There are greater differences in the extreme maximum temperatures, which are more than 30 to less than 10°C in winter, and from more than 40 to about 15°C in summer from the low towards the high parts, while the extreme minimum temperatures show approximately equal values everywhere – from –15 to –30°C in winter and from –5 to +5°C in summer, and in the transitional seasons they are –5 to –20°C in autumn and –20 to –25°C in spring, which shows that the spring season in the mountains is colder than the autumn one.

Table 5.2 Mean and extreme air temperatures (t °C) by altitude belts

Altitude belts (m)	Mean monthly t		Mean annual t	Temp. amplitude	Extreme temperatures							
					Maximal				Minimal			
	I/II	VII/III			Winter	Summer	Autumn	Spring	Winter	Summer	Autumn	Spring
0–200	1–2	> 22	> 12	19–21	30	> 40	> 30	> 30	–15 to –30	–5 to +5	–5 to –20	–20 to –25
200–600	0–1	20–21	10–11		25	40	30	30				
600–1,000	0 to –2	18–19	7–9		20	35	30	30				
1,000–1,600	–3 to –4	16–17	4–6		15	30	25	20				
1,600–2,200	–5 to –7	14–15	1–3		10	20	15	10				
> 2,200	<–7	< 14	< 0			15	< 15	< 10				

Source of information: Moraliiski and Gocheva, in: The natural and economic potential of the mountains in Bulgaria, 1989 (with additions).

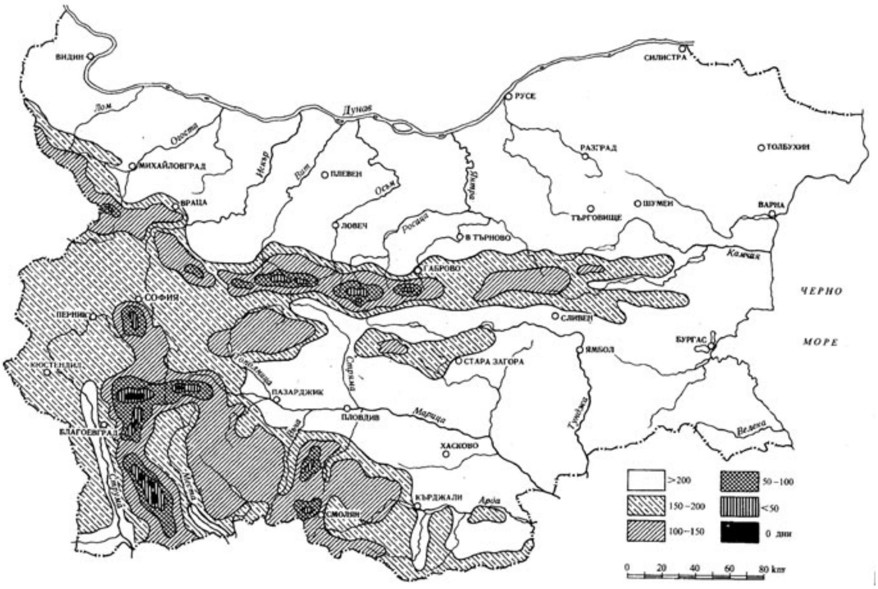

Fig. 5.2 Mean duration (days) of the period with sustainable temperature above 10°C (from The natural and economic potential of the mountains in Bulgaria, 1989). >200 – most favorable; 150–200 – favorable; 100–150 – medium favorable; 50–100 – unfavorable; <50 – extremely unfavorable; 0 – lack of conditions for vegetation

The duration of the period with a sustainable temperature of the air exceeding 10°C represents a very indicative thermal characteristic for the conditions of vegetation of natural and cultural plants (Fig. 5.2).

A basic climatic characteristic is also moistening in the most general sense, with precipitation being the most important factor for life and human economic activities; it provides a basic contribution to the river basins in the formation of the vitally necessary water resources. It is also ensures soil moisture, especially important for agricultural crops during the vegetation period. The circumstance that all of the larger rivers derive almost entirely their runoff in the mountain territories and are dominated to a great extent by only transit flow through the plains, emphasizes the extremely important role of the higher amount of precipitation in their spring areas, where the annual precipitation sums exceed 1,000 mm, this figure gradually decreasing to 500–550 mm towards the neighboring plain lands (Fig. 5.3).

Of course, all the other characteristics of climate (atmospheric pressure, air humidity, cloudiness, mists, icing, etc.) are also rather important, especially from the viewpoint of habitation environment, transport and production, but in the context of the present evaluative analysis they are not considered.

Climate in the mountains is of great importance – both as a resource and as a condition – for the versatile human activity and as a factor for this activity – respectively for improving the parameters of its sustainable development.

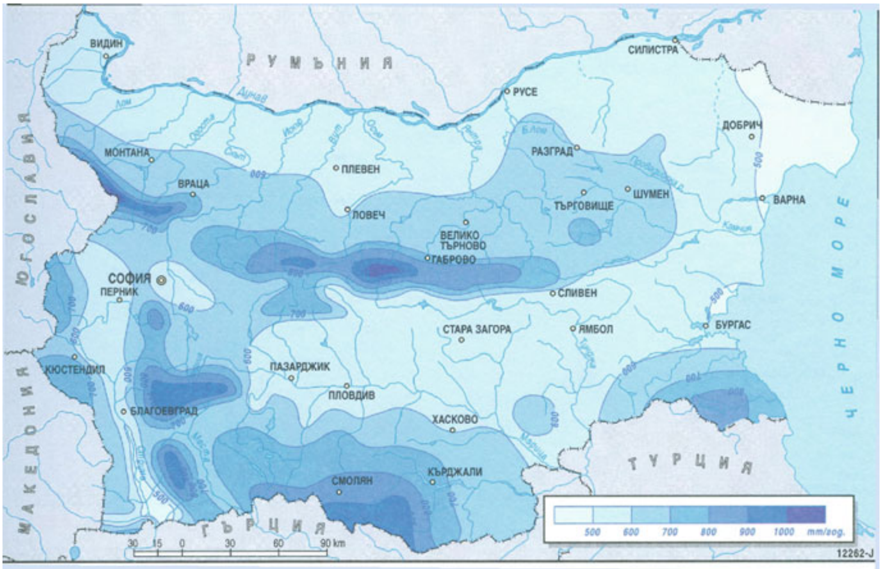

Fig. 5.3 Annual sum of precipitation (mm) for the period 1961–1990 (by Sharov, In: Geography of Bulgaria, 2002)

As a resource climate finds application in power generation, climatic medical treatment, recreation and tourism. In principle, all climatic resources are inexhaustible and the more active is their utilization, or the higher is their share compared to the utilization of other, exhaustible natural resources, the more significant is the contribution of the respective human activity to sustainable social development.

In the sphere of power generation two climatic elements are used as resources – the sun and wind. They represent the basic renewable energy sources and it is expected that their relative share with respect to the utilization of conventional energy sources will be violently enhanced not only in dimension but in intensity. The mountain regions represent one of the places with the most significant potential for these two climatic resources.

With respect to wind the Bulgarian mountains are characterized by average annual values of about 800–1,000 W/m^2. Values are on average 300 W/m^2 for the low-mountain regions, and about 2,000 W/m^2 in the high parts of the mountains. In this connection the wind's speed is the most important characteristic, which regularly increases with height, more intensively above 1000 m, but with a different vertical gradient for different mountains – higher for Stara Mt. and Vitosha in comparison to the Rila–Rhodopy massif for example. Bare, flat mountain ridges, where single wind power generators or large-scale wind power parks may be situated, are the most suitable for wind power purposes. However, this depends also on other important factors such as transport and electric power transfer accessibility, ecological admissibility, land ownership, etc.

With respect to the sun – the mountain regions are characterized by higher clarity and transparency of the atmosphere, and the mountain ridges – by higher orographic bleakness, which is favorable for increasing solar intensity and the respective helio-power potential. However, at the same time the mountain regions exhibit more significant values of cloudiness, number of dark days, precipitation and mists, which decrease the respective energy potential of these regions. On average the Bulgarian mountains are characterized by values of about 1,800–2,200 sunny hours per year, which is relatively favorable for the construction of solar parks. The capacity and effectiveness of these parks depend also on a number of other local factors, the orographic bleakness and southern exposition being especially important.

In the sphere of recreation and tourism, climate may be used as a resource for heliotherapy, aerotherapy, cryotherapy and winter sports. The first three of these activities belong more closely to climatic therapy and climatic prophylaxis, which in our opinion are not sharply differentiated from the recreational-tourist activity, but rather represent its specific parts.

Heliotherapy is based on the physiological role of solar radiation on the human organism, representing one of the most important – and vitally necessary for man – elements of climate. Its significance is expressed in two basic aspects: as a heat source, in the system of the thermal exchange between the human body and the environment, and as a source of ultraviolet (UV) radiation.

UV radiation, within the range of definite doses, exerts favorable effects on the cardio-vascular and nervous system of the organism, the metabolism, and endocrine gland functions. UV radiation annihilates harmful microbes and normalizes fat exchange, increasing the resistance of the organism to different diseases. A deficiency of UV leads to pathological states, known as "light hunger of the organism," but excess of UV has a blastomogenic impact. For 320 days of the year the territory of Bulgaria has the potential to provide the necessary UV doses. However, under real conditions this possibility is reduced depending on the momentary thickness of the ozone layer in the high parts of the atmosphere, the transparency of the latter, the weather conditions, and in particular on the character of cloudiness (Mateeva, 1999).

Aerotherapy represents the treatment of disease by the use of air which may be saturated with specific components, for example medicinal species such as phytoncides and other specific particles, and cryotherapy represents stimulation of the organism at minus temperatures.

Winter sports are directly dependent on snow cover, which is formed annually in Bulgaria, but it is stable only in the mountains at an altitude exceeding 1,100–1,400 m. Basic factors relating to snow cover are snowfall, as well as temperature of the air and the underlying substrate. Snowfall in the mountain regions of Bulgaria represent about 20% (from the total sum of precipitation) in their low parts, between 20 and 40% in the medium-high mountain parts and more than 40% in their high parts. Snow cover is formed first in the high-mountain belt – as early as in the second half of October, and in the middle- and low-mountain belt – in November. The first snow cover in the mountains of Southeast Bulgaria – Strandzha, Sakar, the East Rhodopes – appears at the beginning of December. The last snow cover is observed from the end of March in the low-mountain belt till the end of May and even the beginning of June in places with an altitude above 1,500–1,700 m.

In addition to being a resource, climate is also of very high importance as a condition (environment), in which all human activities proceed in the open – from the numerous daily individual activities to economic activities such as forestry and agriculture, construction, recreation and tourism, collection of herbs and mushrooms, hunting, fishing, etc. Here it has to be noted that with respect to recreation and tourism, climate is an important factor not only as a resource but also as an environment, in which the recreational-tourist activity takes place, including activities using the above-mentioned specific elements of climate as a resource. The climatic environment exerts various effects on man and his organism – physical (by means of precipitation, winds, mists, etc., which restrict in a purely mechanical manner the ability of people to stay in the open, as well as aerosols, noise, odor and pollen pollution of the air environment, and UV radiation), biotropic (by exchange of the air masses), psycho-emotional (most often related to the degree of lighting – the duration of sunlight and of the day, cloudiness, visibility, etc.), and thermo-physiological (Mateeva et al., 2009). The latter occupies a special place among the climatic effects of the environment, since it affects the thermo-physiological comfort of man and hence his general biostatus. For this reason it is considered the most significant climatic factor of the environment.

The thermal environment exerts an impact on the thermo-physiological status of the human organism via thermal exchange, realized with it, which depends on the combination between the parameters of air temperature, humidity, wind, solar and thermal radiation, and the level of human activity/clothing/exposure. The assessment of this process is realized by a method involving the heat balance of the human body. In conformity with the spatial and temporal regularities, the thermal balance parameters for Bulgaria show the following: during the warm half-year transpirant exchange prevails, and in the cold half-year – turbulent thermal exchange is dominant. This is because of the specificities of the wind regime, regardless of the characteristics of the air temperature. With increasing altitude the structure of thermal exchange is subjected to significant alteration – regardless of season, the turbulent thermal exchange increases, while the transpirant one decreases. In the summer season this process is so clearly manifested that on the high parts a type of thermal exchange is formed, which is just the opposite of that in the low parts of the country. Concerning the heat balance of the human body and respectively its general physiological loading, occurring as a result of the impact of climatic conditions, the warm half-year is most favorable in the high mountain parts and the cold one – in the plains in the interior of the country and in the low-mountain belt (Mateeva, 2002).

The investigations of the mountain and fore-mountain regions in Bulgaria (Bioclimatic potential of the mountains in Bulgaria, 1983) show that in a considerable part of these localities, weather without restriction on the continuous stay of people in the open predominates all the year round (Fig. 5.4a). The frequent change of the various types of weather as well as the degree of contrast between the single changes, are also important criteria for human comfort. In this respect, the season

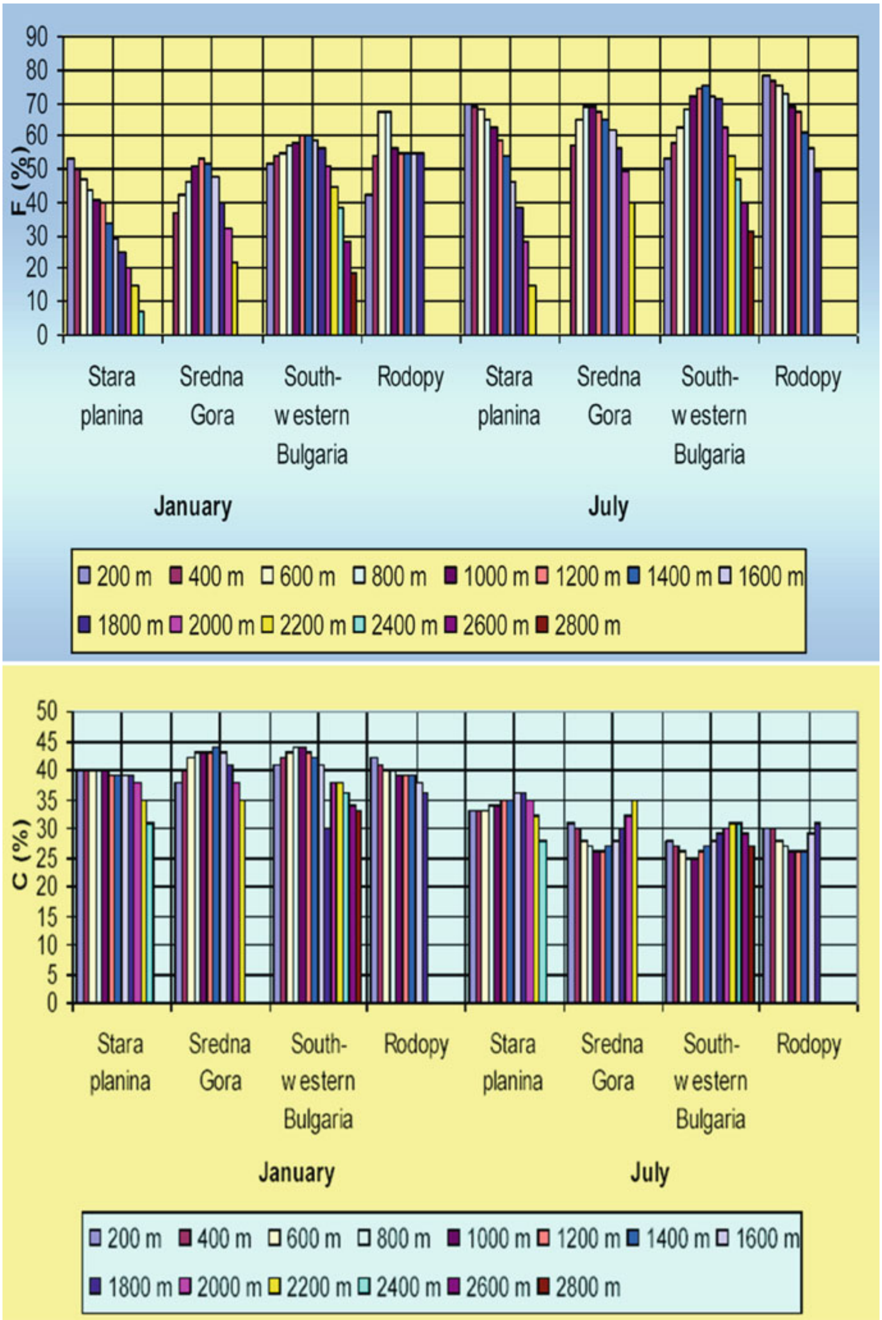

Fig. 5.4 (**a**) Frequency (F) of cases of weather without restriction on the continuous stay of people in the open at high levels in the mountains. (**b**) Frequency (C) of the contrast changes of weather at high levels in the mountains

that has the highest contrast in Bulgaria is winter, followed by spring and autumn, and summer is distinguished by the highest stability of weather (Fig. 5.4b).

5.2.3 Assessment of Water

Bearing in mind the genetic formulation for the formation of water as a product of climate, it may be pointed out that the mountains receive the highest amount of precipitation. The mountains, with restricted evaporation conditions due to the relatively low temperatures, are areas constantly generating water resources in Bulgaria. More than half of the annual volume of river runoff is formed in the altitude belts above 600 m, and including the belt within the range 300–600 m, their share exceeds 80% (Fig. 5.5). The highest water abundance belongs to the highest ridge locations – above 800 mm, for a runoff coefficient above 80% with respect to precipitation in these areas, and the lowest (more than 300 mm) belongs to the low-mountainous and foothill areas, with a runoff coefficient above 50% (Fig. 5.6). It has to be noted that with respect to precipitation and runoff conditions the East Rhodopes with their low altitude (on the average 330 m) are comparable with the medium- and even high-mountainous parts (with an average altitude of $\geq$1,000 m) of West and Middle Stara Planina, the West Rhodopes, Rila and Pirin, i.e. this is one of the most water-bearing low-mountainous parts of the country – with its occupied area of only about 4.5%, more than 12% of the water resources of the country are formed here (Physical geographic and social-economic regionalization, 1989). However, the river runoff is with strongly expressed inconstant regime – with extremely high river floods usually in winter-spring period and with continuous deep low-water during the summer-autumn when even the bigger rivers become dry. On the contrary, the river runoff in the high mountains is naturally regulated in the typical for them broadly spread ridge and slope flattened areas, often with peat cover, thick forests, thick and permanent snow cover and not on the last place with lower evaporation even in the summer.

In total 700 water reservoirs have been built for utilization of the water potential of the mountains in Bulgaria for different purposes (water supply, irrigation, power generation), which are distributed irregularly in the height belts of the single mountains and regulate a significant volume of the river water formed in these mountain localities. The volume of the artificially regulated river discharge in the water reservoirs of different size and location in the mountains by altitude belts amounts approximately to 5 billion m^3 and represents 70% of the stored water volume in the country (Mandadjiev, in: The natural and economic potential of the mountains in Bulgaria, 1989).

The technically feasible usable hydraulic energy potential of the mountains is estimated to be about 3,400 MWt, and the energy potential provided by the ca. 70 hydropower plants (HPP) that were constructed till the end of the 1980s at the water reservoirs in the mountains, is 1,900 MWt. As one can see there is still significant non-utilized hydraulic energy potential, which is one of the perspective renewable energy sources, in combination with climatic sources, for solving problems of sustainable regional development in mountainous territories and in the

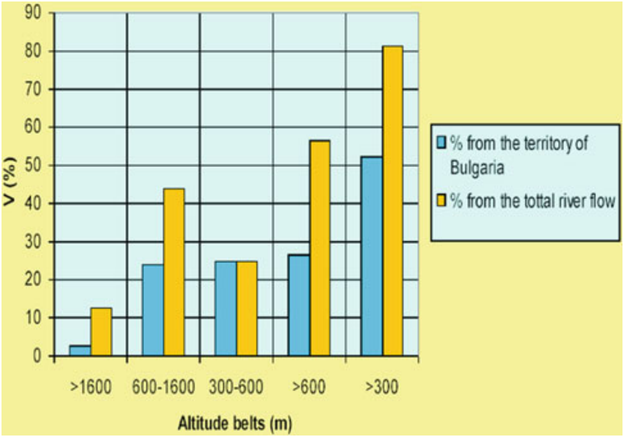

Fig. 5.5 Mean annual volume of river flow (V) by altitude belts (from Table 71, in: The natural and economic potential of the mountains in Bulgaria, 1989)

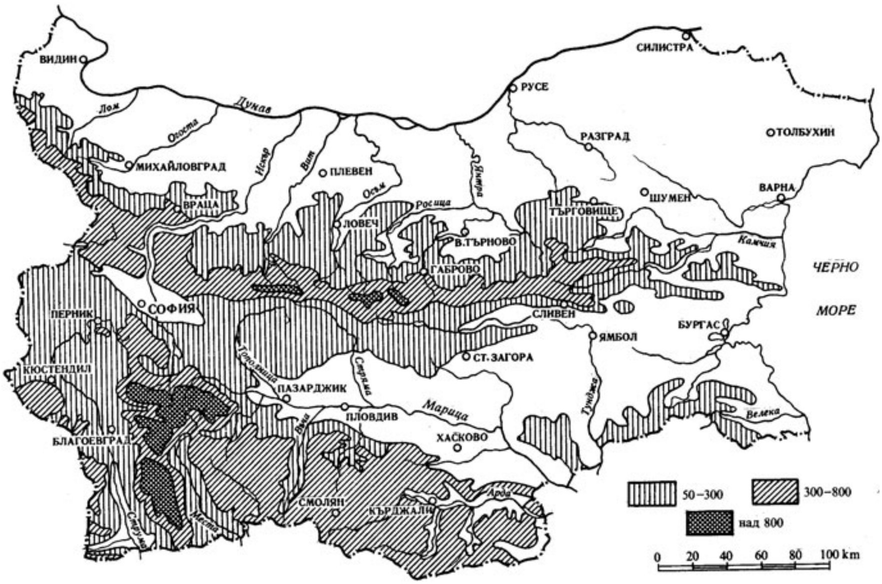

Fig. 5.6 Mean annual water flow (mm) (by Mandadjiev, in: The natural and economic potential of the mountains in Bulgaria, 1989)

whole country. On the other hand, bearing in mind the relatively reduced water use for irrigation and industrial production related to economic stagnation in the country over the last 20 years, it may be considered that a considerable water reserve is available for economic purposes and even for the needs of settlement water supply.

The recreational-tourist potential of the mountains, related to water, is extremely important, for example sites that are usually appropriate for mass forms of recreation and tourism are the numerous mountain rivers, the hundreds of high-mountain lakes in Rila (140) and Pirin (119) and artificial water reservoirs in the lower zones of all mountains, as well as the numerous attractive waterfalls. Mineral water occupies a special place within the recreational-tourist activity. It is connected mainly to fault zones in the mountainous areas – representing in total about 70% of all the mineral water deposits in the country. This natural mountain resource is traditionally used in a number of outstanding balneological centers including Hisarya, Pavel Banya, Narechen, Devin, Velingrad, Kyustendil, Sandanski, etc., as well as for production of bottled mineral water.

5.2.4 Assessment of the Soils, Vegetation and Animal World

The soil potential of the mountains is evaluated by means of the forests and pastures, developed mainly on mountain soil types, formed on 3.71 million hectares, and partially of arable lands, amounting to about 1.64 million hectares (more than one-third of the arable lands in the country, which are 4.5 million hectares). However, it has to be noted that the main part of the more than 1 million hectares of arable land abandoned during the last several decades is in the mountain areas (Raykov, In: The natural and economic potential of the mountains in Bulgaria, 1989). One of the major features of the soil cover in the Bulgarian mountains is the great soil diversity and the shallow profile of almost all soil types, distributed in the mountains. The respective soil belts are formed by increasing altitude and the regularly changing climatic conditions (lower temperatures and higher moistening).

The soil potential of the mountains, measured by soil fertility, represents the basis for the development of forestry and mountain agriculture. Concentrated in the mountains are more than 70% of the forest resources and about two-thirds of the plant species and phytocenoses encountered in the country, about 65% of the areas suitable for growing oriental tobacco and potatoes, more than 85% of the areas under meadow, and more than 70% of the common pastures and other pastures in the country (The mountain regions in the Republic of Bulgaria, 1994).

The natural vegetation in the Bulgarian mountains, in addition to its high species diversity, is characterized also by high endemism and relictness. From the known ca. 250 species and subspecies of Bulgarian endemics more than 150 occur in the mountains – mainly in the Rhodopes, Pirin, Rila and Stara Planina. Also, the predominating number of Balkan endemics occurs mainly in Bulgaria. The tertiary relicts are also typical. All this distinguishes the Bulgarian mountains as foci of flora species formation not only on Bulgarian territory (Velchev et al, in: The natural and economic potential of the mountains in Bulgaria, 1989).

The following vegetation zones are distinguished in the mountains with height: Mediterranean vegetation belt (up to 300–400/500 m) mainly with cenoses of *Quercus coccifera*, tree-like juniper (*Juniperus excelsa* Bieb.), etc. – along the mountain slopes towards the Struma and Mesta River valleys and in the East Rhodopes; xerothermic oak forest belt (up to 600–700 m) – developed in all mountains; hornbeam–common oak forest belt (between 600–700 and 900–1,000 m) – in all mountains; beech forest belt (between 900–1,000 and 1,300–1,500 m) – in all mountains except East Stara Planina and Strandzha; coniferous forest belt (between 1,300–1,500 and 2,000–2,100 m) – the Rhodopes, Rila, Pirin, Slavyanka and fragmentarily Stara Planina, Osogovo and Vlahina Mts.; sub-Alpine thin forest belt, pine-scrub and juniper shrub cenoses (between 2,000–2,100 and 2,500 m) – in Rila and Pirin and more restricted in Stara Planina, Vitosha, Osogovo and Belasitsa – at a lower height (less than 2,000 m); Alpine vegetation belt (above 2,500 m) – in Rila and Pirin (Velchev, In: Geography of Bulgaria, 2002).

Parallel to its extremely important environment-forming function, the natural vegetation (tree, herbaceous and shrub) is also traditionally used as an important source of diverse resources – wood, fodder, food, fruits, herbs, raw materials (tanning extracts, ethereal oils, resins, dyes, etc.), many plant species being also nectiferous (about 600) or with decorative features (more than 1,000) (Velchev, In: Geography of Bulgaria, 2002).

In the animal world, mainly birds and mammals are of interest from the resource viewpoint. Their distribution is usually connected with the altitude vegetation belts and the following types of fauna are distinguished: fauna in the oak belt, fauna in the beech belt, fauna in the coniferous belt and fauna in the sub-Alpine and Alpine belt with typical representatives of each belt. The economically important species are those that can be hunted, defined as game, representing a resource also for international hunting tourism. Fish fauna, related to the relatively pure water of both mountain rivers and the numerous natural lakes and artificial water reservoirs is also important for the economy – especially in relation to sport fishing.

5.2.5 Complex Assessment of Mountain Landscapes

Specific features of the landscape are formed by the combination and mutual interaction of individual natural components, with mainly relief and climate taking the leading role, with the physiognomic participation mainly of vegetation and partially of water. These features are expressed in the alternation of specific landscape belts with height. Six types of height landscape spectra are distinguished in the mountain groups and single mountains of Bulgaria (differing according to location and height): Rila–Pirin, West Rhodopean, Stara Planina, Kraishte–Sredna Gora, Osogovo–Belasitsa, and East Bulgarian. Each single type has an inherent set of height landscape belts, provisionally defined by the names of the hypsometric belts: low-mountains, mid-mountains, high-mountains and Alpine; the so-called fore-mountain belt being distinguished in some of them. There are differences in height and area of these belts in the single mountains depending on morphographic peculiarities, as well as on climatic differences, in connection with the macro exposition of the mountain slopes, the boundaries of the landscape belts being 100–200 m lower on slopes with a northern component (Table 5.3). The differences are well expressed in the high mountains: Stara Planina, Rila, Pirin, Vitosha.

Naturally, the Rila–Pirin type of height landscape spectrum is characterized by the highest number of landscape belts due to the presence of an Alpine belt with

Table 5.3 Altitude (m) of the landscape belts' boundaries (from The natural and economic potential of the mountains in Bulgaria, 1989)

Type of altitude landscape spectrum	Low-mountain	Mid-mountain	High-mountain	Alpine
Rila–Pirin (generally)	900–1,400	1,400–1,900	1,900–2,300	>2,300
(macroslopes NE-SW)	700/900-300/1,500			
West Rodopean	300–900	900–1,700	> 1,700	
Stara Planina (N)	500–700	700–1,800	> 1,800	
(S)	500–900	900–1,900	>1,900	
Osogovo–Belasitca	700–1,300/1,400	1,300/1,400–1,900	>1,900	
Kraishte–Sredna Gora	600/700–1,200/1,400	1,200/1,400–1,700/1,800	> 1,700/1,800	
East Bulgarian mountains	> 300			

low-, middle- and high-mountain zones. The smallest number of landscape belts – only one – is established for the so-called East Bulgarian type of landscape spectrum, typical for the lowest small mountains on the territory of Bulgaria – Sakar and Strandzha, and for a part of the bigger mountain systems such as East Stara Planina and East Rhodopes. They can be distinguished as a general independent type by the strongly expressed Mediterranean effect on almost all natural components and especially – on the soil-vegetation cover.

The landscape features of the height belts determine on the one hand the natural-resource potential which is suitable for various target utilization, for example industrial, power generation, forest, water resource and potential for construction, recreational-tourist potential, etc. On the other hand the landscape features determine the dynamic processes of self-purification, recovery (regeneration), degree of changeability during anthropogenic impact. It is much more important to consider possible manifestations of anthropogenically provoked or activated degradation processes. This especially concerns the output of resources and construction under conditions of higher dismemberment and slopes, typical for belts in the single mountains with varying heights. It is necessary to precede the design and realization of any type of activity by comprehensive scientific analytical and synthetic investigations and classifications.

5.3 Assessment of the Possibilities for Sustainable Utilization of the Natural Potential of the Mountains

The assessment of the natural potential of the mountains in Bulgaria as available resources and conditions is only the first but very important step towards ensuring the necessary prerequisites for sustainable development. The following steps are connected subsequently with the determination of: the needs of the various anthropogenic activities of the respective resource potential, the degree of its suitability or favorableness, the character and strength of impact on it, the direction and extent of its change and finally – the possibilities for optimizing its use with a view to its preservation.

The evaluation of the needs of suitable conditions and resources for the different anthropogenic activities is directed towards meeting the specific requirements of each activity type with respect to particular quantitative and qualitative parameters of the resources and the environment, i.e. the evaluation is subordinate to the so-called "subject–object relations," the respective activity being implied as the "subject." In addition, parallel evaluation is made of the integral and partial potentials – for example, if the landscape characteristics of all natural components are important for the broadly developed mass forms of tourism, only a few relief characteristics are sufficient for some specialized forms of tourism – rock structure and slopes (for alpinism, ski sports, etc.).

The evaluation of the degree of suitability or favorableness of the resource potential and the environment is carried out in a differentiated manner according to partial potentials, but also in an integral way, by considering in detail the basic properties of the natural components, representing a special interest, and on their basis an integral assessment rating degree is attained for the territory. Rather often coefficients of significance or weight are introduced for the most important assessment parameters with the view of limiting the inevitable leveling of the integral assessments in the synthesis of the partial ones. The boundary conditions, connected with the given natural component, or its basic property, should also be subjected to assessment analysis, and the degree of its suitability is determined on the basis of the ratio between the positive and negative evaluations (Kantsebovskaya and Semenov, 1968).

The evaluation of the character and strength of the impact of the single types of anthropogenic activity on the natural potential of the mountains is directly related to the criteria for sustainability in the context of the requirement for balanced anthropogenic loading in accordance with the "bearing capacity" (carrying capacity) of the natural components and landscapes. The impact is realized on the one hand by the "introduced" anthropogenic objects in the environment and on the other hand – by their functioning according to their basic designation, as well as by pollution with liquid, solid and gaseous substances. In this case it is important to know not only their direct reflection on the used natural component or its property (relief – for construction, water, wood, game, etc.) but also the character and strength of their mutual effect during their continuous interaction and mutual penetration as various media (rock – soil – air – water – biota), especially taking into account the multiplication effect in the exchange of pollutants.

The assessment of the direction and extent of change of the environment and the resources is a direct consequence of the impact and is subordinate to the principles of sustainable development, including the natural potential preservation. It is performed by determining the character of the occurring processes of degradation during anthropogenically activated unfavorable natural processes and phenomena – erosion, landslides, rock falls, damming up of river flows, etc., or anthropogenically provoked – during construction, connected with slope cutting, excavations, forest cut down, extraction of mineral and other resources. Their identification forms part of the basis of timely prevention of catastrophic consequences. The degree of change may be characterized by the stages of relief degradation (Rakovskaya, 1982) as a foundation and a factor of landscape, which are in their turn the consequence of the observed still broader and uncontrolled loading, which neglects the bearing capacity of the natural environment.

The evaluation of the possibilities for optimizing the use of the resource potential with a view to its protection is in fact a step towards the realization of sustainability in the development of the anthropogenic activity. It is manifested in several basic aspects. Conformity with the law in determining the potential for the needs of the respective anthropogenic activity and the possible boundaries of its development should be ranked in first place, so that the use of resources beyond their "purpose" and with higher intensity than envisaged preliminarily is inadmissible. The monitoring system, ensuring adherence to the ecological requirements for maintaining the ecological equilibrium may be ranked in second place, and the normative regulations with exactly formulated standards for the degree of loading and alteration, as well as with strictly formulated sanctions for violations should be ranked in the third, but not last place. Valuable activities in this respect were carried out in the course of harmonization of the Bulgarian ecological legislation with the European documents, but there are still some adverse practices.

5.4 Conclusion

In conclusion it may be pointed out that nature in the Bulgarian mountains is preserved to a significant extent in its virgin form not only due to the nature-protection status of the large national and natural parks and numerous reserves and natural remarkabilities in almost all mountains but also to the organized activities of large groups dedicated to the preservation of nature especially within the framework of the "Natura 2000" international program. The mountains in the border space with neighboring Balkan countries have been relatively unaffected or only slightly affected by anthropogenic activities due to the guarded regime in the border zones that existed until recently and the Rhodopes have even been stated to be one of the biggest so-called "ecological bricks" in Europe (Politische Ökologie, 1990). The opening of our boundary geographic space not only on the Balkan, but also on the European, and in a certain sense – on the world-wide scale, provides the possibility of reviving these to a great extent economically underdeveloped peripheral regions of the country, and respectively of ensuring economic prosperity on the basis of their rich natural resource potential by cooperation between countries, especially in the tourist and ecological spheres.

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Chapter 6
Morphometry and Land Use on the Mountains in Republic of Macedonia

Ivica Milevski

Abstract In this chapter, basic morphometric (geomorphometric) characteristics and their influence on the land use of high mountains in the Republic of Macedonia are presented. Morphometric elements are computed from 3"SRTM DEM model. Special attention is given to hypsometry, slopes and aspects which are characteristic for each mountain. Land use is calculated from Corine Land Cover 2000 data and appropriate raster map in the scale 1:100,000, according to the CLC categorisation. Land-use patterns on the high mountains are analysed with respect to hypsometry, slopes and aspects, finding large differences in all of these elements. Parts of these differences result from anthropogenic influences and human impact in the landscape, which is also highly influenced by topography. That fact must be taking into account considering sustainable development of mountain areas, especially with regard to accelerated erosion and overall landscape degradation.

Keywords Morphometry · Land use · High mountains · Sustainable development · CLC2000

6.1 Introduction

As a result of powerful local and regional geotectonic movements in the past, the landscape in the Republic of Macedonia (25,713 km^2) has characteristic chess-like relief with frequent changes of mountains and depressions. In general, hilly-mountain areas highly dominate in the relief, covering 78.8% of the country (Stojmilov, 1981), while mountains cover only 12,254.5 km^2 or 47.7% of the country (Markoski, 1995, 2004). From about 40 mountains, 13 are grouped as high, extending above 2,000 m a.s.l. (Panov, 1976; Stojmilov, 1976), while the highest – Korab – reach 2,753 m. According to the area which they occupy (29.3%), high mountains have large importance for the Republic of Macedonia. However,

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they are unequally outspreaded; most of them are located in the west and central part of the country, while only two, Osogovo (2,252 m) and Belasica (2,029 m), are in the eastern part. Because of variable genesis and geomorphic evolution, high mountains have significant morphometric differences, clearly evident in its hypsometry, slopes, aspects, curvatures, etc. (Milevski, 2009). Although these are important for the physical-geographic processes, mountain morphometry highly influenced human activities as well. According to Markoski (1995), in 1961 the area of high mountains was populated with 136,217 inhabitants, while in 1981 with 124,250 inhabitants of which 37,760 settled above 1,000 m of altitude (about 30,000 by latest estimation for 2002). The spatial distribution of this population and its activities in the mountain areas are closely related with the topography. On the other side, topography with terrain morphometry largely determinates land-use structure, which is analysed in this work by the Corine Land Cover 2000 (CLC2000) data. CLC2000 is used as a very representative and standardised source of data for the Republic of Macedonia (prepared between 1998 and 2000 as a part of the project of EEA European Environment Agency), although there are other possibilities for remote sensing based land-use detection sources like Landsat ETM+, ASTER (Milevski, 2005b). Thirty-one land-use classes have been identified and mapped in the country, with unit resolution of 20 ha. Joint analyses of morphometry and land use in this work show considerable differences of land-use distribution by hypsometry, slopes and aspects, which are very significant for further sustainable development of mountain areas (Fig. 6.1).

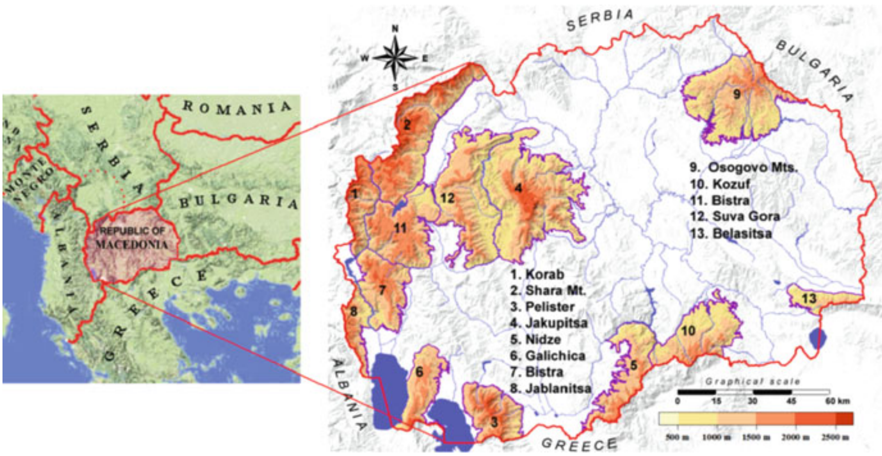

Fig. 6.1 Geographic locations of high mountains in the Republic of Macedonia

6.2 Methodology

Two basic analyses were made, for the purpose of this chapter: one of mountain morphometry and other of mountain area land use. First, high mountains are precisely bounded according to the cartographic (Markoski, 1995, 2004) and morphologic approaches. However, there are problematic areas where mountains gradually pass into bottom flats through hilly terrain. In those cases, most logical hypsometric and morphologic bounding is performed. Then, further analytical procedures were carried out.

The basic tool for morphometry (geomorphometry) analyses is the latest corrected version (v.3) of 3”SRTM (Shuttle Radar Topography Mission) digital elevation model (Jarvis et al., 2006) with global coverage, from which the area of the Republic of Macedonia is extracted. This rectangle is then preprocessed to UTM coordinates with 69 m grid resolution. The model shows sufficient accuracy with average vertical shift of ±5 m to maximum ±15 m (Markoski and Milevski, 2005; Milevski, 2007). To minimise shift effect, empiric coefficients were used during calculations, especially with slopes (Milevski, 2005a). Following, only mountain areas of interest were cut off from the model, to undergo further morphometric processing in SAGA GIS software.

Land-use analyses were made from previously checked Corine Land Cover 2000 raster data model. Some minor errors noted in the model were corrected with comparison of appropriate spectral bands on Landsat ETM+ satellite imagery (mostly by NDVI relation). Then CLC2000 model is carefully re-sampled to 69 m resolution – same as the DEM model, enabling joint identification, calculation and quantification of land-use areas with respect to the topographic elements. Finally, comparative analyses were made, showing some patterns of morphometry influence on land use.

6.3 Basic Morphometric Characteristics

Basic morphometric characteristics of the high mountains in the Republic of Macedonia are presented in Table 6.1. These include base point in foothill (H_{min}), highest peak (H_{max}), relative altitude (H_{rel}), mean altitude (H_{sr}), area (P) and volume (V) of each mountain.

Table 6.1 Basic morphometric characteristics of the high mountains in the Republic of Macedonia

No.	Mountain	H_{min}	H_{max}	H_{rel}	H_{sr} (m)	P (km^2)	V (km^3)	iV/P
1.	Korab	589	2,753	2,164	1,564.9	289.5	282.6	0.98
2.	Shara Mt.	590	2,748	2,158	1,602.7	828.6	839.1	1.01
3.	Pelister	740	2,601	1,861	1,480.3	396.6	293.7	0.74
4.	Jakupitsa	316	2,540	2,224	1,127.2	1,272.7	1,032.4	0.81
5.	Nidze	272	2,520	2,248	1,197.3	460.0	425.5	0.93
6.	Galichitsa	693	2,288	1,595	1,294.3	346.3	208.2	0.60
7.	Stogovo	570	2,268	1,698	1,345.8	458.0	355.3	0.78
8.	Jablanitsa	574	2,256	1,682	1,314.2	207.6	153.6	0.74
9.	Osogovo	424	2,252	1,828	1,074.8	981.0	638.5	0.65
10.	Kozuf	449	2,165	1,716	1,058.5	543.9	331.6	0.61
11.	Bistra	587	2,163	1,576	1,384.9	643.7	513.6	0.80
12.	Suva Gora	301	2,061	1,760	1,070.7	923.4	710.8	0.77
13.	Belasitsa	268	2,029	1,761	843.6	167.5	96.3	0.57
	Average	490	2,357	1,867	1,248.3	578.4	452.4	0.77
	Total	–	30,644	–	–	7,518.8	5,881.2	–

Table 6.1 shows that five mountains are higher than 2,500 m (Korab, Shara, Pelister, Jakupitsa and Nidze), while four mountains have relative altitude higher than 2,000 m (Nidze, Jakupitsa, Korab and Shara). Shara and Korab have highest mean altitude (H_{sr}) and highest index of volume (iV/P) according to their overall area. It is interesting that Bistra Mountain is 11th in peak altitude, but 4th in mean altitude and 5th in volume index, which is a consequence of its characteristic morphology. Mean altitude of all high mountains is 1,248 m, which is 416 m higher than mean altitude of Macedonia which is 830 m (Milevski, 2007). Average volume index of 0.77 indicates generally high mountains with respect to their area.

6.4 Basic Land-Use Characteristics

As already expected, analyses of CLC2000 data (compared and corrected by Landsat ETM+ satellite imagery) indicate dominance of forests and scrubs on high mountains (Table 6.2). However, most of the forests are broad leaf, partly degraded and with unsuitable structure and density.

According to the data shown in Table 6.3, on most of the 13 high mountains, broad leaf forests prevail, except on Nidze Mountain, where coniferous occupied significant area. On Korab, Shara and Galichitsa Mountain, instead of forests, scrubs dominate, partly because of high altitude and partly as a result of forest cleansing for mountain pasture widening. Osogovo Mountain is characterised with large agricultural areas (274.9 km^2 or 28%), most of which is land principally occupied by

Table 6.2 General land-use types (according to the CLC2000) on the high mountain in the Republic of Macedonia

Main type	Area (km^2)	Area (%)	Subtype	Area (km^2)	Area (%)	CLC code
Artificial	11.0	0.15	Industrial	1.9	0.03	121–124
			Mine, dumps	3.9	0.05	131–133
			Urban	5.2	0.07	112–142
Agriculture	916.0	12.18	Arable land	6.4	0.09	211–213
			Permanent	3.2	0.04	221–222
			Pastures	134.5	1.79	231
			Heterogenic	772.0	10.27	241–244
Forests and scrubs	6,585.8	87.59	Broad leaf	3,235.4	43.03	311
			Coniferous	500.1	6.65	312
			Mixed	461.7	6.14	313
			Scrub	2,361.0	31.40	321–324
			Open space	27.7	0.37	331–335
Wetlands	2.3	0.03	Wetlands	2.3	0.03	411–412
Water bodies	3.6	0.05	Water bodies	3.6	0.05	511–512
Total	7,518.7	100.00	–	7,518.7	100.00	–

Table 6.3 Main types of land use (according to the CLC2000) on each of the high mountains in the Republic of Macedonia

Mountain	Artificial	Agricultural	Broad	Coniferous	Mixed	Scrubs	Other	Wetland	Water	Total
Korab	0.0	22.0	116.1	11.8	12.9	122.0	4.6	0.2	0.0	289.5
Shara Mt.	2.6	92.1	263.9	25.5	36.4	401.8	4.6	0.4	1.3	828.6
Pelister	0.5	30.4	183.1	30.7	24.6	125.5	1.7	0.0	0.0	396.6
Jakupitsa	0.0	109.6	492.9	90.0	99.5	473.8	6.9	0.1	0.1	1, 272.7
Nidze	0.0	30.6	131.5	154.5	65.0	77.7	0.8	0.0	0.0	460.1
Galichitsa	0.3	39.3	127.3	16.5	18.8	144.1	0.0	0.0	0.0	346.3
Stogovo	0.2	45.8	242.1	15.5	14.8	135.4	3.1	0.6	0.6	458.0
Jablanitsa	0.7	26.6	105.0	6.5	6.5	59.7	0.9	0.6	1.1	207.6
Osogovo	2.3	274.9	405.4	37.0	42.1	214.9	3.9	0.2	0.4	981.1
Kozuf	1.2	29.2	263.8	49.8	78.6	120.8	0.4	0.0	0.0	543.8
Bistra	2.2	41.4	371.0	24.7	25.8	177.2	0.8	0.3	0.3	643.6
Suva Gora	0.9	156.6	422.0	32.0	30.9	280.8	0.1	0.0	0.0	923.4
Belasitsa	0.2	17.7	111.1	5.5	5.8	27.2	0.0	0.0	0.0	167.5
Total	11.0	916.0	3,235.4	500.1	461.7	2, 361.0	27.7	2.4	3.7	7, 518.8

agriculture (101.1 km^2), pastures (56.5 km^2) and complex crops (55.3 km^2). That is a consequence of oak deforestation and introduction of agriculture on terraces and flats below 1,000 m.

6.4.1 Hypsometry and Land Use

Hypsometry of the high mountains in the Republic of Macedonia is derived from precise analysis of 69 m DEM, according to the standard altitude ranging 500 m (accuracy shift < 1%, Table 6.4).

Obviously, there are large hypsometric differences between mountains. Thus, only Shara Mountain and Kozuf have significant area above 2,000 m of 21.7 and 14.6%, respectively, after which is Pelister with 10.0% of its total area. As already mentioned, in Macedonia, Belasica does not reach 2,000 m, because the highest peak is in Bulgaria (Radomir, 2,029 m). It indicates that majority of mountains have largest areas in the hypsometric zone of 1,000–1,500 m which correspond to its mean altitude of 1,248 m. Such hypsometric structure influences local climate (decrease of temperatures, increase of precipitations), hydrography, vegetation, soil types, population density, human activities and certain land-use patterns. Thus, according to the major land-use classes on high mountains, agricultural areas prevail on lower altitudes up to 1,000–1,500 m. Forests are especially dominant on 1,000–2,000 m (i.e. 800–1,800 m), with upper limit (anthropogenic) of about 1,800–2,200 m. Above are natural grasslands and bare rocks, extending up to the mountain top (Table 6.5).

It is interesting that oak complex (as well as other forests) on the lower mountain sides is significantly devastated by human impact (mostly by over-cutting and cleansing). Similarly, dense coniferous forests above 1,800 m were destroyed in the past, transforming these areas to grasslands for pasturing. As a result, severe erosion occurs, especially on the mountain bottoms.

Table 6.4 Hypsometry (m) of high mountains in the Republic of Macedonia

Mountain	< 500	500–1,000	1,000–1,500	1,500–2,000	2,000–2,500	> 2,500	Total
Korab	0.0	25.4	97.0	124.9	40.5	1.7	289.5
Shara Mt.	0.0	104.7	224.7	319.4	171.1	8.7	828.6
Pelister	0.0	28.2	188.6	140.2	39.1	0.6	396.6
Jakupitsa	14.6	582.3	428.2	178.2	69.2	0.1	1,272.7
Nidze	15.3	85.7	273.0	76.8	9.1	0.1	460.0
Galichitsa	0.0	48.7	205.8	84.7	7.1	0.0	346.3
Stogovo	0.0	78.3	226.2	138.5	15.0	0.0	458.0
Jablanitsa	0.0	47.7	92.2	60.2	7.5	0.0	207.6
Osogovo	3.8	432.8	427.6	114.2	2.6	0.0	981.0
Kozuf	1.6	270.6	199.3	70.6	1.8	0.0	543.9
Bistra	0.0	104.5	274.3	259.0	5.9	0.0	643.7
Suva Gora	15.0	393.2	409.5	105.5	0.2	0.0	923.4
Belasitsa	18.9	100.9	40.8	6.9	0.0	0.0	167.5
Total	69.1	2,303.0	3,087.2	1,679.0	369.2	11.1	7,518.7

Table 6.5 CLC2000 land-use types (km^2) with respect to hypsometry

code	Type\slope	< 1,000 m	1,000–1,500 m	1,500–2,000 m	> 2,000 m	P (km^2)
2–11	Artificial	6.70	3.18	1.12	0.00	11.00
12–22	Agriculture (all)	562.56	340.09	13.35	0.00	916.00
18	Pastures	72.76	59.79	1.98	0.00	134.50
20	Complex crops	117.79	54.94	2.09	0.00	174.80
21	Land-agriculture	240.91	135.30	4.73	0.00	380.94
23	Broad leaf	905.54	1,740.50	582.83	6.51	3,235.40
24	Coniferous	114.99	232.71	146.51	5.88	500.10
25	Mixed forests	139.86	192.97	121.96	6.92	461.70
26	Natural grassland	111.11	155.29	539.66	276.88	1,082.94
27	Moors. heathland	82.57	81.67	115.23	41.77	321.25
28	Scleroph. veget.	118.18	104.85	52.10	8.46	283.59
29	Transitional	312.97	233.78	107.57	18.92	673.24
	Total (with other)	2,372.10	3,087.23	1,679.03	380.34	7,518.7

6.4.2 Slopes and Land Use

Slopes are very significant morphometric elements which influence numerous natural and anthropogenic aspects. In this work, only slope angle is analysed in detail, although slope length and slope curvature also have considerable significance. Slope angle of the high mountain in the Republic of Macedonia is derived from 69 m DEM by applying an additional empirical correction factor (because of resolution) in the form: $\alpha = \alpha(1 + \alpha/150)$ (Milevski, 2005b, 2008, Table 6.6).

The data show that the highest mean slope (from 25.8 to 24.1°) has Korab, Shara Mountain and Pelister, which are also the highest mountains in the country. The causes for such high slopes are geotectonically predisposed steep sides and deeply

Table 6.6 Slope angle by area (km^2) on the high mountains in the Republic of Macedonia

Mountain	0–10	10–20	20–30	30–40	40–50	< 50	P (km^2)	$\alpha°$sr	LS
Korab	19.1	70.3	103.2	69.1	22.5	5.3	289.5	25.8	34.8
Shara Mt.	64.2	269.9	289.6	149.1	48.8	6.8	828.6	23.5	33.2
Pelister	27.8	95.7	165.8	100.3	6.5	0.4	396.6	24.1	32.0
Jakupitsa	187.6	403.9	405.3	221.0	45.8	9.1	1,272.7	21.6	27.4
Nidze	56.6	162.2	163.3	67.8	9.4	0.6	460.0	20.4	25.2
Galichitsa	88.8	138.4	85.7	27.2	5.6	0.6	346.3	17.0	21.7
Stogovo	62.3	172.5	154.8	52.5	13.6	2.4	458.0	20.4	26.7
Jablanitsa	36.5	72.6	64.5	26.9	6.1	1.1	207.6	20.0	25.1
Osogovo	136.5	415.1	331.9	89.3	8.0	0.2	981.0	19.1	22.6
Kozuf	88.7	215.6	174.6	53.8	9.7	1.5	543.9	19.2	22.7
Bistra	119.6	242.8	180.4	69.3	23.8	7.8	643.7	19.7	24.7
Suva Gora	125.5	308.3	311.3	154.8	22.1	1.4	923.4	21.1	26.7
Belasitsa	30.7	50.9	49.7	30.2	5.8	0.3	167.5	20.9	26.7
Total	1,044.0	2,617.9	2,480.2	1,111.3	227.8	37.6	7,518.7	20.9	26.9

incised river valleys. Jakupitsa and Suva Gora have moderate slopes, with steep sides but flattened karstified planes on top. The lowest mean slope has Galichica mountain (only 17°), as a result of very large flat top surface with many shallow dolines, sinkholes, karst poljes, etc. on the central and northern parts. Overall, average slope of the high mountains in Macedonia is 20.9°, which is significantly higher than the average slope of the country of 13.5° (Milevski, 2007). It is interesting to stress out that the average slope of most mountains sharply increase with altitude up to about 1,000 m, after which the slope values fluctuate between 15 and 25° (because of morphological changes). On highest altitudes, slope trends decrease, especially towards ridge and peak areas on the top.

Good slope indicator of the analysed mountains is LS (length-slope) factor, which is slope angle multiplied by length of constant slope. From Table 6.3 it is evident that the three highest mountains have the greatest LS values (34.8–32.0), meaning long, steep slopes. Galichitsa has the lowest value because of the relatively short, flat slopes on the large karstified top surface.

However, among the other, slopes directly or indirectly influence land-use pattern. Data from Table 6.7 show that on smaller slopes (0–20°), agricultural land prevails, especially areas with complex crops. This is logical because agricultural activities are much easily practised on lower slopes and in these ranges are most of the population and rural settlements. On the contrary, forests are present on higher slopes, with significant areas even above 30°. Normally, bare rocks, sparse vegetation, etc. are present on all slopes with noteworthy percent above 30°.

Significant presence of agricultural land on slopes with values 10–20° or even 20–30° (formerly broad leaf forests), which are usually on altitudes below 1,000 m, causes land degradation and soil erosion. With time, part of that land will be abandoned and transferred to grasslands, pastures or bare rocks.

Table 6.7 CLC2000 land-use types (%) with respect to slope categories (degree)

Type\slope	0–10	10–20	20–30	30–40	40–50	>50	*P* (%)	*P* (km^2)
Pastures	26.7	43.6	23.8	5.3	0.6	0.1	100.0	134.5
Annual crop	23.5	43.8	26.0	5.9	0.6	0.2	100.0	31.0
Complex crop	34.0	43.3	18.6	3.6	0.5	0.0	100.0	174.8
Land-agriculture	20.6	44.2	28.8	5.8	0.6	0.0	100.0	380.94
Agro-forestry	15.2	41.5	33.7	8.6	0.9	0.1	100.0	185.29
Broad leaf	8.5	31.6	37.6	18.2	3.6	0.5	100.0	3,235.38
Coniferous	10.9	33.8	34.9	16.4	3.3	0.7	100.0	500.07
Mixed forests	12.0	34.6	33.3	15.4	3.8	1.0	100.0	461.68
Natural grassland	18.2	36.6	29.1	12.7	2.9	0.4	100.0	1,082.94
Moors. heathland	17.3	34.4	31.0	14.0	2.8	0.5	100.0	321.25
Scleroph. veget.	19.3	36.9	27.8	12.8	2.7	0.6	100.0	283.59
Transitional	18.4	36.5	27.7	13.6	3.2	0.6	100.0	673.24
Beaches.	14.1	24.3	24.9	22.6	8.8	5.2	100.0	6.10
Bare rock	10.9	26.2	28.2	19.1	9.6	5.9	100.0	7.43
Sparsely	12.6	25.4	29.4	20.7	7.5	4.3	100.0	13.28

6.4.3 Aspects and Land Use

Terrain aspects are also significant morphometric elements on the high mountains in the Republic of Macedonia, resulted from geotectonic processes and geomorphic evolution. At the same time, aspects have importance for the intensity of erosion processes, local climate and vegetation, type of soils, as well as for the anthropogenic activities in the space.

Table 6.8 shows large differences in the aspects' structure between mountains due to numerous causes: geotectonic and morphologic elements, dominant directions of mountains, directions of valleys, position of the border mountains (where only the area in Macedonia is analysed), etc. Overall, west aspects dominate, as well as east ones which are in line with NW–SE (Dinaric) directions of the mountains. Nidze, Kozuf, Osogovo and Belasitsa are exceptions because of their E–W directions (consequence of N–S neotectonic extension; Milevski, 2006). It is interesting that the largest aspects have lower and longer slopes than least present, which have much stepper slopes, and vice versa (Milevski, 2009).

Aspects significantly influence local climate, vegetation, hydrography, soils and human activities in the space, as well as on land use. On this latitude, north aspects are colder and wetter than others, with dense vegetation, deep soils and less human impact. The opposite is on south slopes, where because of intensive human impact, usually severe land degradation and erosion occur. However, major types of land-use patterns are presented in this chapter according to the four main aspects: east, south, west and north (Table 6.9).

According to the CLC2000 data, artificial and agriculture land-use types dominate in the south, south-east and east sides, where there is the greatest distribution of population and human activities. For the same reasons, scrubs, especially grasslands, are present more in the south aspects (relative to the percent of south areas)

Table 6.8 Aspects on the high mountains in the Republic of Macedonia

Mountain	NE	E	SE	S	SW	W	NW	N	Total
Korab	52.1	64.3	50.0	38.5	26.7	15.0	11.7	31.1	289.5
Shara Mt.	109.4	153.7	177.8	140.9	90.0	48.6	46.4	61.9	828.6
Pelister	50.7	54.3	50.0	32.1	40.8	54.9	51.5	62.3	396.6
Jakupitsa	171.5	181.8	143.0	131.4	160.7	191.9	154.2	138.2	1,272.7
Nidze	66.6	42.8	33.0	35.2	54.9	75.4	76.5	75.5	460.0
Galichitsa	42.8	55.1	35.2	25.9	34.3	74.1	49.5	29.5	346.3
Stogovo	58.9	61.8	52.2	53.7	75.6	63.4	46.3	46.3	458.0
Jablanitsa	48.9	55.8	33.4	20.8	10.1	6.5	10.8	21.1	207.6
Osogovo	102.7	121.4	112.5	126.2	163.2	147.8	109.6	97.6	981.0
Kozuf	87.1	75.1	43.7	31.9	47.9	89.3	88.2	80.5	543.9
Bistra	93.6	93.2	75.0	67.4	72.0	81.5	79.9	81.1	643.7
Suva Gora	118.4	125.4	131.0	118.1	92.8	93.7	111.4	132.4	923.4
Belasitsa	27.5	14.9	7.4	11.6	19.1	22.3	26.4	38.4	167.5
Total	1,030.3	1,099.6	944.1	833.7	888.2	964.4	862.3	895.9	7,518.7

Table 6.9 CLC2000 land use by aspects on the high mountains in the Republic of Macedonia

code	Type\slope	E	S	W	N	P (km^2)
2–11	Artificial	3.35	4.08	2.17	1.39	11.00
12–22	Agriculture (all)	280.87	269.64	202.71	162.78	916.00
18	Pastures	36.28	41.18	34.29	22.75	134.50
19	Annual crops	8.47	9.58	7.67	5.29	31.00
20	Complex crops	58.78	52.79	37.12	26.12	174.80
21	Land-agriculture	121.65	111.93	79.39	67.97	380.94
22	Broad leaf	888.96	595.57	795.91	954.96	3,235.40
23	Coniferous	106.02	87.19	163.32	143.58	500.10
24	Mixed forests	106.80	84.33	141.91	128.66	461.70
25	Natural grassland	357.06	292.72	230.13	203.03	1,082.94
26	Moors. heathland	87.39	74.90	86.43	72.53	321.25
27	Scleroph. veget.	84.28	79.78	69.10	50.44	283.59
28	Transitional	203.64	214.60	161.35	93.66	673.24
–	Other	13.93	9.69	8.27	1.57	33.46
	Total	2,132.3	1,712.5	1,861.3	1,812.6	7,518.7

and east aspects. On the contrary, forests occupy smaller portions on these sides, while are much extended on north and west aspects. It is clear that human impact has a large influence on land-use structure, according to aspects.

6.5 Conclusion

From presented data, it is obvious that topography of the high mountains has large direct or indirect influence on land use. Thus, on lower altitudes with south aspects (with denser population and higher human impact), forests are usually degraded, destroyed or replaced by cultural vegetation. Because of this, accelerated soil erosion occurs, devastating the landscape. Calculations from the soil erosion map of the Republic of Macedonia (Djordjevic et al., 1993) show high average soil erosion rate in the region of high mountains of 724 m^3/km^2/y (786 m^3/km^2/y below 1,000 m). In opposite are higher mountain regions, especially those with north aspects and stepper slopes. These are unsuitable for human activities, which result in better preserved natural areas. However, with infrastructure and transport modernisation in recent times, influence of morphometry on anthropogenic activities slowly decreases, followed by some land-use shifting. This will be even more pronounced in future, when climate change takes effect.

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Chapter 7
Usage of the Mountain Areas in the Republic of Macedonia

Mirjanka Madzevic and Biljana Apostolovska Toshevska

Abstract According to the geomorphologic structure of the relief in the Republic of Macedonia mountain areas (along with the frontiers of displaced villages) cover around 47.6% of the total area. Almost 25% of the total number of village settlements in the country is on this territory (Panov, 1993; Panov M., 1998; Stojmilov, 2005), but only 9.5% of the total village population recorded in 2002 in the Republic of Macedonia lives in it. In the past 50 years, there has been rapid decline of the population in mountain areas. As a result, in 2002, 47 village settlements in the mountains had been displaced, and the population density was barely 10 people per km^2. In favor of this is the fact that in 2002 there had been 1.2 ha arable land per person which is double in comparison with 1961. Especially, negative usage of farmlands happened in the villages of up to 300 people, with 5.2 ha per person. These villages have mostly single and aged households. At the same time, although mountainous areas have conditions to develop other activities, such as mining, various types of tourism, they are not adequately used.

Keywords Mountains areas · Population · Arable land · Usage · Resources

7.1 Introduction

No matter how paradoxical it sounds, there is a truth in the claim that mountain areas are so rich and yet so poor. This claim comes from the fact that mountain tracts have abundance of diverse natural resources of regional and state significance, but these are not used completely.

In order to stress the degree of inadequate usage of mountain areas as well as potential possibilities for that, several existing and planned activities which contribute or will contribute for more adequate usage of the areas will be distinguished in the following chapter. In the whole chapter the main landmark for usage is the

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population, considering the fact that human resource is the main driving force in maintaining certain area.

7.2 Population as a Precondition for Area Usage

As a result of the powerful and quite intense socioeconomic changes in the last period, with emphasized industrialization and urbanization of the city centers, and great migration movements of the population toward bigger attractive settlements located in the lower regions of the country, there are evident changes which have happened in the mountain village settlements in the Republic of Macedonia. The main characteristic of their population-geographical development is the change in the number of population that lives in the settlements in the mountain areas of the country. In just a few decades, villages that were once significantly stronger in population and economic structure transform in smaller in population settlements with impaired age and economic structure of the population, as well as a number of other problems that question their sustainable development. Those unfavorable changes in the development of the settlements were confirmed by the statistics of the censuses of population and households in the second half of the 20th century, as well as by the numerous scientific and fieldwork done in the area where the mountain villages are located. From the data presented in the table below we can notice the dynamic with which the number of the population in the mountain villages has been changing (Tables 7.1 and 7.2).

In 2002, the biggest part of the population or 45.8% lived in the region of Polog, followed by the Southwest region with 29.2%. Following all census years, it is obvious that the biggest part of the population in mountain areas was concentrated in the west part of the Republic of Macedonia. At the same time, contrary to the trend of decline of population of mountain villages from the other regions, or certain variations in the Southwest region, the region of Polog after 1953 records an increase. This increase is partly due to the fact that parallel with the decline of the absolute number of village population in the other regions, in the region of Polog the general part of the population was retained as a result of the high population birth rate, mostly consisted of Macedonian Albanians.

Table 7.1 Number of the population in mountain villages

Census year	Population total	Basic index	Chain index
1948	164, 937	100	
1953	176, 157	106.8	106.8
1961	149, 122	90.4	84.7
1971	128, 850	78.1	86.4
1981	104, 195	63.2	80.9
1994	83, 123	50.4	79.8
2002	74, 453	45.1	89.6

Source: Census of the population and households according settlements 1948–2002

Table 7.2 Structure of the total population in mountain area according to regions (in %)

Region	1948	1953	1961	1971	1981	1994	2002
Skopje	7.1	7.3	7.1	6.1	6.5	8.2	7.2
Vardar	7.5	7.2	5.6	3.8	2.9	3.5	4.2
Northeast	15.1	15.2	15.7	15.4	11.8	8.9	7.2
East	10.3	10.8	10.6	10.9	9.4	8.8	7.8
Southeast	3.8	3.7	2.3	2.1	2.0	1.8	2.0
Pelagonia	13.6	13.1	13.2	11.9	11.6	5.8	5.6
Southwest	22.2	21.7	22.2	21.4	20.1	21.4	20.2
Polog	20.5	20.9	23.3	28.3	35.6	41.5	45.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Census of the population and households according settlements 1948–2002

The period after World War II is the so-called compensational period when there were not some big economic capacities in the towns to draw the population from the rural surrounding. Immediately after the war, the number of population in these village settlements in the period of 5 years increased by 6.8%. In fact, in that period the number increased to 11,220 people or in average of 2,244 people per year. Consequently, follows a period which is characteristic for the permanent reduction of the population. As a result, in only 8 years period of time, between 1953 and 1961, these villages had lost over 27,000 people or in average of 3,380 people per year, which is decrease in population mass of 15.3%. This decrease had continued in the following period between 1961 and 1971 when a contingent of 20,272 people had resettled or in average of over 2,000 people per year.

The period of 1971–1981 is the period when the biggest changes have happened. Migration processes continued with greater intensity which led to reduction in number of people in these villages by 24,655 people or decrease of one fifth of the population. In subsequent years, due to the fact that a great deal of the population already moved out from these villages, the decrease was proceeded with somewhat slower pace, but it was still noticeable. Permanent reduction of the population in these villages in 2002 led to decrease in number of nearly 102,000 people or by 57.7% in comparison with 1953. This indicates the fact that apart from the constant population of the researched villages, the whole population growth was misplaced. In fact, due to a number reasons it happened that most frequently whole households migrated and very seldom only individual members of a household.

The illustrated changes in the number of the population are associated with the powerful socioeconomic changes which had taken place in the country, with the uneven regional development, the negligence of the development of the rural surroundings, the insufficient infrastructure and institutional equipment of these villages, as well as many other factors. The situation would have been much worse for this group of mountain villages, if it had not been for those several settlements which record increase in the population. Here we have higher population growth. Such examples are the villages from the area of Shar Mountain and others. These changes have led to certain problems, especially the restricted use of the areas and the insufficient use of the natural resources.

7.3 Size of Villages According to Population Number

In order to have detailed and more complex realization of the population changes of the villages which are defined as mountain villages, it is eminent to recognize the changes that have happened in their population size. The negative tendency of the number variation of the total population directly reflected the size of the villages according to population number and the coverage of certain population groups of villages.

According to the elaborated in detail data, we obtain more information about the current changes. The main change is the one where population reduction of the mountain areas led to reorganization of the villages according to their size and the shift from one group to another.

From the total of 391 villages which are subject of research it is evident that dominant villages are those small in population. The villages with a size from 1 to 300 people are most frequent and their number increased permanently. Therefore, increase by 59.8% had been noticed in the whole analytic period. In fact, out of 174 villages in 1948, by 2002 that number increased to 278 villages which represents 71.1% of the mountain villages (Fig. 7.1).

Analogous to the changes in number of the total population, villages of 1–300 inhabitants in the period between 1948 and 2002, record 46% reduction in population. Then again, a special characteristic of these villages, in terms of

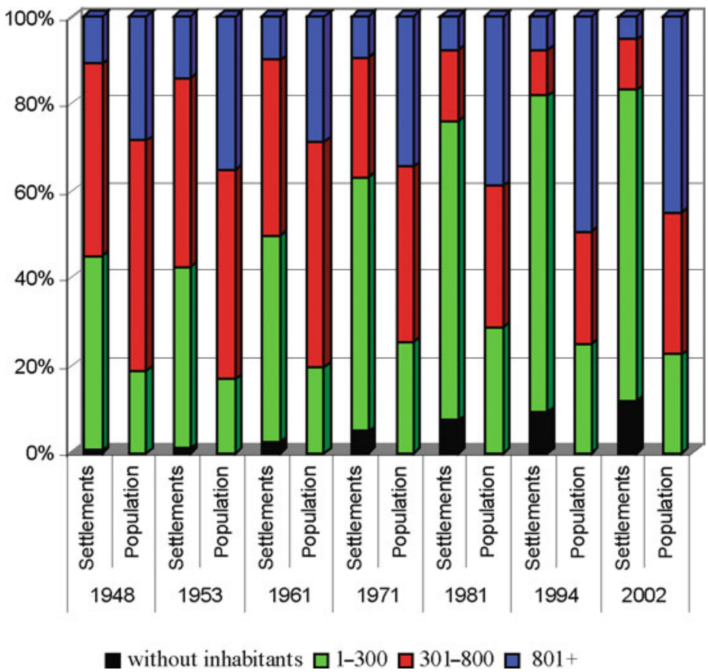

Fig. 7.1 Settlements according to population size

percentages, is the evident increase in the population number that lived in those villages, which varied with 18.8% in 1948 and 28.7% in 1981, and less than a quarter in the last census. This group of villages is the only one where the average size of the settlements reduced from 179 people in 1948 to 60 people in 2002. This group also includes the smallest villages of up to 100 people. Their participation in the total number of mountain villages increased with 8.2% in 1948 and 56.3% in 2002 which shows that half of the mountain villages are very small. Only a small part of the population of mountain villages, which is less than one tenth, lives in the villages of up to a hundred settlers.

Villages of 301–800 inhabitants, which are considered as middle-size villages, show noticeable decline in their number of –73.8% in the whole analytic period. Their representation in the network of settlements was relatively stable until the 1960s, and they had participated with around two quarters in the total number of mountain villages. Powerful migration processes that had affected these and other villages are the reason for their drop in number from 107 villages in 1961 to 45 villages in 2002. In that sense, their participation in percentage terms had been decreased from 27.4% in 1961 to 11.5% in 2002. In these villages there was decline in the population number of –72.2%. The biggest concentration of population was in the average-size mountain villages up until 1971. The average size of these villages rose from 504 people in 1948 to 535 people in 2002.

Villages that have over 800 inhabitants are categorized in the group of large villages. Their number in the last period halved; in other words, the number decreased from 55 villages in 1953 to 30 villages in the period between 1981 and 1994, and to 21 settlements in the last census. At the same time, there was 28.8% reduction in the population that had lived in it in the period between 1948 and 2002. The population number in terms of percentages varied slightly with 28.6% in 1953 and 49.3% in 1994, or 45% in 2002. From 1981 onward the biggest part of the population of mountain villages has been concentrated in this group of villages. A lot of contribution for that is participation of the large villages of over 800 people which number records some significant oscillations and decrease in the last 30 years, and yet part of the large villages maintain their population and continue to increase. The villages of over 800 people record rise in the number of the population from 1,097 people in 1948 to 1,560 people in 2002, which is an increase with 45.8%.

Concerning fact about the size of mountain villages is the negative change of the population number which is followed by constant increase of the number of displaced villages. The population number of only two villages in 1948 increased to 47 settlements in 2002, and they represent 12% of the total number of mountain settlements.

The presented changes concerning the size of the villages imply the need for resolving problems related to their development. Demographical problems and unsuitable conditions affect their future population, as well as economic development. Taking into consideration the fact that we talk about relatively large number of settlements, and that to all of these belong different resources which are not sufficiently and inadequately used, it is eminent to include relevant factors for directing their revitalization and sustainable development.

7.4 Usage of the Areas of Mountain Villages

The biggest number of mountain villages expands in the west part of the Republic of Macedonia, to be precise, in the region of Polog and the Southwest region, which area is around 40% of the total land of mountain villages. A large number of them are spread along the border area, which in the future collaborative inter-neighboring endeavor for economic development of the mountain tracts should be used as a positive developing predisposition and not as idiosyncratic handicap (Table 7.3).

In the land structure predominant are the forest areas with 46.6%, which represent 32.2% of the total forest areas in the country. According to percentile presence of forest, a part of the areas are used for the needs of forestry. The work force involved in the woodcutting and transportation is from the local region. A good part of the population lives on illegal woodcutting, which is characteristic for the whole mountain area in the Republic of Macedonia. This chosen existential alternative is certainly not to be supported from a point of view of the suitable development of the mountain area and forest, but that kind of existence is provoked by the constant bad policy of economic development of the mountain areas.

Although a few, there are some examples of a location of small productive facilities for primary wood processing (sawmills), as well as for production of wooden packing.

Pastures are involved with nearly 1/3 of the total pasturelands. The largest areas of mountainous pasturelands expand over Shar Mountain, Karadjica, Bistra, and Osogovo Mountains (Milenkovski, 1981). These mountains have almost 2/3 of pasturelands below mountainous areas in the country. According to the size of the pasturelands, next in line are the mountain areas of Pelister, Korab, Stogovo. Pastureland nutrition of the livestock, considering the effort and measures put in it (besides being a characteristic of extensive form of stock-breeding), represents the cheapest way of feeding the livestock. Hence, the pasturelands are respectable predisposition for development of the stock-breeding. However, parallel with the

Table 7.3 Land structure of mountain villages in the Republic of Macedonia according to regions (in %)

Region	Area	Arable land	Pasturelands	Forest
Polog	20.6	14.2	23.8	14.6
Southwest	19.8	17.5	18.1	22.2
Pelagonia	15.4	18.3	22.2	12.1
Skopje	6.9	8.0	7.4	7.2
Vardar	8.4	5.1	5.4	11.1
Southeast	6.1	2.7	2.9	9.8
East	12.1	13.2	10.8	13.6
Northeast	10.7	20.9	9.5	9.3
total	100	100	100	100

Source: DGU (1984): Macedonia through cadastre evidence, Skopje continuous decline in the number of livestock fund, and this is especially true for the head of sheep, it is apparent that there is lesser usage of the pasturelands. The most intensively are used the areas of Shar Mountain, Korab, Bistra, Osogovo Mountains, and Maleshevo Mountains where the biggest number of sheep, 1,500,000, is bred, this was recorded in the last agricultural census in 2004.

Large numbers of sheepfolds are located in the mentioned areas and characteristic cheese and yellow cheese (berovsko, mariovsko, galichko) are being made there. In the last 10 years there has been positive increase in the breeding of goats. Nonetheless, the records show that stock-breeding in mountain tracts provides low incomes (cow lactation is no more than 1,200 l per year and sheep lactation is 50 l per year). The low strive for change of agro and zoo-technical measures, parallel with decline of the population of the villages, result in diminishing the possibilities for optimum usage of pasturelands.

Arable land is involved with only 15% of the total land (Table 7.4).

These areas also have possibilities for intensification of orcharding. The areas which are not appropriate for cultivating other crops can be used for the development of orcharding. Market demand and processing industry, as well as the possibilities for export, should be taken into consideration in the structural placement of the orcharding.

Generally, the basis for increase of the income is redirection of this agricultural production, where everything and anything is being grown, toward agriculture that will agree with the market demands. The main point should be directed toward finding adequate solutions for better placement on the market. Some products have to be left out, and new ones, which are suitable for the new market demands, should be introduced. Although the agriculture in the mountain areas provides low income, it is wrong to believe that the situation will improve only by providing means from the community. Instead, the solution should be found in the possibilities of interrelation and help from the other areas based on the mutual interest, considering the fact that there is a need for these to complement and link each other (Azderski et al., 2003).

Table 7.4 Structure of the usage of arable land presented through ha farmland per person

Region	1948	1953	1961	1971	1981	1994	2002
Skopje	0.6	0.6	0.7	0.9	1.1	1.1	1.4
Vardar	0.4	0.4	0.6	0.9	1.6	1.6	1.5
Northeast	0.8	0.7	0.8	1.0	1.6	2.6	3.6
East	0.7	0.6	0.8	0.9	1.2	1.7	2.1
Southeast	0.4	0.4	0.7	0.9	1.2	1.6	1.7
Pelagonia	0.8	0.7	0.9	1.1	1.4	3.5	4.1
Southwest	0.4	0.4	0.5	0.6	0.8	0.9	1.1
Polog	0.4	0.4	0.4	0.4	0.4	0.4	0.4
total	0.6	0.5	0.6	0.7	0.9	1.1	1.2

Source: Own calculations according DGU (1984): Macedonia through cadastre evidence, Skopje and Census of the population and households according settlements 1948–2002

Of course, the social factors and the whole community need to be involved in this, but the intervention of the community is of secondary importance.

In agreement with the country policy, in the last years there has been striving for development of the small businesses, starting your own business and self-employment. Parts of these initiatives are being realized in the village boundaries. Although a part of them have seasonal character, they are still of great importance for the tenable development of the area. Examples for that are the already existing drying rooms for wild berries, drying room for mushrooms of local geographic origin and the local population participates in the gathering of these wild berries and mushrooms. According to the data of the field researches, whole families from the villages below Shara Mountain, the villages from Osogovo Mountain, the mountainside of Jakupica exist on the gathering of mushrooms, wild berries, and remedial plants.

A great deal of mine resources is concentrated in the mountain areas and for that reason mining is existent in the villages. Such an example is the boundaries of the village Sasa in the Osogovo Mountains (where there is lead and zinc mine), as well as the surrounding of Rzanovo where there is nickel and iron ore. These natural resources are the foundations of the ferrous and non-ferrous metallurgy in the Republic of Macedonia. Here we will also mention the abundance in the mountain tract of Kozuf where the mine Alchar is located and where the rare loran can be found.

Mountain areas are the only expanses that have better water potentials. Very often, these are captured due to the water supply of the local population as well as the population in the surrounding. Large numbers of rivers abound in hydroelectric power potential, but this potential is used minimally. Register are around 100 bigger springs on Shar Mountain among which is Vrutok with lavishness of 1,500 l/s. Also, there are around 20 big mountain rivers. They are flowing and have fast and clear watercourses. The largest are Pena, Mazdrcha, Leshochka River, Tearchanka, Bistrica, and others. Characteristic for Pelister are 23 rivers with total length of 212 km, which are abundant in trout, etc (Stojmilov, 2003). Some of these Mountain Rivers are used for raising fishponds for trout and carp. One part of them associates this activity with catering, which accentuates the attractiveness of the area, and the income is significantly higher (e.g., fishpond in the village Nezilovo – the upper flow of the river Babuna) (Madzevic et al. 2007).

Tourism as a peculiar form of usage of the rural area, although outwardly unpretentious, is slowly enlivened. This usage of mountain areas highlights the possibility of usage of the natural and anthropogenic tourist motifs. It should be especially emphasized the possibility for usage which is based on the development of many types of tourism, such as village inns, eco-tourism, sport and hunting (mountain hunting grounds at Osogovo, Bistra, and Shar Mountain) and fishing tourism, also the opportunities for mount climbing, alpinism, etc. Furthermore, using tourism for promoting of areas where healthy food is produced, as well as village manifestations and folk traditions, creating of ethno-parks, etc. In some villages in the Republic of Macedonia for a long time certain manifestations take place, such as the Galichka wedding in the village of Galichnik, on the July 12th each year, on St. Peter's Day, also there are manifestations in Gari and Lazaropole. Churches and monasteries, build seven, eight or more centuries ago, are also in favor of tourism. Especially distinguishable are the monastery above the village of Matejche (1,005 m), the monastery St. Prechista on the hillside of Vrvoj (920 m), St. Joakim Osogovski at the Osogovo Mountains (825 m), St. Preobrazdenie in Krushevo (1,500 m), and others. In these monasteries there are lodgings in which guests can stay over night (Panov N., 1998).

Specially organized types of usage of mountain areas are the national parks (Pelister, Mavrovo, and Galichica), as well as some natural reserves (e.g., Jasen), which provide opportunities for development of different types of tourism.

In order to have even better usage, mountain areas should be used for educational purposes. The idea is to place educational centers and natural laboratories designed for students of different age in certain mountain areas which flourish with prominent characteristic natural-geographic elements.

7.5 Conclusion

From all of the abovementioned we get the impression that the usage of mountain areas is far from optimum possibilities of usage. One of the measures that would be considered prolific is the stimulating tax policy and the infrastructural adjustment of the area. This kind of investment of the state would be minimal in comparison with the positive effects which are likely to be achieved. First of all, the area is being established as attractive for investment, primary for the development of agriculture and tourism. The area becomes attractive for the young population, which if unemployed, in the Republic of Macedonia may secure their existence. The natural production is oriented toward market production, which results in higher income and the higher income is a precondition for a bigger investment. In that way, conditions for further self-revitalization and economic strengthening of the area are being created.

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Chapter 8
Landscape Structure and Ecosystem Services of Etropole Municipality

Stoyan Nedkov

Abstract The chapter represents an approach to investigate the landscape structure at municipality level and the possibilities of using it for the valuation of the ecosystem services. Landscape differentiation of the area was investigated using GIS-based model. The most important ecosystem services of the Etropole municipality are provided by the forest landscapes. Only 27% of their total value belongs to the provisioning service, which is the most used at present. The importance of their regulation services, especially the regulation of the flood-risk will increase in the future because of the climate change. The valuation of ecosystem services is considered as an important and useful activity for the achievement of sustainable development. It gives the opportunity to involve some resources and services, which are usually ignored in the process of regional planning. Further progress of the valuation and assessment methods will improve their preciseness and reliability.

Keywords Landscape structure · Ecosystem services · Valuation

8.1 Introduction

The small municipalities in Bulgaria located in mountain areas have low economic potential. Their labour force and productive capital are limited, so in most cases they should rely mainly on the natural resources. Their economic valuation is usually concentrated on the possibility to extract row materials or in some cases tourist potential. A lot of useful ecosystem functions like storage and retention of water, regulation of atmospheric chemical compounds, regulation of disturbance regimes, etc. are ignored. One of the reasons is that the profits they provide are not direct and need long-term planning. On the other hand, the conventional methods of economic valuation are not applicable for them. The concept of ecosystem services gives the

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opportunity to solve this problem. It is based on the assumption that “the services of ecological systems and the natural capital stocks that produce them are critical to the functioning of the earth’s life-support system, they contribute to human welfare and therefore represent part of the total economic value of the planet” (Costanza et al., 1997). This concept is fully compatible with the idea of sustainable development because it gives the possibility to involve important resources and services for the future generation like genetic material and habitat function in the processes of economic valuation and regional planning.

The ecosystem services are defined as “the conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfill human life . . .” (Daily, 1997), “ecological processes that benefit people directly (e.g. food) or indirectly (e.g. pollination) . . . (Luck et al., 2003), “benefits that people derive from ecosystems” (Millennium Ecosystem Assessment, 2005). Ecosystem services consist of flows of materials, energy and information from natural capital stocks which combined with manufactured and human capital services to provide human welfare (Costanza et al., 1997). The term ecosystem services lumps together economic benefits that can be classified as: (1) goods – products obtained from ecosystems, such as resource harvest, water or timber; (2) services – certain ecological regulatory functions, such as water purification, climate regulation or erosion control. Thus, in the current literature the word “goods” is usually left out from the term but the meaning remains the same. According to the Millennium Ecosystem Assessment (2005), the ecosystem services are grouped into four broad categories: *supporting services; provisioning services; regulation services; cultural services*. The ecosystem functions providing these services can be classified into four primary categories (de Groot et al., 2000): (1) *regulation functions* – related to the capacity of natural ecosystems to regulate essential ecological processes and life support systems through bio-geochemical cycles and other biospheric processes; (2) *habitat functions* – natural ecosystems provide refuge and reproduction-habitat to wild plants and animals and thereby contribute to the (in situ) conservation of biological and genetic diversity and evolutionary processes; (3) *production functions* – photosynthesis and nutrient uptake by autotrophs convert energy, carbon dioxide, water and nutrients into a wide variety of carbohydrate structures which are then used by secondary producers to create an even larger variety of living biomass; (4) *information functions* – because most of human evolution took place within the context of undomesticated habitat, natural ecosystems provide an essential “reference function” and contribute to the maintenance of human health by providing opportunities for reflection, spiritual enrichment, cognitive development, re-creation and aesthetic experience. The valuation of ecosystem services is an important task “inseparable from the choices and decisions we have to make about ecological systems” (Costanza et al., 1997).

The landscape is considered as “a heterogeneous territory consisting of cluster of interacting ecosystems that are repeated in space” (Forman and Godron, 1986). The ecosystems could have different spatial extend and the mapping of all ecosystems for particular area (i.e. municipality) is almost unattainable task. On the other hand, the valuation of the ecosystem services requires appropriate spatial data for the investigated area, so it is better to carry out this activity at a landscape level. Remote sensing data and GIS database can be useful tools for its realization. This chapter represents an approach to investigate the landscape structure at municipality level and the possibilities of using it for the valuation of the ecosystem services.

8.2 Study Area

The municipality of Etropole is situated in the north part of Bulgaria with an area of 371.7 km^2 (Fig. 8.1). It occupies the northern slopes of the easternmost part of the West Stara Planina Mountain (Called Etropolska Mountain) and the average elevation is 914 m. The climate is typical temperate-continental characterized with relatively warm summer and cold winter. The temperatures gradually decrease from north to south with the increase of elevation from 9.5 to 2°C. The annual precipitation varies from 750 to 800 mm in the north part to 1,100 mm for the highest parts of the mountain. Due to the mountainous character of the region, the extreme precipitation is intensive and most often concentrated in single parts of the catchment areas. Malki Iskar River with its tributaries Ravna, Suha, Jablanitsa and Stara reka drains the area. There are nine protected areas within the municipality: four natural landmarks and five protected sites.

The municipality contains one town, Etropole (11,840 inhabitants) and nine villages. The biggest of them are Lopian (516) and Malki Iskar (351). The population

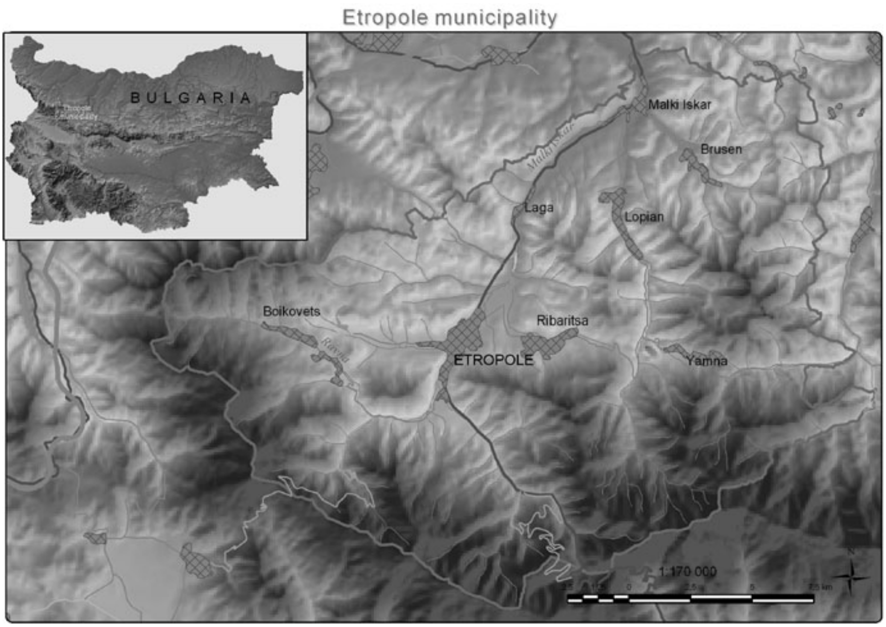

Fig. 8.1 Study area Etropole municipality

of the municipality is characterized with unfavourable age structure and negative growth rate. The share of the industrial enterprises in the economic sector in 2003 is 73% and they ensure 57.3% of the workplaces in the municipality. The agriculture is dominated by stock breeding. According to data of the municipality, the wood output within its boundaries has been drastically increased in the course of the last 7–8 years – from 12,000 to 35,000 m^3 annually. The plan for municipal progress till 2013 envisages development of tourism on the basis of the nine protected territories and the remarkable cultural heritage.

8.3 Materials and Methods

The mountain landscapes are characterized by higher lever of heterogeneity due to the great variety of geographical conditions. The change of landscape units in the mountains takes place within few kilometres while in the plains the corresponding change can be detected after hundreds and thousands of kilometres. This necessitates the implementation of a specific approach, which takes into account the third dimension of the landscape – the elevation. To investigate the landscape heterogeneity, methods by which spatial patterning can be described and quantified are necessary. That is why we develop an approach using regression dependencies and GIS tools for spatial analyses to model the spatial pattern and produce landscape maps for the mountain areas. It is based on a regression model of interpolation using correlation dependencies between hydro-climatic indices and the altitude (Gikov and Nedkov, 2005). The GIS map layers of the climatic indices are analyzed and verified using satellite images and forest cadastre data in order to create a map layer of the potential landscapes in the area. CORINE Land Cover data are used as a basis to create map layers for the contemporary landscapes. They are transformed and generalized to fit the working map scale and then intersected with the previously created map layers. The landscape map was created using two-level classification scheme to represent the hierarchical structure. The first level (landscape types) represents the landscape differentiation caused by the influence of main flows of energy and matter, calculated by hydro-climatic indices. Land-use data were used at second level for delineation of the contemporary landscapes. CORINE land cover classes have been generalized to 11 land-use types, which represent the contemporary landscapes of the area.

There are various methods used to estimate both market and non-market components of the value of ecosystem services (Costanza et al., 1997). The valuation needs synthesized approach based on a variety of methods used in different scientific disciplines, noting the limitations and assumptions underlying each. The value of ecosystem services is divided into three main types: ecological, socio-cultural and economic (de Groot et al., 2002). The later can be divided into: (1) Direct Market valuation; (2) Indirect Market valuation; (3) Contingent valuation; (4) Group valuation. The first one is easily applicable for most provisioning services like row materials, food or fresh water because of their wide use in the economy. The indirect methods use different techniques in order to reveal the Willingness To Pay or Willingness To Accept compensation for the availability or loss of these services. It includes Avoided costs (services allow society to avoid costs that would have been incurred in the absence of those services), Replacement costs (services could be replaced with human-made systems), etc. Contingent valuation uses social survey questionnaire to express their willingness to pay for particular service. Group valuation is a method derived from social and political theory based on the principles of deliberative democracy.

The valuation of ecosystem services in Etropole municipality was made using some of the values given in different investigations of the world ecosystems (de Groot, 1994; Costsanza et al., 1997; Millennium Ecosystem Assessment, 2005) and regional studies (MakKinnon and Yan, 2001; Barklay and Batker, 2004; EFTEC, 2005; Weber, 2005). The work of Zevurdakis et al. (2007) makes an attempt to valuate the ecosystem services of the Rhodope Mountain area in Bulgaria. They also recalculated all values in Bulgarian currency – BGN. Their results are useful source for the situation in Bulgarian mountain areas, but they used CORINE land cover as an initial spatial data for the evaluation. The values from all these sources have been verified for the study area and corrected where necessary. For example, Zevurdakis et al. (2007) valuated the provisioning functions from the forest ecosystems 282 BGN/ha/year but in the landscape typology there is a possibility to classify them in more details. There are beech forests, hornbeam-oak forests and artificial coniferous forest, which have some differences in their services. The beech forests in the higher part of the area have higher disturbance regulation services, which were detected using GIS-based hydrologic models (Nedkov, 2008; Nikolova et al., 2008). The valuation of the mixed classes like forest-arable land areas has been calculated using the values of the original land-use types reduced according to their share in the particular area. The value of transitional woodland-shrub class was calculated by reduction of the forest values with the services that this class is not able to support (for example, timber production) or has less potential (regulation of disturbance regime). For the review of ecosystem services, the chapter follows the Millennium Ecosystem Assessment typology, grouping the ecosystem services into four main categories (see above). As the supporting services are considered to be necessary for the production of all other services, they were not included in the valuation at this stage of the investigation.

8.4 Results

The area of Etropole municipality belongs entirely to the mountain landscapes. According to the classification scheme made by Velchev et al. (1992), modified for mountain areas by Gikov and Nedkov (2009), there are 2 landscape types and 11 contemporary modifications (Fig. 8.2). The south part of the municipality is occupied by *temperate subhumid landscapes in the beech forests belt*, which cover 25,180 ha (69% of the area of the municipality). They are located in the mountain

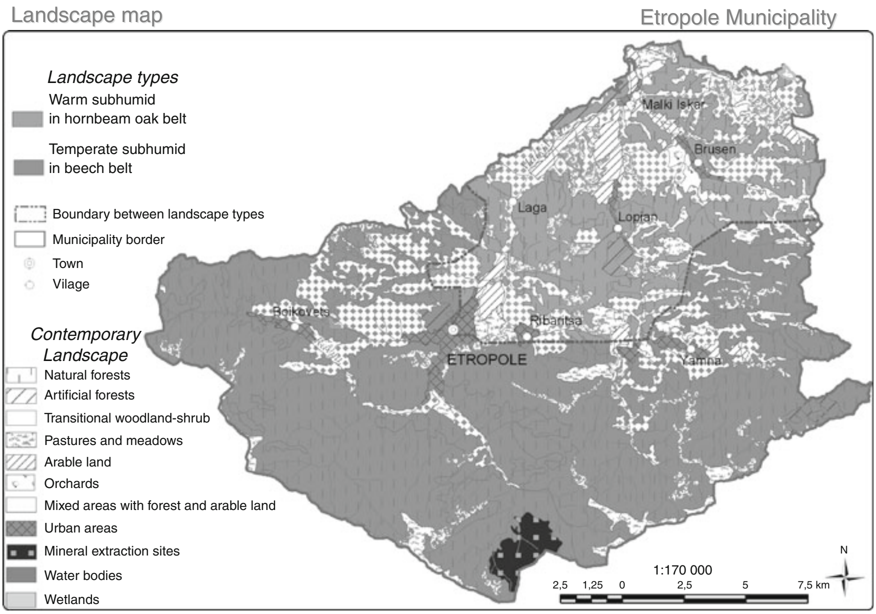

Fig. 8.2 Landscape map of Etropole Municipality

belt above 450 m. The natural beech forests are very well preserved occupying 75% of the area. There are no extended arable lands within this type. They are represented by relatively small patches surrounded by forests or grassland. That is why the second largest land-use type is *mixed areas with forest and arable land* (12%). The Pastures and meadows occupy about 5% of the area. They are represented mainly by secondary vegetation types on the place of former forests, used predominantly for livestock grazing. Transitional woodland-scrub landscapes (5% of the area) are located in areas used for timber extraction in the past, which are now at different stage of reforestation process. The north, lower part of the municipality is occupied by *warm subhumid landscapes in the belt of hornbeam-oak forests*, which cover 11,542 ha (31% of the area of the municipality). The share of natural forests here is less than in the previous type (41%) but they still occupy the largest area. The arable lands are larger, but still most of them are included in the mixed land-use class (27% of the area) and only 3,068 ha (8%) are identified as extensive cultivated fields. The share of the *artificial forests* (3%) here is bigger than in the previous type, as well as the *transitional woodland-shrub* and *pasture* landscapes, which is due to the higher level of anthropogenic influence in this part of the municipality (Table 8.1).

The valuation based on the described approach shows that the potential value of the ecosystem services provided by landscapes of Etropole municipality to the society is 35.3 million BGN/year. Provisioning services make up 27% of this, while the share of the regulation services is almost half of the value (46%). Forest landscapes by far provide the biggest contribution (28.6 million BGN/year) accounting

Table 8.1 Value of the ecosystem services in Etropole Municipality (the area of mineral extraction sites is not included)

Landscapes	Area (ha)	Value of the ecosystem service (in BGN/ha/year)			Value for the whole landscape (in thousand BGN/year)			Sum (in thousand BGN/year)
		Prov.	Regul.	Cult.	Prov.	Regul.	Cult.	
Temperate subhumid								
Natural forests	18,869.1	288	581	382	5,434	10,963	7,208	23,605
Artificial forests	215	80	481	250	17	103	54	174
Transitional woodland-shrub	1,377.7	60	335	–	83	462	0	544
Pastures and meadows	1,164.6	107	26	200	125	30	233	388
Mixed areas with forest and arable land	2,954.2	365	235	–	1,078	694	0	1,773
Arable land	77.5	421	69	0	33	5	0	38
Water bodies	12	156	550	0	2	7	0	8
Urban areas	510.3	0	662	0	0	338	0	338
Wetlands	0	143	588	100	0	0	0	0
Sum	25,180.4	–	–		6,772	12,602	7,495	26,868
Warm sumhumid								
Natural forests	4,734	210	471	382	994	2,230	1,808	5,032
Artificial forests	298.7	40	431	250	12	129	75	215
Transitional woodland-shrub	955.4	30	285	–	29	272	0	301
Pastures and meadows	921.3	107	26	200	99	24	184	307
Mixed areas with forest and arable land	3,068.8	325	235		997	721	0	1,719
Arable land	925.4	421	69	0	390	64	0	453
Orchards	269.8	421	69	0	114	19	0	132
Water bodies	16	156	550	0	2	9	0	11
Urban areas	317.9	0	662	0	0	210	0	210
Wetlands	35	143	972	100	5	34	4	43
Sum	11,542.3	–	–	–	2,641	3,712	2,071	8,424
Whole municipality	36,723.7	–	–	–	9,413	16,314	9,565	35,292

for 81% of the total value. The extraction of row materials (mainly timber) has 3,303 BGN/year, which is only 11% of their total value. The excessive timber production menaces some of the regulation services, which could have negative effect in the future. The forest ecosystems in the temperate subhumid landscape type have higher regulation value because of their role in the flood-risk reduction (Nikolova et al., 2008). This value is calculated to be 4.7 million BGN/year, which is almost half of the total value of the regulation services. The provisioning services in the warm subhumid landscapes have lower value because the hornbeam-oak forests there have lower timber quality and the forest fragmentation is higher. On the other hand, the non-tree forest resources there are bigger, which reduce the difference. The artificial forest landscapes have lower values, because they are mainly coniferous with lower timber quality, lower regulation capacity and lack of non-forest resources. The anthropogenic landscapes have relatively high value compared with their area, which is due to their high cultural value and the assessment method, which takes into account the replacement costs for the building of equipment producing this service. As the cost of the land for building in the urban areas is high, the value also increases (Zevurdakis et al., 2007).

8.5 Conclusion

The most important ecosystem services of the Etropole municipality are provided by the forest landscapes. Only 27% of their total value belongs to the provisioning service, which is the most used at present. The importance of their regulation services, especially the regulation of the flood-risk will increase in the future because of the climate change (Nikolova et al., 2008). This necessitates prevention activities directed to the preservation of the regulation function of the forest ecosystems in the critical areas of the basin. Such measures would have positive effect also on the genetic and regulation services and the total economic value as well (Nedkov, 2008). The use of landscape approach gives opportunity for more precise valuation than using pure land cover data (i.e. CORINE). The quality of the spatial data is very important factor for the preciseness of the valuation. CORINE land cover is a good source for broad and middle scale research but for small municipalities, investigated in finer scale, it is necessary to involve satellite images with high resolution. ASTER Terra images provide satisfactory quality (15 m resolution) at reasonable cost for that purpose.

The valuation of ecosystem services of the municipality is important and useful activity for the achievement of sustainable development. It gives the opportunity to involve some resources and services, which are usually ignored in the process of regional planning. Although, this valuation is “certainly difficult and fraught of uncertainties” (Costanza et al., 1997) and criticized by many authors, its contribution for the sustainable development can be very useful. Further progress of the valuation and assessment methods will improve its preciseness and reliability.

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Chapter 9
Evaluation of the Avalanche Danger in Northwest Rila Mountain

Krasimir Stoyanov

Abstract The chapter treats the conditions determining avalanche formation and action in Northwest Rila. It provides an analysis of the current morphosculptural impact of avalanches on the Alpine and sub-Alpine mountain zones. The most hazardous avalanche terrains are specified as well.

Keywords Avalanches · Avalanche danger · Tourism · Northwest Rila mountain

9.1 Introduction

The formation of avalanches is a risky geomorphologic process and a common event upon the steep slopes of the high mountains. Avalanche is the snow slide on slopes with certain declination. The place from where the avalanche breaks off is called the beginning and the line of its breaking—an edge of breaking off. The distance from there until the place where it stops is the route of the avalanche and the snow piled up is called the avalanche cone.

Northwest Rila Mountain with its Alpine type of relief and the formation of a thick and durable snow coverage is a region with a big intensity of the avalanche formation.

The Alpine part of Northwest Rila Mountain is frequently visited by skiers and snowboardists. The accelerated development of these sports is connected with the expanding of the locations for their practicing. Nowadays skis are mainly practiced around the Mountain Base *Malyovitsa* and the hostel "Rila Lakes". In the future with the performing of tourist infrastructure projects, the number of the visitors in the high part of the mountain will increase many times. The region is also one of the important tourist destinations. Here are located various sites of the "Hundred national tourists sites"—the most popular and visited mountain lakes in our country—the Seven Rila lakes, the highest waterfall in Rila Mountain—the

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Skakavitsa Waterfall, here also pass a part of the main tourist paths to the Rila Monastery. The territory of Northwest Rila falls within the boundaries of the National Park"Rila" and the Natural Park "Rila Monastery". In this region can successfully be developed the ecologic tourism, as well as natural scientific, cultural, and religious (Zhechev and Stoilov, 2003).

Northwest Rila Mountain also is the main center of alpinism in the country. The region is with a built-up tourist infrastructure and is visited almost during all seasons. This also means more avalanche incidents. A significant part of the avalanches are caused by the tourists themselves.

9.2 Avalanche and Avalanche Danger

There are different *classifications* of the avalanches. They are grouped according to different signs (Fig. 9.1). The avalanches are sliding along the slope, flowing or moving in the air. They have a different speed—the avalanches of dry snow are moving faster then those, formed by a wet snow (Fig. 9.1).

The avalanche formation in Northwest Rila Mountain creates specific *ground surface forms.* The avalanches perform the biggest contemporary denudation gravitation changes in the high part of the mountain. They break off, shake down, and transport with a big speed different rock pieces in the Alpine and the sub-Alpine zones. At certain conditions, they also destroy the forest plants.

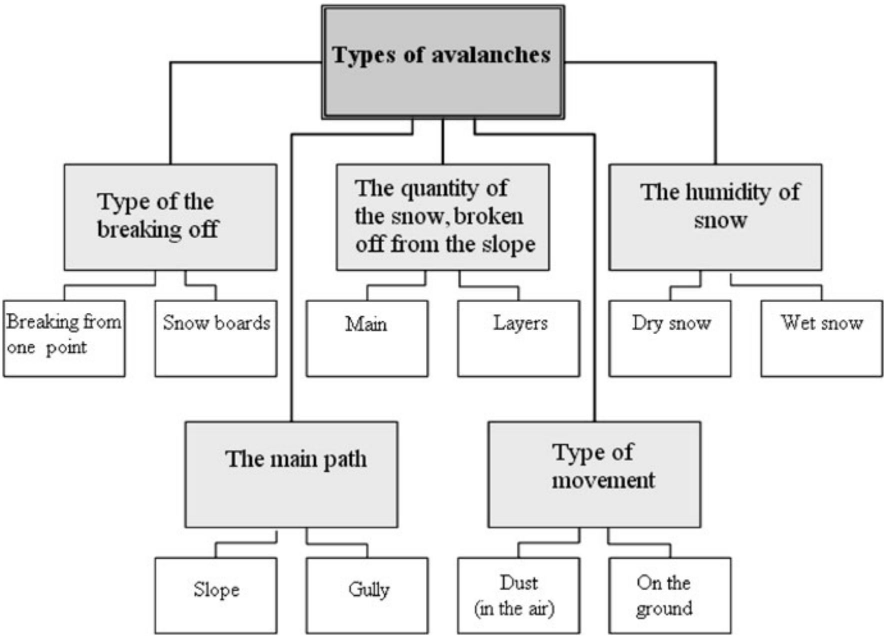

Fig. 9.1 Classification of the avalanches

Fig. 9.2 An avalanche cone on the left valley slope of the river Skakavitsa

The main ground surface forms which are formed by the activity of the avalanches are the avalanche gullies, the avalanche rails and cones. The first two types in their genesis are nival corrosion and gravitation forms, because they are formed along the strongly declined slopes of the circuses and the glacial trough valleys. Almost all avalanche gullies end in their mouths with an avalanche sediment under the form of an avalanche cone (Fig. 9.2; Peev, 1968; Peev and Dimitrov, 1971).

In the Northwest Rila Mountain can be seen one of the most specific avalanche gullies in the whole mountain. Such can be seen at the circus of the Seven Lakes, Urdinia Circus, under the southern edge of the Koupen Ridge to the valley of Rilska River and the Meadow of Cyril—the location The Evil streams, the Alpine part of the valley of the rivers Malyovitsa, Dupnishka Bistritsa, and Skakavitsa, the northern slopes of the Kalinian part, the Otovishki circus, etc. (Figs. 9.2 and 9.3).

Avalanches are formed under certain *climatic and geomorphologic conditions*. Almost all slopes in the Alpine part of Northwest Rila Mountain at the availability of the relevant conditions can be avalanche dangerous. On some of them, the skiers often do ski-dropping and snowboarding, which can be very dangerous.

The biggest and most dangerous avalanches are formed along the slopes with declination between 25 and 45° (Mardirosyan, 2007). Very important are the specifics of the snow coverage—its thickness, structure, and the peculiarities in its distribution. The leeward slopes have a thicker snow coverage.

The mountain hostels located in the Alpine zone of Northwest Rila are “Ivan Vazov”, “The Seven Lakes”, “The Rila Lakes”, “Skakavitsa”, and “Malyovitsa”

Fig. 9.3 The Northern steep and rectilinear slope of the Otovishki ridge is avalanche dangerous and keeps until late spring a lot of snow

(Fig. 9.4). In winter at certain conditions, their approaches are avalanche dangerous.

In the region of the hostel "Ivan Vazov" (2,300 m above the sea level) was observed a snow coverage with a thickness of 3–4 m, when the posts of the winter marking are also covered up. The approaches to it in winter are with a moderate avalanche risk.

For the last few years, the region around the hostel *The Seven Rila Lakes* became extremely popular between the admirers of the free-ride driving in Bulgaria. In the region avalanche dangerous is the eastern slope of the Dry Hill, turned to the circus of the Seven Lakes and especially its northern part. The gullies opposite the hostel *Rila Lakes* are very steep and after January in the central gullies are formed also big peaks. This makes them quite dangerous after snowfalls and winds. Many of the self-confident skiers underestimate this danger and they ski along the gullies under any kind of conditions.

Another avalanche dangerous part of the mountain is the valley of the Malyovitsa river. Along all routes to the Shelter "*BAK*", *The Rila Monastery*, "*Ivan Vazov*", there is a high level of avalanche danger. The gullies of the Kalbura Hill over the first terrace are very unstable right after the snowfalls (Panayotov, 2004). Along the right slope of the valley between the peaks The Black Rock and The Camel in the winter of 2006, an avalanche of 1 km long and 300 m broad broke off. Six Slovak tourists were affected but they managed to get away only with some small grazes and

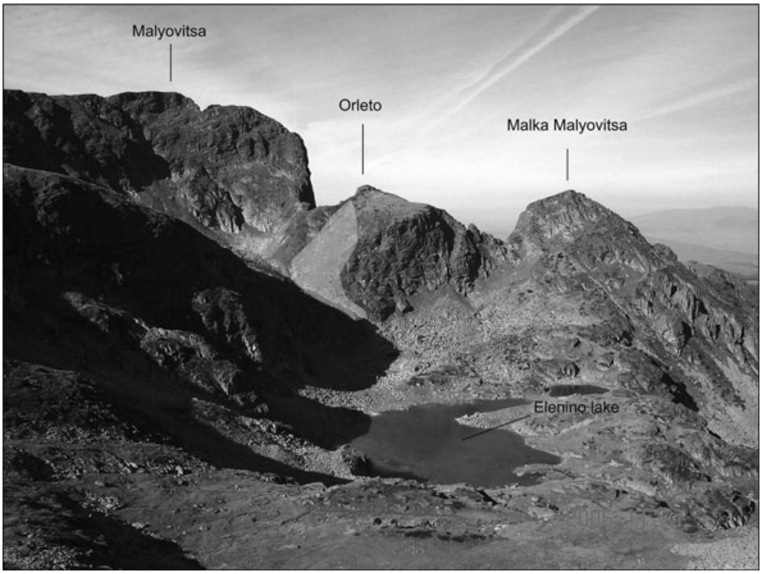

Fig. 9.4 The way of the avalanche along the southwest slope of the Orleto Hill from December 1965

traumas. According to the mountain rescuers from the region, such a big avalanche was not seen for the recent years at Malyovitsa.

The southwest slope of the Orleto Hill is with the most sad reputation. In December 1965 an avalanche dropped down this slope and it passed only 50–60 m but took the life of 11 people (Fig. 9.4). Also dangerous is the southern slope of the Malka Malyovitsa Hill. The last case was with a woman, covered up by an avalanche while she was moving a little over the marked path for Malyovitsa Hill on the second terrace (Panayotov, 2004).

The region of the hostel *Skakavitsa* is also avalanche dangerous. Especially dangerous are the gullies over the chalet on the eastern slope of the Kabul Hill. Small avalanches are also falling along the path to the chalet *Rila Lakes* when there is a lot of snow, right above the forest belt. Also avalanche dangerous is the valley of Skakavitsa river above the chalet where the avalanches form specific avalanche gullies. They are clearly reflected in the relief with the formed swells and rocky pilings as well as by destroying of the foliage (Fig. 9.2).

From the chalet *Ivan Vazov* to the village of Bistritsa there are also a few dangerous places where there are pilings caused by avalanches. The first one is along the slope of the hill Skalitsa (2,666 m) and the Birds' Peak. The second is along the Otovishko Bilo whose Northern slope is avalanche dangerous and large peaks are formed (Fig. 9.3). Other extremely dangerous slopes on Northwest Rila are the slope before the lake The Eye, the big gully left of the Water Fall Skakavitsa (Fig. 9.5).

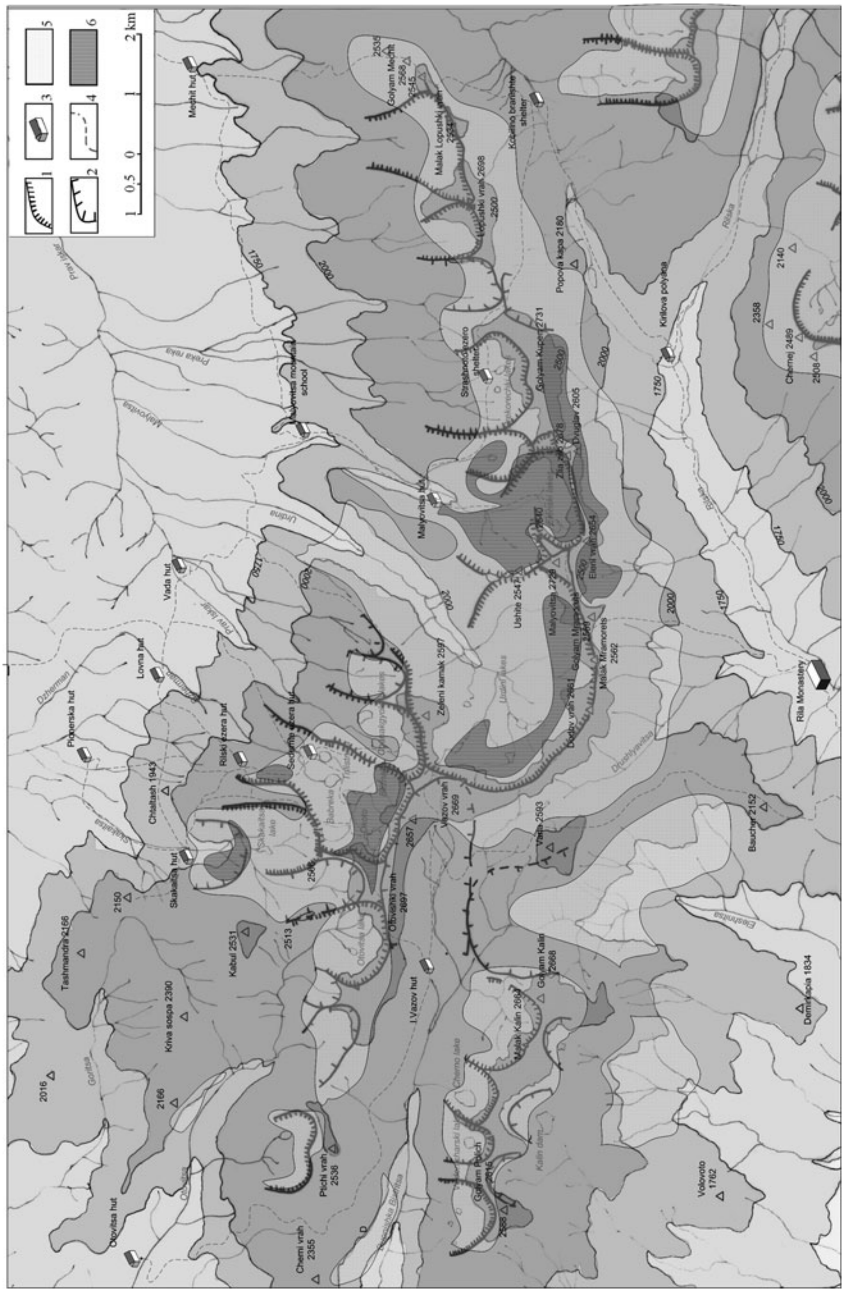

Fig. 9.5 Tourist infrastructure and avalanche danger in Northwest Rila Mountain. (1) Outlined in the relief and well-formed circuses; (2) Embrionic, shallow circuses with steep slopes; (3) Tourist hostels and shelters; (4) More important marked paths; (5) A region with a high avalanche danger. Avalanches drop at certain conditions non-periodically; (6) A region with a high avalanche danger. Avalanches fall a few times during the season along the well-known routes.

9.3 Conclusions

The formation of avalanches is a risky geomorphologic process for whose formation must be available specific climatic and geomorphologic conditions. The formation of avalanches in Northwest Rila is with a big intensity. The destructive activity of the avalanches is caused by the detonation caused by the snow mass and the preceding air wave. The avalanches cause not only direct demolitions but also the formation of avalanche gullies, at the base of which are piled up rock aggregations.

Avalanches can be formed also in a thin forest and on their way they also affect the forest belt by lowering the upper boundary of the forest.

The number of the victims of an avalanche does not depend on its size. An example for this is the small avalanche that dropped down from the Orleto Hill and took the lives of 11 people.

The region is with a well-developed infrastructure and is visited all the year round. This also presupposes more avalanche incidents. A significant part of the avalanches are caused by the tourists themselves.

An important snow-keeping significance has the plant coverage. By relevant activities the formation of avalanches can be significantly decreased.

The avalanches arise most frequently along the steep slopes of the glacial through valleys of the rivers Malyovitsa, Urdina, Skakavitza, Prav Iskar, Dupniska Bistritza, Drushliavitza, etc. as well as along the circus walls of all circuses in the region. At certain conditions even with the winter marking there is not a completely safe road.

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Chapter 10
Management of Snow Avalanche Risk in the Ski Areas of the Southern Carpathians-Romanian Carpathians

Case Study: The Bâlea (Făgăraş Massif) and Sinaia (Bucegi Mountains) Ski Areas

Mircea Voiculescu and Florentina Popescu

Abstract Snow avalanches represent an undeniable reality in the Southern Carpathians both as a geomorphologic process and as a type of natural risk with the highest number of fatalities and injuries and also substantial impact upon forests, highways and people. This study focuses on the Făgăraş massif and Bucegi Mountains, representative mountain units in the eastern part of Southern Carpathians with altitudes surpassing 2,500 m, large quantities of snowfall, between 6 and 8 months/year of snow depth and high occurrence of snow avalanches. The importance of management of snow avalanche risk resides in the fact that these mountains represent an attractive tourist area and have a high winter sports potential.

Keywords Management · Snow avalanches risk · Ski areas · the Southern Carpathians

10.1 Introduction

Management of snow avalanche risk represents a stringent aspect in several countries with a large proportion of mountain covered areas which are endowed with characteristic and complementary winter tourist activities in Europe, Canada and the United States. Snow avalanche risk has an important impact on human life (Fuchs and Bründl, 2005; Höller, 2009) and implicitly, on human activities such as skiing (Höller, 2007, 2009; Stethem et al., 2003) or other economic activities (Höller, 2009; Keiler et al., 2006). Winter tourism is a very important economic activity (Rixen et al., 2003). Alpine skiing as attribute of winter tourism, and in the same time sport activity, has generated an entire industry within mountain areas (Agrawala,

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G. Zhelezov (ed.), *Sustainable Development in Mountain Regions*, 103
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2007; Bürki et al., 2005; Hudson, 2002; Lew et al., 2008). Winter sports entail a series of investment as far as blue-printing, infrastructure and connected activities are concerned and they are destined for a tourist segment that is willing to invest time, money and physical effort.

This item becomes important through its affiliation to the global concern regarding the relationship between tourist practices, especially skiing, and natural risk within mountain areas, in the present case (Casale and Margottini, 2004; Herwijnen and Jamieson, 2007; Quinn and Phillips, 2000; Schweizer and Camponovo, 2001; Schweizer and Jamieson, 2001; Schweizer and Lütschg, 2001).

Snow avalanches are one of the most important natural risks and hazards of the mountain environment in ski areas and cause each year several fatalities (Höller, 2007; Jamieson and Stethem, 2002; Keiler, 2004; Keiler et al., 2005; Voiculescu, 2009) and serious damages upon human settlements and infrastructures (de Scally, 1994; Fuchs and Bründl, 2005; Fuchs et al., 2004, 2005; Jamieson and Stethem, 2002; Stethem et al., 2003; Voiculescu, 2009).

The purpose of this chapter is to present the state of the management of snow avalanche risk in two of the most representative mountain areas of Southern Carpathians, Bâlea ski area of the Făgăraş massif and Sinaia ski area of the Bucegi Mountains. These are known for their natural potential with regard to ski practices, but also for the high incidence of snow avalanches, some even triggered by skiers.

10.2 General Facts of the Studied Area

The Făgăraş Massif is situated in central Romania at the intersection of the 45° 30′ parallel with the 24° 30′ meridian, within the Făgăraş group from the Southern Carpathians (Fig. 10.1).

They are also known as the Transylvanian Alps due to their high altitudes that surpass 2,400–2,500 m (Modoveanu Peak-2,544 m, Negoiu Peak-2,535 m), their massiveness, their sharp glacial crests, their inherited glacial landforms (cirques and glacial valleys), but also due to their present periglacial processes of high spatial dynamics. The Făgăraş massif occupies over 1,500 m^2 and the alpine level, which represents the basis for skiing activities, occupies around 438.5 km^2, from which 148.8 km^2 is on the northern slope and 684.7 km^2 on the southern slope (Voiculescu, 2002). In the Făgăraş massif, skiing takes place traditionally in the Bâlea glacial area which includes the cirque and the glacial valley (Fig. 10.2). If until the 1989 Romanian Revolution, only the alpine skiing was practiced here, afterwards and especially in the latest years the skiing activities have been extended towards snowboarding, heli-skiing and especially towards free-ride and free-style skiing; which therefore complete the range of tourist activities practiced in the Făgăraş Massif and which pertain to the alternative forms of tourism according to Beedie and Hudson (2003), to Buckley (2006) and to Pomfret (2006).

It is the only area which apart from a good accommodation infrastructure has also ski trails. These trails are neither contoured nor smoothed during summer and during winter do not have buoys delineating their extent, nor do they have warning

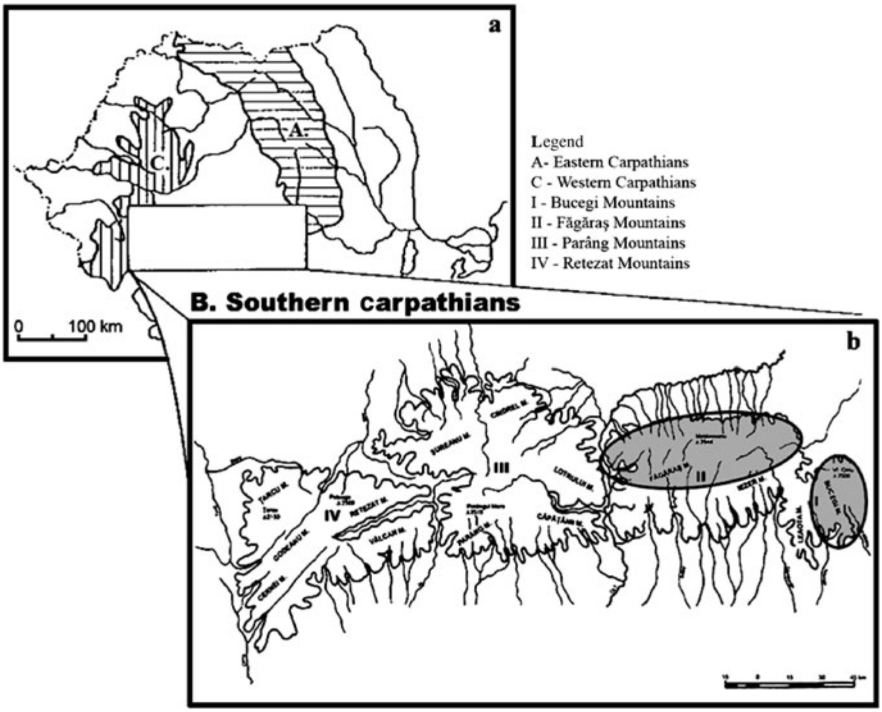

Fig. 10.1 The geographic location of Făgăraş massif and Bucegi Mountains

signs related to avalanche danger. As for cable transportation this ski area has only one cable car.

The Bucegi Mountains are located in the eastern part of the Southern Carpathians, within the mountain group that bears their name (see Fig. 10.1). The Bucegi Mountains are bordered by cliffs to the east towards the Prahova Valley, to the west towards the Rucăr-Bran-Dragoslavele Corridor and to the northern side towards the Braşov Basin and by the Ialomiţa's Subcarpathians in the south. They have the form of an amphitheatre with its opening towards the south, where the Ialomiţa Valley lies. The highest altitudes are concentrated in the northern part. The foremost important orographic knot is situated in the northern part of the Bucegi Mountains and is represented by the Omu Peak-2,505 m. The mountain mass appears as being suspended, the altimetry differences oscillating between 1,200 m, above the Prahova river (favourable element for the implementation of ski trails, due to the relief's high potential) and 500 m on the western part where the Rucăr-Bran corridor is located.

The most important ski area of these mountains is to be found in their southern part. This area pertains to the resort of Sinaia, covers about 116 ha (Bogdan, 2008) and it is divided into two sectors (Fig. 10.3).

This ski area is endowed with three cable cars, two chair lifts and only one ski lift. Apart from these, unfortunately, there are five more ski lifts which are dysfunctional at the present moment.

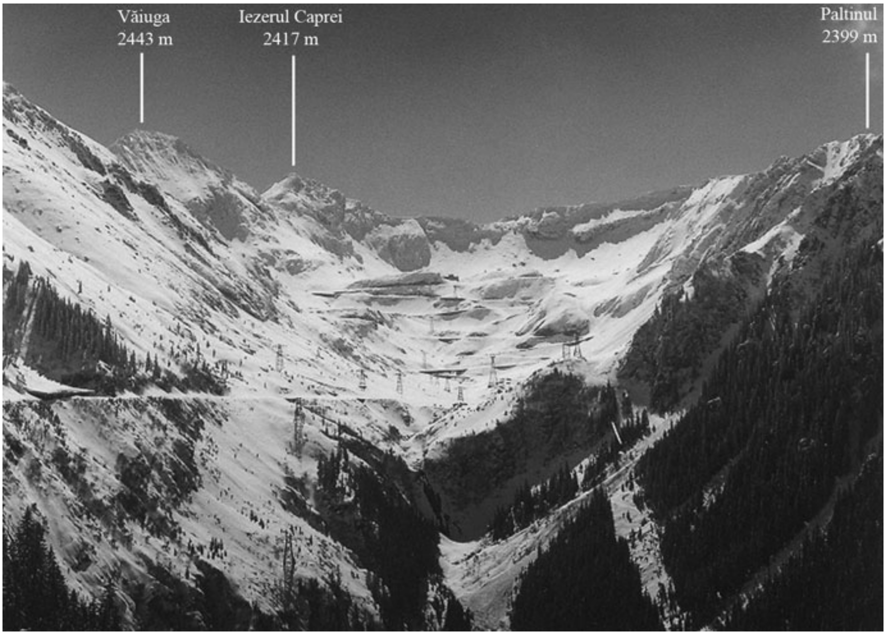

Fig. 10.2 Bâlea ski area (by Voiculescu, 2005)

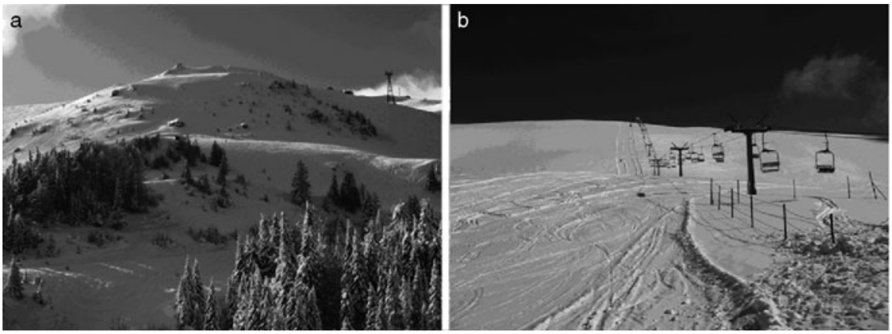

Fig. 10.3 Sinaia ski area, Carp sector (on the *left*) and Valea Dorului sector (on the *right*) (photos by Voiculescu, 2007 and Popescu, 2008)

10.3 Terrain and Climatic Analysis as Favourable Elements for Ski Practices

The ski natural potential is favoured first and foremost by the parameters of two components of the mountain environment (Jamieson and Johnson, 1998; McClung and Schweizer, 1999; Schweizer and Jamieson, 2001): terrain factors and climatic variables.

10.3.1 Terrain Factors

Terrain factors are represented by elevation, slope and aspect. Altitude is essential for skiing activities, and for the latitude of temperate climate in which our country is located, it has to be of at least 1,000 m (Besancenot, 1990) in order to maintain a favourable snow layer for at least 3 months/year.

Slope represents another factor of great importance for skiing activities. This is the element that separates the categories of this activity's practitioners into two large categories: skiers and beginners. The first category was defined as *users of skis, snowboards or other gravity-propelled recreational devices whose design and function allow users a significant degree of control over speed and direction on snow* (Penniman, 1999, p. 36) and as for beginning skiers or beginners as: *those individuals who are using one or another of these devices for the first time or who possess marginal abilities to turn or stop on slopes with incline greater than 20%* (Penniman, 1999, p. 36).

Performing a more analytical classification in accordance with the degree of slope declivity there have been established the following categories: beginners or novices that make use of slope gradients with a declivity not higher than 11.5°, intermediates that use the slope gradients between 18 and 19°, advanced, who use the slope gradients of 19° and experts who use slope gradients that surpass 19° or even 39° (Borgersen, 1977, quoted by Penniman, 1999; Gaylor and Rombold, 1964, quoted by Penniman, 1999). For economic exploitation we need to consider the slopes between 10 and 45°. Any ski area needs to comprise all the categories of slope gradients. It is a well known that most of the skiers would rather ski on slopes under 30° and that the beginners will usually not surpass the ones over 10°.

Using the applications of some GIS programmes (CartaLinx, Idrisi Kilimanjaro, ArcGIS) and making use of their working methods (Török, 2001–2002), we have created the digital elevation model (Fig. 10.4) which we used in generating the thematic maps (elevation, slope and aspect) for the Bâlea ski area and for the Sinaia ski area (Figs. 10.5 and 10.6).

The altitude of the ski trails is a crucial element for practicing the specific activities. The Bâlea ski area is situated at high altitudes where skiing is practiced on the glacial cirque walls, just under the cliffs, within the cirque, but also along the glacial valley. The elevation map highlights this mathematic element (Fig. 10.5).

The Bâlea ski area is endowed with trails that are not groomed or even named, for that matter, which have high slopes, and can only be used by expert or advanced skiers. The slope map points out the high degree of declivity for the studied area. The values between 1 and 15° represent 6.9% (3.4 km^2), the values between 15 and 25° represent 18.1% (9 km^2), the values between 25 and 35° represent 11.1% (5.52 km^2), the values between 25 and 35° represent 33.2% (16.4 km^2), the values between 35 and 45° represent 31.8% (15.8 km^2) and the values above 45° represent 9.5% (4.7 km^2) from the total of the Bâlea area.

Another important topographic factor is the aspect of the slopes, especially because it influences the insulation and the presence of the wind. For this purpose we have constructed the aspect map. For the Bâlea ski area the aspect map shows

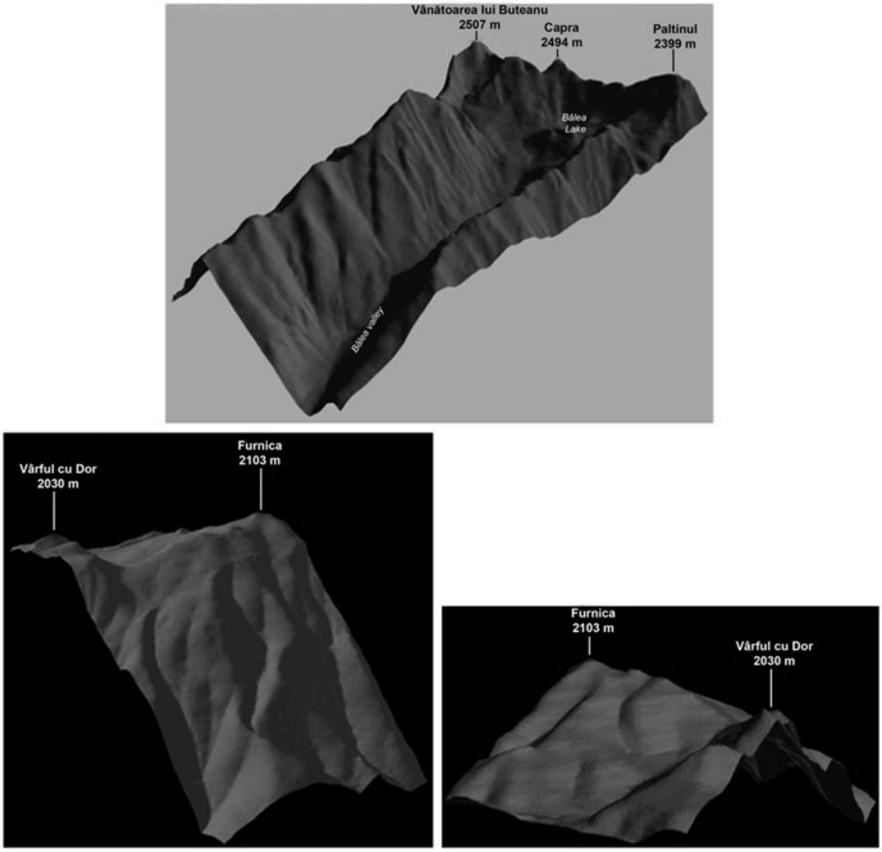

Fig. 10.4 Digital Model of Terrain of Bâlea ski area (on *top*), of Carp ski sector of Sinaia ski area (*bottom left*) and of Valea Dorului ski sector of Sinaia ski area (*bottom right*)

that western slopes cover 27.1% (1.86 km^2) of the area, the north-eastern slopes 20.3% (1.39 km^2) and the eastern slopes 19.5% (1.34 km^2).

Within this topographic context, the ski trails in the Bâlea area are especially prone to the advanced and expert skiers which practice free-ride or free-style skiing. Unfortunately, under these circumstances, the danger of producing snow avalanches is imminent and therefore human victims, fatalities and wounded are registered.

The Sinaia ski area has gradually enlarged its surface, the number of trails and their length: from 85.1 ha and 12 trails with a length of 15.1 km in 2001 (Ţigu, 2001), to 16 trails measuring 23.01 km (Bogdan, 2008) and even to 24 trails with a total length of 22.3 km (according to INCDT, 2009). The average declivity of this ski area ranges between 25 and 30°, which compels with the skier's preference (of under 30°), but neglects or overworks the beginners.

Within the Sinaia ski area there are 24 trails (Table 10.1) of which 11 are for expert skiers, which hold a percentage of 45.8% of the total, 6 are for advanced skiers, which represent 25% of the total area and 7 are for beginner skiers, which represent 29.1% of the total.

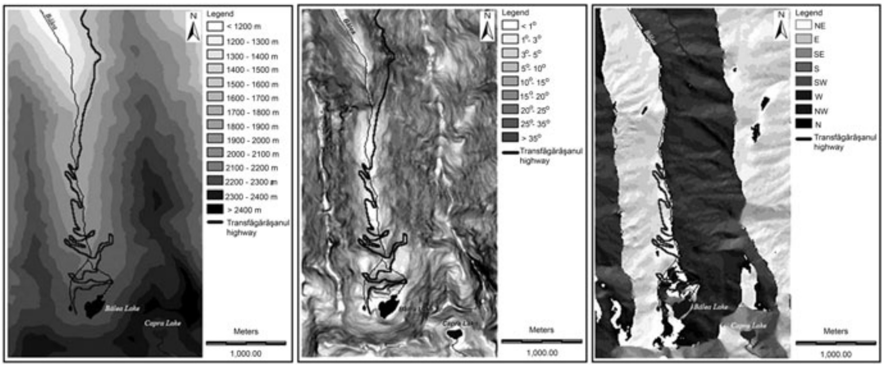

Fig. 10.5 Bâlea ski area – hypsometric map (*left*), declivity map (*centre*) and the aspect map (*right*)

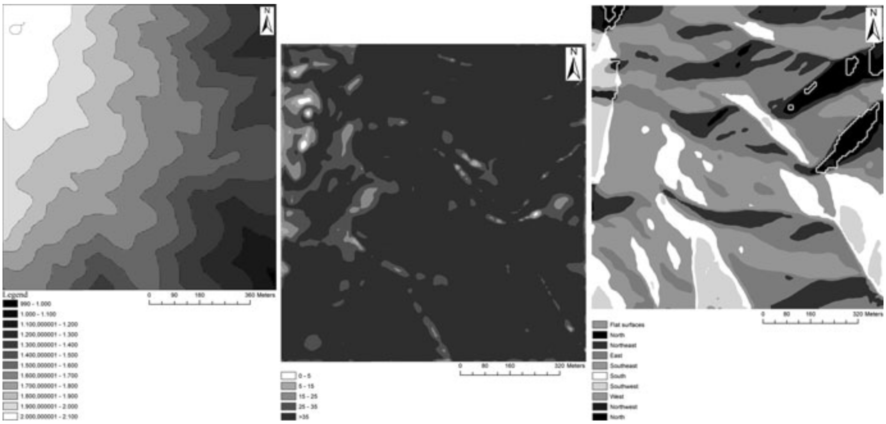

Fig. 10.6 Sinaia ski area – hypsometric map (*left*), declivity map (*centre*) and the aspect map (*right*)

The mathematic parameters of the terrain underline the high potential of the Sinaia ski area for tourist practices. Therefore the altitude of the ski trails is relatively high, around 2,000 m for both sectors of the ski area – Carp and Valea Dorului (Fig. 10.6). The slopes map emphasizes the predominance of high values, explaining the classification of trails predominantly for expert and advanced skiers (see Fig. 10.6). The aspect map shows two different situations: within the Carp area eastern slopes are predominant, while in the Dorului Valley the western orientation is predominant, both profiting from good insulation. In detail, especially for the Carp area, we note the eastern, south-eastern and north-eastern aspect, the latter favouring the persistence of snow until late spring. Small surfaces have south and south-western aspect, which have a good insulation, slopes between 25 and 35° and no woodland vegetation. These are prerequisite conditions of snow avalanche triggering, which influence the winter tourism and ski practices (see Fig. 10.6).

Table 10.1 Characteristics of Sinaia's ski trails (INCDT, 2009)

NR.	Trail name	Difficulty	Length(m)	Vertical drop (m)
1.	Carp (Vârful Furnica – Cota 1400)	Expert	2, 500	585
2.	Carp, Călugărul	Expert	800	400
3.	Carp, firul văii	Expert*	1, 200	300
4.	Carp faţa ascunsă	Expert*	150	60
5.	Carp faţa mare	Expert*	300	200
6.	Târle	Expert*	250	150
7.	Papagal (Telescaun – Cota 1400)	Expert*	300	180
8.	Valea Mioriţei	Expert*	500	250
9.	Spitz	Expert**	400	250
10.	Furnica	Expert**	600	350
11.	Vânturiş (Vârful cu Dor – Cota 1400)	Expert**	250	180
12.	Drumul de vară	Advanced***	2, 350	560
13.	Scândurari	Advanced***	400	180
14.	Valea Dorului-dreapta (Vârful cu Dor – Cabana Valea Dorului)	Advanced***	600	210
15.	Valea Dorului-stânga (Vârful cu Dor – Cabana Valea Dorului)	Advanced***	600	210
16.	Valea Soarelui (Vf. Furnica – Cabana Valea Dorului)	Advanced***	1, 180	210
17.	Valea Dorului-firul văii	Advanced***	1, 080	210
18.	Turistică (Cota 1400 – Sinaia)	Beginner****	2, 800	460
19.	Valea Soarelui-firul văii	Beginner****	900	210
20.	Laptici	Beginner****	650	180
21.	Drumul Vechi	Beginner****	3, 500	450
22.	Furnica – Platou	Beginner****	500	75
23.	Popicărie	Beginner****	300	50
24.	Poiana Stânii	Beginner****	200	25

Expert – trail recommended for experienced skiers; Expert* – off-trail terrain recommended for experienced skiers; Expert** – off-trail terrain, recommended for experienced skiers, can be accessed only by foot, have a high risk factor; Advanced*** – trail recommended for advanced skiers; Beginner**** – trail recommended for beginner skiers

10.3.2 Climatic Variables

The climate through its variables becomes an important tourist resource (Besancenot, 1990) and is analyzed considering the snow depth with regard to the ski activities, being safe to say we have a snow-reliable area if: *in seven out of ten winters there is snow covering of at least 30 cm on at least 100 days between 1 December and 15 April* (Becken and Hay, 2007, p. 38).

Romania is located within the temperate-continental climate zone which is characterized by large quantities of snowfalls and snow avalanches specific to maritime and transitional climate (Birkeland and Mock, 2001; Hägeli and McClung, 2004;

McClung and Schaerer, 1993; Mock, 1996; Mock and Birkeland, 2000). As a consequence of its geographic position, many types of climatic influences can be identified on the mentioned ski areas. The northern slope of the Făgăraş massif, where the ski area of Bâlea can be found, is under the humid oceanic influences. The Sinaia ski area is under continental influences. Therefore, the regional climate also determines the solar radiation, temperature, snowfall quantity and type of snow (McClung and Schaerer, 1993; Zingg, 1966). Characteristics of the climate of the Făgăraş massif are registered at the weather stations of Bâlea Lake (2,070 m) and Cozia (1,577 m) and at the weather stations of the Bucegi Mountains at Vf. Omu (2,505 m) and Sinaia (1,500 m). The collected values were subsequently analyzed to produce average annual values (Table 10.2):

Snow is the very important resource for winter tourism, especially for skiing (Breiling and Charamza, 1999). Snow cover and duration play a major role in environmental and socioeconomic practices within mountain regions (Beniston, 1997, 2003; Beniston et al., 2003).

On the other hand, the number of days with snow layer (Fig. 10.7) is another important factor for ski practices. This parameter is subjected to altitude variations but also to local conditions.

Therefore for the Bâlea area the highest values are registered within the December–March interval, the total number within the October–May interval summing up 150 days. For the Sinaia ski area, the highest values regarding the days with snow layer is reached within the November–March interval at the highest altitudes and November–April in the middle and lower part of area. The total number of days with snow layer is of 224 at the highest altitudes, around 66 in the middle and only 45–46 days in its lower part. Therefore we can ascertain that in the case of the Bâlea ski area also in the case of the higher part of the Sinaia ski area the prerequisite condition of a minimum of 100 days of snow depth, as it is stated in the dedicated literature (Becken and Hay, 2007; Besancenot, 1990) is accomplished. In order for skiing to take place in good conditions, it is necessary that the snow depth be of at least 30 cm (Agrawala, 2007; Becken and Hay, 2007; Besancenot, 1990; Freitas, 2005; Hall and Higham, 2005). In accordance with the snow depth, we have determined the type of the seasonal variation of snowfall or the type of nivometric regime (Besancenot, 1990), so that for the Bâlea Lake ski area the characteristic nivometric regime is bimodal which is characterized by a secondary maximum of the snow depth in February and the main maximum in April, and between the two existing a relative winter minimum. This type of regime is characteristic for high altitudes. For the Sinaia ski area we noticed a mutation from the monomodal regime, with a single maximum in the middle of winter towards the type of balanced regime, displaying similar quantities of snowfall in the months of December, January and February. Towards the highest altitudes the type of nivometric regime is bimodal as well (Fig. 10.7).

The necessary 30 cm of snow are provided in all cases (Agrawala, 2007; Becken and Hay, 2007; Besancenot, 1990; Freitas, 2005; Hall and Higham, 2005) (see Fig. 10.7).

Table 10.2 Main climatic characteristics of the Făgăraş massif and the Bucegi Mountains

		T°C								
Meteo St.	Sun rad. (Kcal/cm^2)	Ann.	Number of cold nights t°min≤–10°C	Number of winter days t°max≤0°C	Number of freezing days t°min≤0°C	Pp. (mm)	Humid. (%)	Days with snow	Depth of snow (cm)	Sunny days with snow cover
Vf. Omu (2,505 m)	92–93	–2.5	95.2	144.9	254.5	1,134	87	>220	37–38	34.8
Bâlea Lake (2,070 m)	80–100	0.2	68.2	120	207.9	1,246.2	83	>150	66–67	30.4
Cozia (1,577 m)	–	3	37.7	89.1	164.7	844.2	–	63–64	39–40	26.1
Sinaia (1,500 m)	–	3.7	37.7	72.2	163.3	1,226.9	78	90.6	29.1	32.8

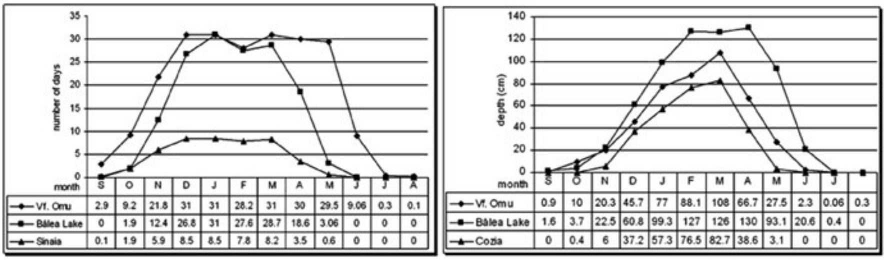

Fig. 10.7 The variation of number of days with snow depth within the Bâlea and Sinaia ski area (on the *left*) and the nivometric type of regime in the Bâlea and Sinaia ski areas

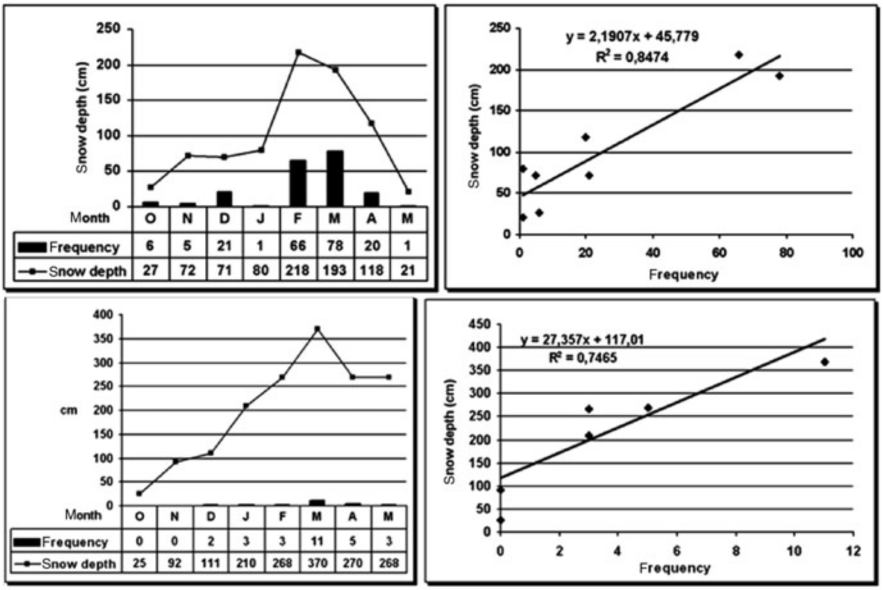

Fig. 10.8 Correlation between snow depth and snow avalanches, between 2005–2006 and 2006–2007

With regard to the same issue, the snow avalanche climatic potential, we have analyzed the relation between snow depth and the snow avalanche frequency in years with considerable snowfall (Fig. 10.8):

10.4 The Management of Snow Avalanche Risk

The Făgăraş massif is characterized by high snow avalanche activity, especially in the Bâlea ski area. Many snow avalanches are triggered by skiers as it is mentioned in several works (Grímsdóttir and McClung, 2006; Schweizer and Camponovo,

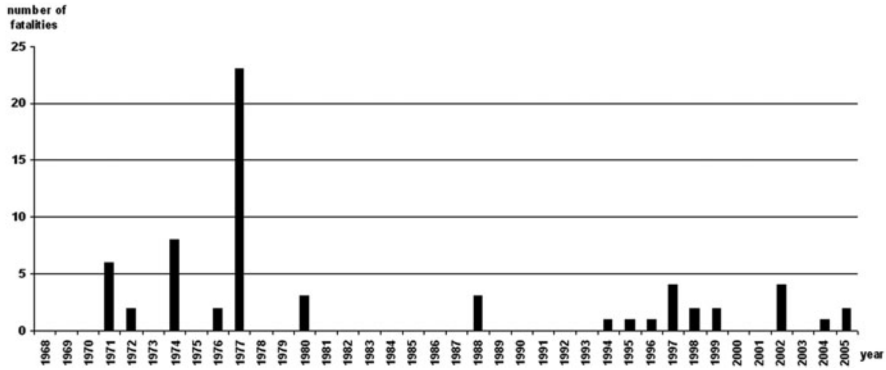

Fig. 10.9 Number of fatalities in Făgăraş massif, between 1968 and 2005

2001; Schweizer and Lütschg, 2001; Tremper, 2001). The statistics department of the Mountain Rescuers from the Sibiu County registered the largest number of accidents (Fig. 10.9) in the whole Carpathians over the course of time (Voiculescu, 2009). Here, in the Bâlea glacial cirque, on April 17, 1977 a huge snow avalanche took place and killed 23 skiers. Also other accidents with fatalities and buried under avalanches have been noted in the Bâlea glacial cirque and on the right side of the Bâlea glacial valley (Fig. 10.10).

Within the Sinaia ski area the frequency of snow avalanches does not have the intensity of the ones in the Făgăraş massif. Nevertheless, due to the large number of skiers, in the last 10 years and also due to the terrain and climatic factors which are favourable for skiing, here accidents also occurred (Fig. 10.11) which determined the local authorities to take some precaution measures.

According to topography and the new measures undertaken, especially after the year 2003, we can consider two large categories of management of snow avalanche risk. Thus, especially in the Bâlea ski area of the Făgăraş massif where snow avalanche activity is considerably high, we can identify the old, traditional forms of management of snow avalanche risk. In this category we include snow sheds, snowpack support structures, drainage systems and deflecting dikes as in other areas affected by snow avalanches (Höller, 2007, 2009; Jamieson and Stethem, 2002). All these appeared in Făgăraş massif at the same time with the construction of Transfăgărăşan highway between 1970 and 1974 (Fig. 10.12), but also for the safety of skiers.

In the Sinaia resort of the Bucegi Mountains the attention upon management of snow avalanche risk was drawn quite recently, due to several accidents that took place here. This mainly consists of delineating the ski trails by signs and marking the difficulty degree on the already mentioned signs, but also of the implementation of snowpack structures where the occurrence of snow avalanche is imminent, which are the most common and the most efficient form of avalanche preventions. Also warning signs as the ones met in other mountain areas have been implemented (Weir, 2002), which read “Danger of avalanches” or “Trail closed during winter” (Fig. 10.13).

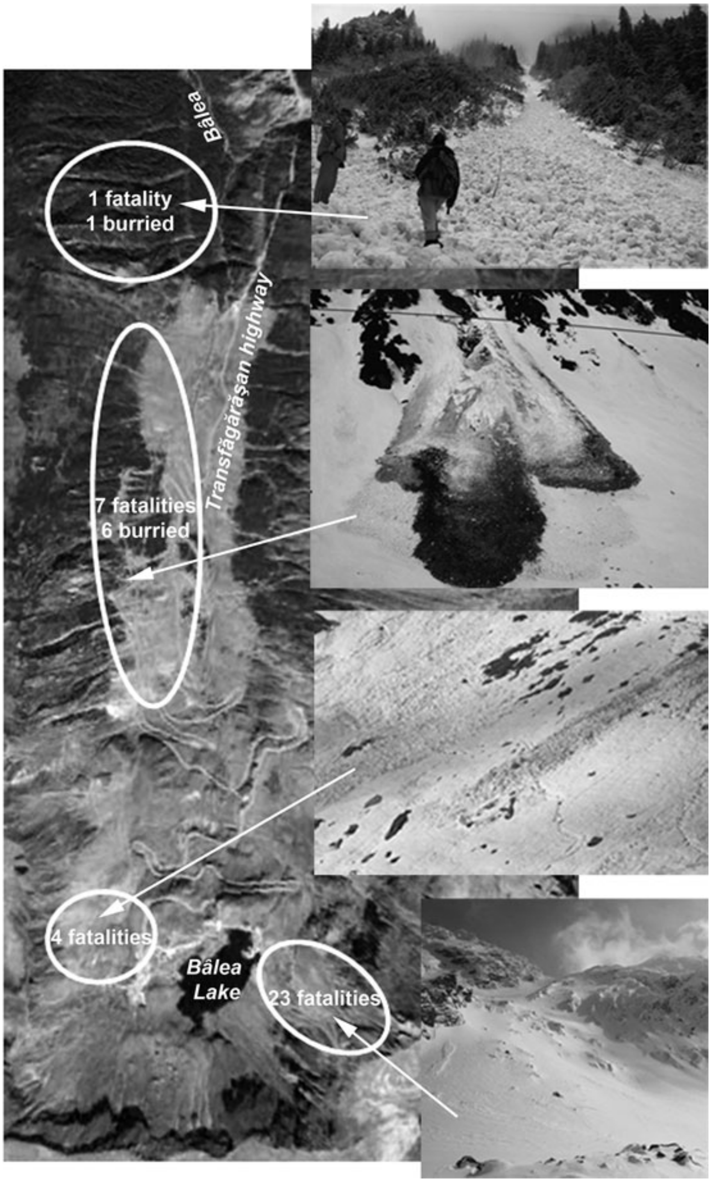

Fig. 10.10 Location of main important snow avalanches and number of fatalities and buried in Bâlea ski area (photos by David, 2010 and by Voiculescu, 2007, 2009)

On the other hand, starting with 2003 the management of snow avalanche diverted to other recent forms of managements required by topography. The first important step was in 2003 when the Programme of nivometeorology was created within the National Administration of Meteorology R.A. (Administrația Națională de Meteorologie) in partnership with Météo France, Centre d'Études de la

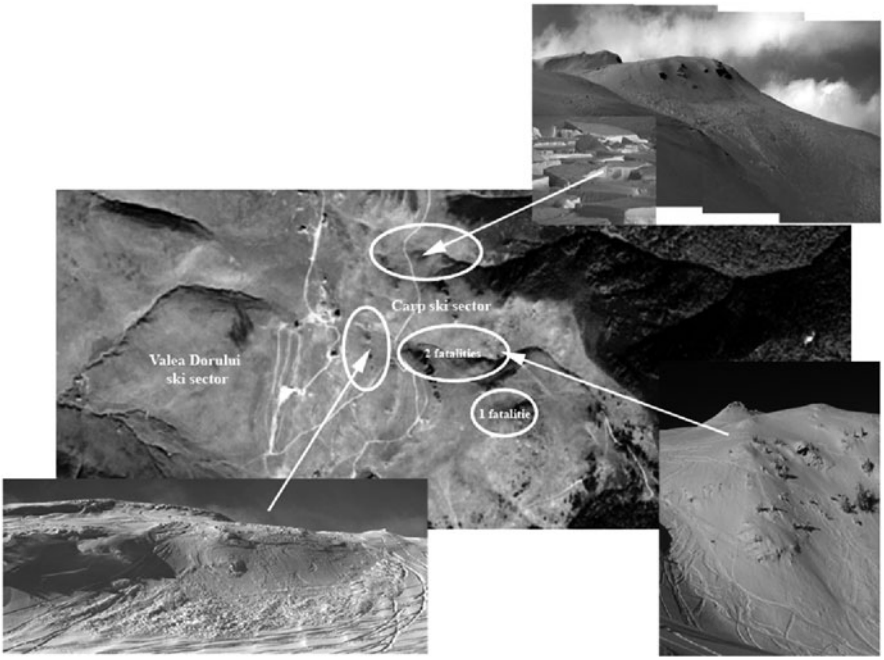

Fig. 10.11 Location of main important snow avalanches and number of fatalities and buried in Sinaia ski area (photos by Voiculescu, 2005)

Neige-Grenoble. The main purpose of the programme is to study snow and its future evolution as well as avalanche triggering conditions. The methodology used for the nivological programme is based both on classical observations and on the profile of snow layer resistance. All nivometeorological data is analyzed by means of two systems developed by Centre d'Études de la Neige-Grenoble known as GELINIV and CROCUS-MEPRA PC.

The nivometeorology programme has a Work Laboratory in the Făgăraş massif at Bâlea Lac. The laboratory studies snow conditions and monitors the frequency of snow avalanches in two glacial valleys: Bâlea on the northern slope of the massif and Capra on the southern. They represent attractive tourist areas and have a high winter sports potential. The second important step in the above-mentioned context is that the Nivometeorology Programme of the National Meteorology Administration R.A. (Administrația Națională de Meteorologie) apart from continuing its activity in the Făgăraş massif will expand in other mountain areas with high avalanche risk such as the Bucegi Mountains and Postăvaru Mountains. At the moment, there are only four points of snow research and snow avalanche hazard monitoring, all placed in the Southern Carpathians, in the Bucegi Mountains (in the Sinaia resort at Cota 1,500 m and at Vf. Omu –2,505 m) and in the Făgăraş massif.

It is an important fact that Romania has joined other European Union countries in both monitoring and snow avalanche hazard prevention; thus after the European

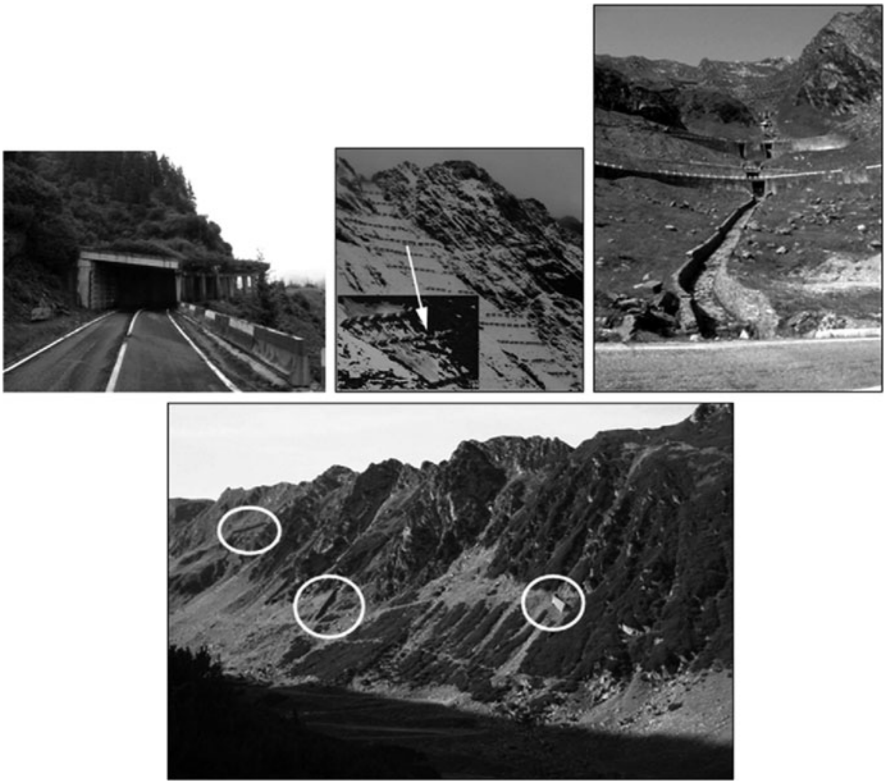

Fig. 10.12 Traditional forms of snow avalanche management: snow sheds (*top-left*), snowpack support structures (*top-centre*), systems drainage (*top-right*) and deflecting dikes (on the *bottom*) (photos by Voiculescu, 2004, 2008)

snow avalanche risk scale was launched in 1993–1994, Romania adopted it due to the need for unique snow avalanche prevention criteria. In this respect, there are permanent broadcasts regarding avalanche risks within periods with large quantities of snowfall according to National Administration of Meteorology (Administrația Națională de Meteorologie, 2004–2005, 2005–2006, 2006–2007, 2007–2008).

A large part of the Romanian Carpathians, such as Eastern Carpathians and Southern Carpathians (except the Western Carpathians), are areas exposed to avalanches. They are recorded in the European Spatial Planning Observation Network (ESPON). On the other hand, research institutes grant a heightened attention to the phenomenon. Therefore the Geographic Institute of the Romanian Academy is developing a general map (using ESRI GIS ArcView) of geomorphologic risks, including snow avalanche hazards. In this respect we need to mention that mapping snow avalanches on hazard maps, which include the zoning criteria *do not prevent avalanches, they reduce the probability of damage* (Höller, 2007, p. 96), and therefore are of high necessity within mountain areas with winter sports potential.

Fig. 10.13 The delineated trails and the snowpack support (on *top*) and the display panels (on the *bottom*) (photos by Popescu, 2009)

10.5 Conclusions

Unfortunately, the management of different natural risk does not yet represent a major concern. The increasing incidence of snow avalanches affects not only skiers, but also the entire economy of the ski areas. The responsible authorities for the management of the ski domains need to invest in:

– the surveillance of the phenomena;
– sending warnings through special services which would transmit meteorological and nivometric bulletins;
– drawing-up hazard maps on the mountain groups of the Southern Carpathians;
– emitting codes;
– risk reduction, the consolidation and extension of snow avalanches protection structures such as: deflecting dike, snowpack support structures, snow sheds and the introduction of explosive controls, as well as, artificial release of snow in ski areas and along roads;
– integrating and using the European avalanche risk scale, especially as Romania is part of the European Spatial Planning Observation Network (ESPON) Data base as far as mountain hazards are concerned;
– implementing standardized pennons (as in the French system) especially within ski domains (where the trail number and type or off trail would be stated) and to implement warning panels (European or North-American System);

– placing display panels which read, for example, “No Stopping” or “Avalanche Area” along the roads or in the ski areas (Weir, 2002) where snow avalanche hazard is imminent;
– establishing more nivology laboratories of the National Administration of Meteorology R.A. (Administrația Națională de Meteorologie) within mountains with snow avalanche risk in order to collect meteorological data useful for GELINIV and CROCUS-MEPRA PC programmes. Using these programmes the snow avalanche risk maps will be made as well as the warnings for skiers and tourists.

Also a more serious preoccupation regarding the use of preventive temporary or permanent measures needs to be undertaken. On the other hand, the management of crisis situations (present emergencies and future misfortunes) needs to be prepared and also the blue-prints of the territory need to be revised, by making snow avalanche zoning maps and other thematic maps of exposure to natural risk phenomena.

And last but not least, Romania needs to achieve international standards through the provision of a good education regarding the understanding and management of natural hazards or risk phenomena.

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Chapter 11
BEO Moussala – A New Facility for Complex Environment Studies

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Abstract The main areas of research at the Basic Environmental Observatory (BEO) Moussala, Rila Mountain, are the aerospace and terrestrial environment. The interactions between cosmic rays and Earth atmosphere, global change parameters and climate research, natural hazards and technological risks are the objectives of the investigations. Real-time measurements of basic parameters of space and atmosphere are carried out. The information is transmitted via a high frequency radio-telecommunication system to the Internet and is stored in a database for further analysis within GAW, EURDEP, EUSAAR and UNBSS international programmes. Ecotoxicological investigations are performed to study the mountain ecosystems. On-line data and detailed information about BEO Moussala are available at: http://beo-db.inrne.bas.bg

In 2009 the scientific research, carried out at peak Moussala, celebrated its 50th Anniversary.

Keywords High-mountain observatories · Cosmic rays research · Environmental studies · Global change · Aerosol research · Space weather

Abbreviations

BEO	Basic Environmental Observatory
CNRS	Centre National de la Recherche Scientifique
CRD – YPI	Cosmic Ray Division – Yerevan Physics Institute
EC	European Commission
ESF	European Science Foundation
EURDEP	European Radiological Data Exchange Platform
EUSAAR	European Supersites for Atmospheric Aerosol Research

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FP5	Fifth Framework Programme (1998–2002) – European Commission
GAW	Global Atmospheric Watch
HIMONTONET	Joining of Beo Centre of Excellence to European Network of High Mountain Observatories
IHY	International Heliophysical Year
ISO	International Organization for Standardization
NIMH	National Institute of Meteorology and Hydrology
OM2	French–Bulgarian integrated project for monitoring and management of high mountain ecosystems
SEVAN	Space Environmental Viewing and Analysis Network
UFS	Umwelt Forschungsstation Schneefernerhaus

11.1 Introduction

Mountain environment as a field for climate studies and recently for climate change has become a global issue. The first high-mountain research station in Europe – the High Alpine Research Station Jungfraujoch in the Swiss Alps, was set up in 1932, which laid a foundation for a chain of similar research stations.

The peak Moussala is the highest peak of the Balkan Peninsula – 2,925.4 m height a.s.l. (42°10′45″N, 23°35′07″E). It is remote from industrial and vehicle pollution. Peak Moussala is reached by the Mediterranean and the continental air masses because of its dominant geographical position over a vast area. Therefore it gives prospects for complex and comparative research of the impact of multiple influences.

BEO Moussala (Stamenov et al., 2007) was built as a facility with modern infrastructure and with all basic appliances for scientific investigation. Local and long range air transport (fine and ultrafine aerosols, coarse particles and gas pollutants), gamma background, climate change and cosmic rays – all this phenomena are monitored. Data for 38 substantial atmospheric and space parameters are stored in a database for retrospective analyses and modelling.

The real-time data are provided via the local measurement system and the telecommunication system to the database.

11.1.1 Climate Notes

The peak Moussala is the coldest place in Bulgaria (Mikhnevsky, 1997). The positive average temperatures take place about 4 months annually. The average wind speed is one of the highest in Bulgaria. The absolute humidity is very low but the relative humidity is high (Table 11.1).

Table 11.1 Basic meteorological parameters

Meteorological parameter	Value
Annual mean temperature	–3.1°C
Prevailing wind direction[a]	N-NE
Monthly mean wind speed	4.9–10.5 m/s
Annual mean wind speed	7.5 m/s
Annual mean rainfalls	1,000–1,300 mm

[a]BEO measurements (2003–2009)

11.1.2 The Station Chronology

1959 – Cosmic Ray Station was set up on peak Moussala
1983 – Cosmic Ray Station destroyed by fire
1993 – French–Bulgarian integrated project OM2 was started for monitoring and management of high-mountain ecosystems
1999 – Cosmic Ray Station was reconstructed and renamed as Basic Environmental Observatory Moussala
2002 – BEO Moussala – Centre of Excellence Award
2003 – BEO Moussala – ISO Certification
2007 – BEO Moussala became pan-European Research Infrastructure
2010 – BEO Moussala – Regional GAW station

The idea of constructing a Cosmic Ray Station on the peak Moussala was given by the prominent Bulgarian scientist Acad. G. Nadjakov and the famous Hungarian physicist Acad. L. Yanoshi. It was realized in 1959. Bulgarian school of Cosmic Rays was developed during a long period of productive common scientific work with the Hungarian group of physicists. The names of the leading scholars as Prof. L. Mitrani, Prof. N. Ahababyan, Prof. I. Kirov and Prof. J. Stamenov stand out in this group. Unfortunately, in 1983, the Moussala Cosmic Ray Station was destroyed by fire.

The station was rebuilt in 1999 with the financial support of the Bulgarian Ministry of Environment and Water and it has become a modern research facility. The measurements restarted, keeping the tradition in cosmic ray research and adding environmental monitoring via the French–Bulgarian project OM2 (Carbonel and Stamenov, 1997) (funded by the French Ministry of Exterior and Centre National de la Recherche Scientifique).

In 2003 BEO Moussala was certified by ISO 9001:2000 "Quality Management" (No3312/0) and ISO 14001:2004 "Environmental management" (No357/0).

In July 2007 BEO Moussala was validated by EC and European Science Foundation (ESF) survey as Research Infrastructure (# 563) of pan-European importance.

The technological status of the Observatory was improved substantially due to the successful HIMONTONET FP5 and BEOBAL FP6 projects implementation. The participation in FP6 EUSAAR and ACCENT projects has created the basis for further development of applied monitoring methods. BEO Moussala received the Center of Excellence Award in 2002. The station was accepted in 2010 in the GAW regional station group for the acknowledged significance of its location in the Eastern Europe as well for high-quality measurements carried out. A team of physicists, engineers and technicians has got together and contributed to the scientific findings at BEO Moussala.

The main feature of BEO Moussala station, after this long history and experience, is its complexity – from cosmic ray investigation to high-mountain monitoring and environmental research.

11.2 Environmental Measurements at BEO Moussala

The aerosols, the greenhouse and reactive trace gases are responsible for the thermal budget of the atmosphere and hence they affect the climate. The precise measurement of these parameters is the main objective of BEO Moussala and provides prospects for climate change studies.

The measurement systems at BEO Moussala (Photo 11.1) were basically set up in the period 2003–2007 in the frame of the EC projects. Some new devices (SMPS*,

Photo 11.1 BEO Moussala measurement station: (1) Automatic Weather Station (Vaisala); (2) Atmospheric gas analysing system (Environment S.A); (3) Aerosol measurement system (TSI, Itf-Leipzig); (4) Gamma background measurement (IGS421); (5) Telecommunication system (2,4 GHz) INRNE-BEO; (6) Cosmic Rays Research Systems

SEVAN*) were installed in 2008 (*see the text below). Since the beginning, the automatic measurement equipment has been connected to local network and the telecommunication system BEO-INRNE has provided real-time data to Internet.

11.2.1 Automatic Weather Station (AWS)

AWS has been operating since August 2003. It is equipped with basic sensors for: air temperature and relative humidity, atmospheric pressure, wind speed, wind direction and precipitation. The AWS provides important information for

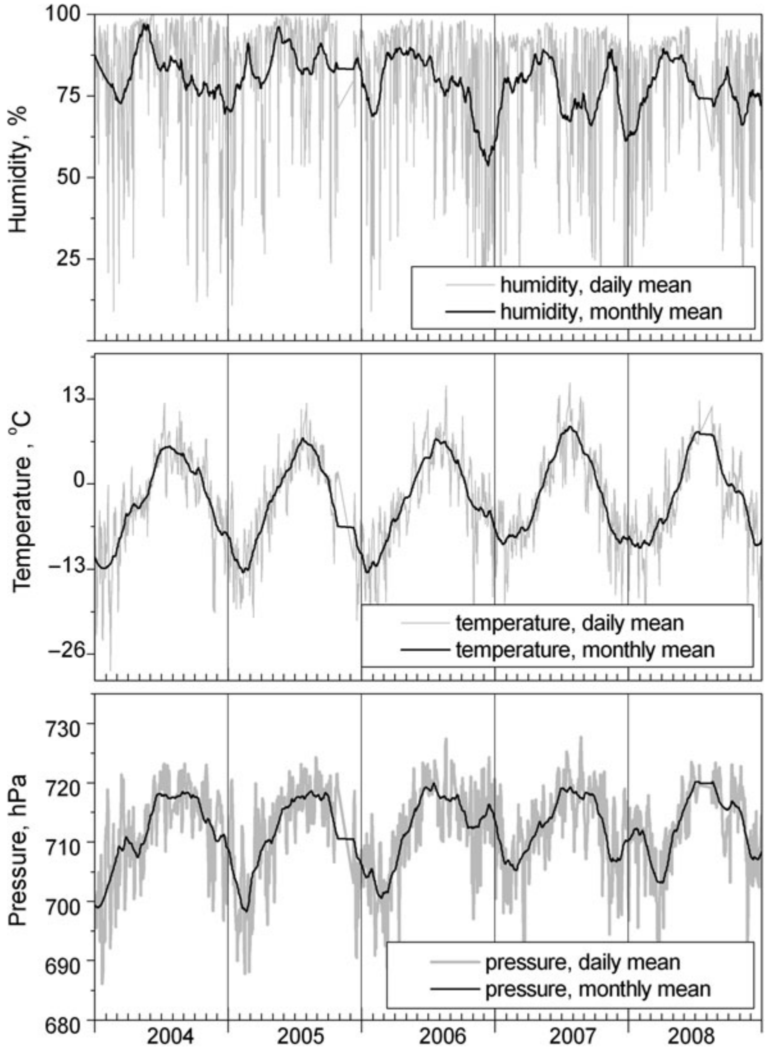

Fig. 11.1 Meteorological data trend 2004–2008: humidity, air temperature and atmospheric pressure at BEO Moussala

atmospheric conditions for the other systems. The sensor collector transmits the data to the computer. Data acquisition and transfer repeats every 10 min. The AWS is designed for heavy weather conditions. Figure 11.1 shows the trends from year 2004 to 2008. Wind till 2009 data show that till 2009 prevailing wind direction was North-Northeast (Fig. 11.2).

Meteorological measurements at peak Moussala have been carried out at NIMH station since 1932 with time resolution of 3 h. Data from both stations show close correlation (see Section 11.4).

UV-AB (280–400 nm) and UV-B (280–325 nm) sensors register the power of the UV radiation, which is very important for day-time atmospheric chemistry. Five video cameras watch the cloud system above the station.

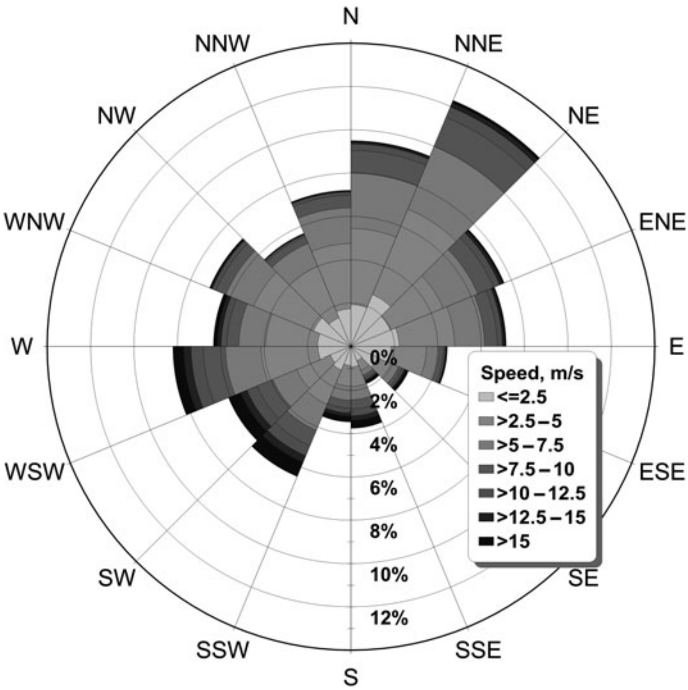

Fig. 11.2 Wind rose 2004–2008 from BEO Moussala data

11.2.2 Atmospheric Gas Analysis System

Greenhouse and trace gases measurements, which are important for climate change investigation, are performed by atmospheric gas analysing system (Table 11.2), (Figs. 11.3, 11.4, and 11.5). BEO Moussala is regional GAW Station since 2009 and provides data from the gas analysers and from the meteorological measurements to WDCGG (http://gaw.kishou.go.jp/wdcgg/). First results of ozone data analyses (Nojarov et al., 2009) were published showing a possible method for pollutants tracking.

Table 11.2 BEO Moussala gas analysers

Gas	Device	Measurement range
NO	AC32M	$NO\text{-}NO_2\text{-}NO_X$ from 0.4 ppb to 20 ppm
CO	CO12M	CO from 50 ppb to 200 ppm
SO_2	AF22M	SO_2 from 0.5 ppb to 10 ppm
O_3	O342M	O_3 from 0.4 ppb to 10 ppm
CO_2	CO12M	CO_2 from 1 ppm to 2,000 ppm

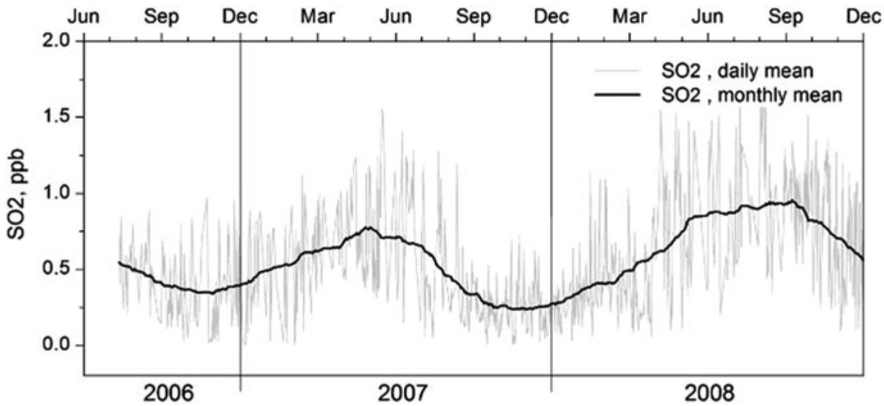

Fig. 11.3 SO_2 trend (2006–2008) from BEO Moussala

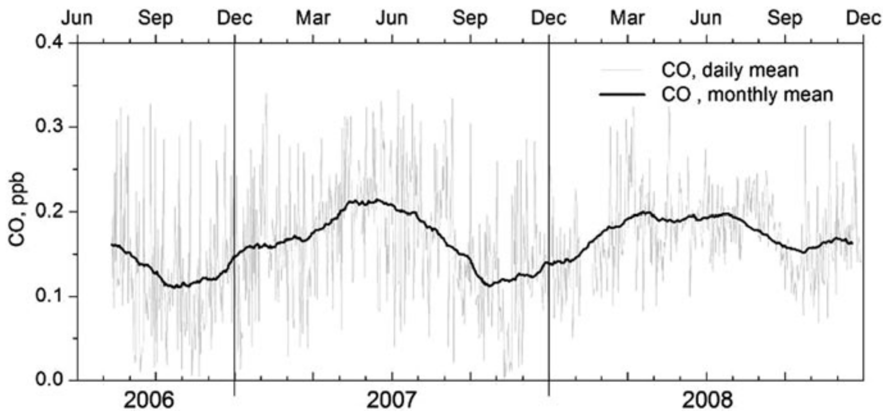

Fig. 11.4 CO trend (2006–2008) from BEO Moussala

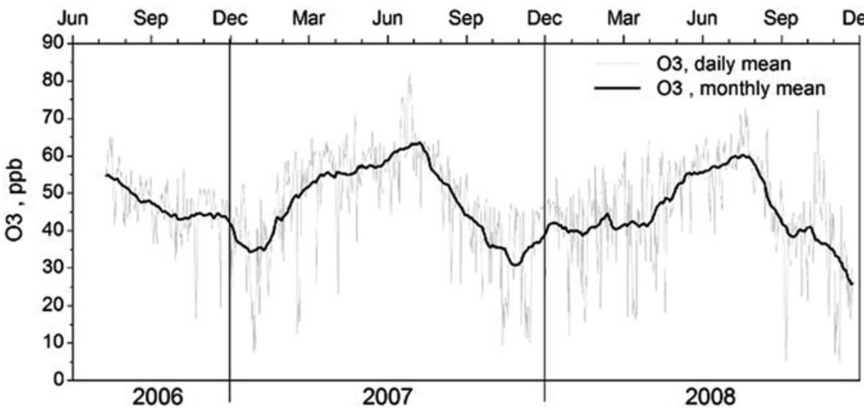

Fig. 11.5 O_3 trend (2006–2008) from BEO Moussala

11.2.3 BEO Moussala Aerosol Measurement and Devices

Scattering and backscattering coefficients of aerosols and aerosol size distribution are measured by integrating Nephelometer and Scanning Mobility Particles Sizer (SMPS).

11.2.3.1 Scanning Mobility Particles Sizer

SMPS is a spectrometric scanning measurement system for fine and ultrafine particles, which was put in operation in November 2008. The measurement range is from 10 nm to 1 μm size (Fig. 11.6). Its sensitivity and measuring range allow measuring of the most sensitive part of the atmospheric composition, subject to local and distant pollutants.

11.2.3.2 Nephelometer TSI3563

TSI3563 is a measurement device for scattering and backscattering coefficients of ambient aerosols/pollutants. It was put in operation in March 2007. Light scattering gives precise data for the amount of particulates/dust in the air. TSI 3563 is measuring in three-wave lengths – 450 nm (blue), 550 nm (green), 700 nm (red), which are sensitive to different particle size scattering and pollutants. The annual cycle of aerosols in year 2009 is shown in the Fig. 11.7.

11.2.4 System for Measurements of Radioactivity in Aerosols

The system includes an air turbine, a filter device, a press for preparing the samples for measurement, Ge-spectrometer and a programme for analysis of gamma

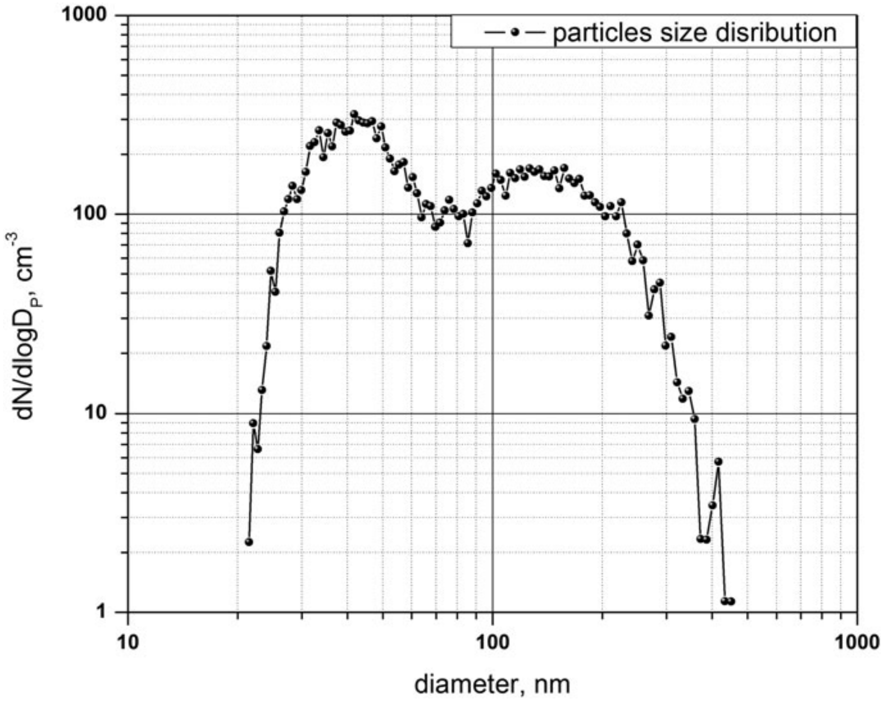

Fig. 11.6 Typical aerosol size distribution in ambient air at BEO Moussala

spectra (Penev et al., 2007). All of them have been developed in INRNE. The air turbine allows 1,500–1,800 m^3 per hour passing through the fibre filter, which is type FPP-15-1.5 with high efficiency: 94–99%. The filter size is 50 × 50 cm. The filter, after the sampling, is pressed to the pill with a diameter 57 mm, and a thickness of 15 mm. The appearance in the atmosphere of Be^7 is a result of deep spallation reaction as a process of interactions between the high energy cosmic particles with the atmosphere. Be^7 quantity gives information for powerful atmospheric process – intrusion of high atmospheric layers. From the results obtained during the recent years several conclusions could be drawn:

– Be^7 integral quantity for a specific place is determined by several factors – mainly by atmospheric processes (including intrusion from stratosphere to troposphere), changes in the intensity of cosmic rays (solar and galactic).
– Be^7 quantity (as a tracer for air masses origin) could serve as additional information for short-term meteorological prognoses

Only activity of the U-Th products was detected in the aerosols at peak Moussala including Be^7, which is well-known product of the cosmic rays. Typical products of the human activity, like Cs^{137} and I^{131}, have not been detected.

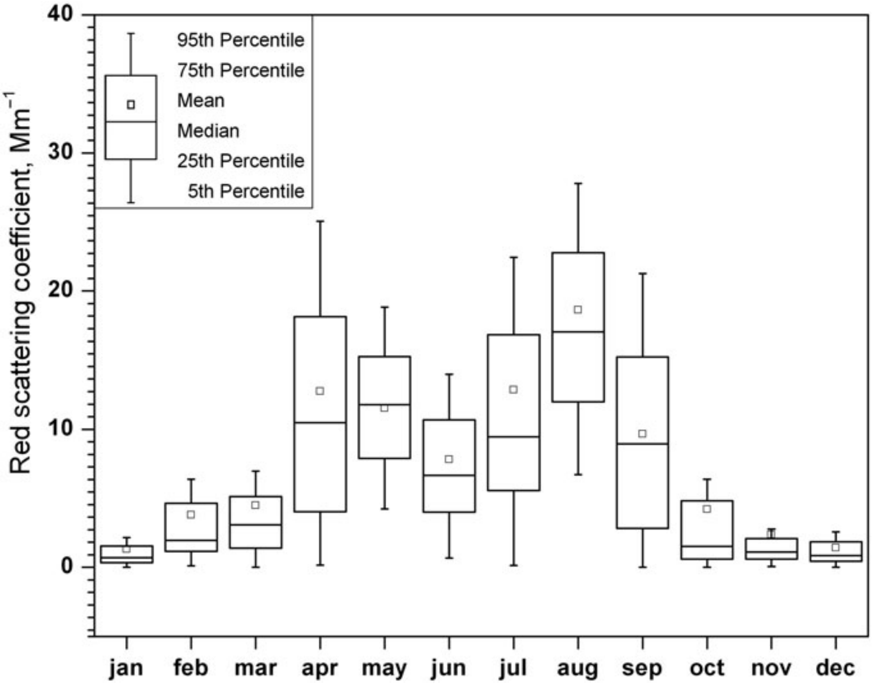

Fig. 11.7 Annual cycle of aerosols in year 2009

11.2.5 BEO Moussala Gamma Background Measurement

Ambient equivalent dose rate is measured by IGS421B1 gamma probe consisting of three Geiger-Muller counting tubes with a sensitivity range from 10 nSv/h to10 Sv/h.

11.3 Cosmic Ray Research at BEO Moussala

11.3.1 Muon Telescope

The telescope has been operating since August 2006. It has surface of 1^2 m and an energy threshold of 0.5 GeV. The time variations of cosmic ray muon flux are measured incessantly in five directions. Connecting the instrument to the existing networks (Neutron Monitors and Muon Detectors Network) for cosmic rays and space weather studies, after the upgrade of the data acquisition software, is planned. These data are also used for probable correlations research between CR intensity and environmental parameters (Fig. 11.8). In Fig. 11.9 is shown Forbush decrease which was detected on 13 December 2006 (Angelov et al., 2009) with an amplitude approximately 4% of the intensity of the muon component of the cosmic rays

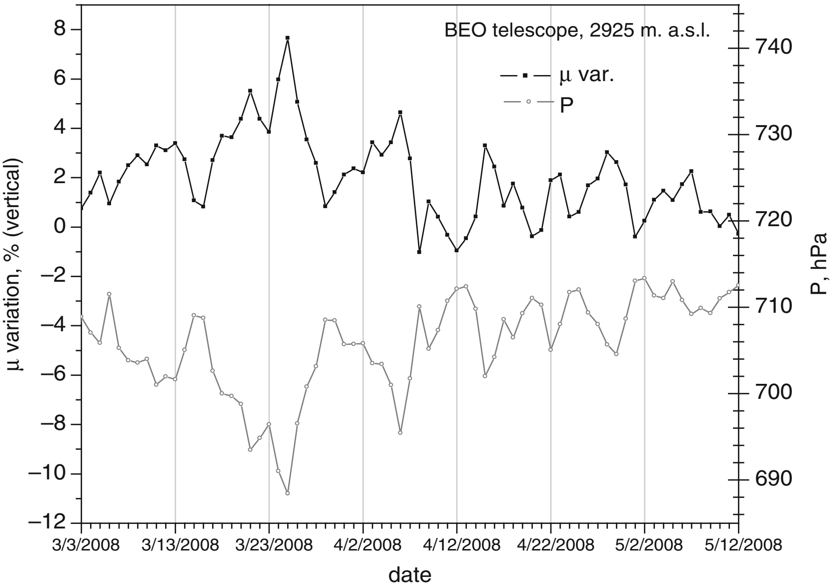

Fig. 11.8 Anti-correlation atmospheric pressure – Cosmic muon flux intensity

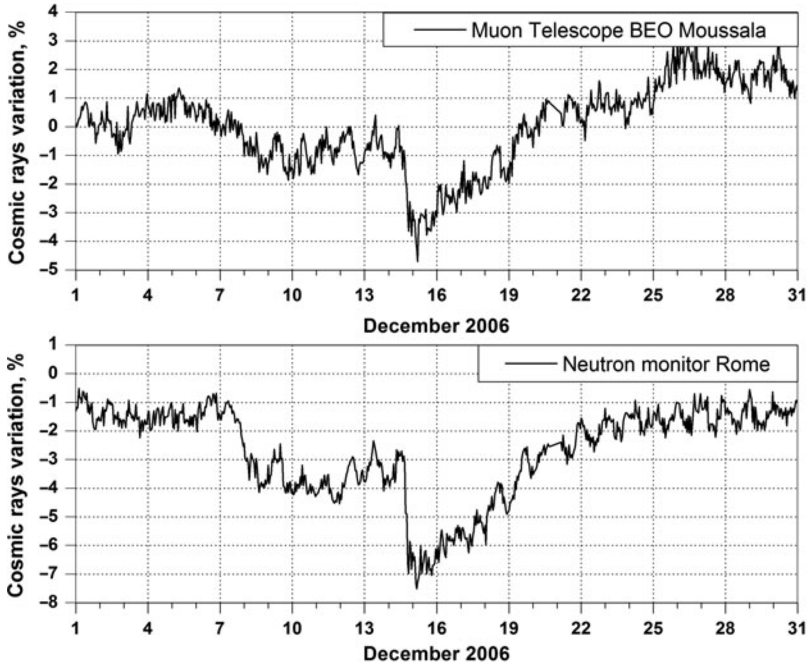

Fig. 11.9 FD registered by muon telescope at BEO Moussala station and Neutron monitor Rome

11.3.2 Neutron Flux Meter

The flux meter is based on six CHM-15 proportional gas counters.

11.3.3 SEVAN

This cosmic rays detector is a part of developing SEVAN network (till now including Armenia, Bulgaria, Croatia). The SEVAN detector and the network have been developed in the CRD – YPI as an element of the Instrument Development Program for the International Heliophysical Year.

One of the major advantages of this multi-particle detector is probing of the different populations of the primary cosmic rays, which initiated particle cascades in terrestrial atmosphere. Fluxes of neutrons and gammas, charged components of low energy and high energy muons are measured by a basic detector of SEVAN network. This diverse information gives the opportunity to estimate the energy spectra of the highest energy solar cosmic rays and distinguish very rare events of direct solar neutron detection.

11.3.4 Cerenkov Light Telescope

The Cerenkov light telescope registers Cerenkov fluxes in air showers with energies 10^{15}–10^{17} eV and also is used for investigation of the primary energy spectrum in the "knee" region 10^{15}–3.10^{15} eV.

11.4 Telecommunication and Information System INRNE-BEO

The main task of the telecommunication system is to collect, transmit and archive the measured data in SAP database (MaxDB), which is enlarged by:

- stored data retrieval in accordance with the needs and permissions of the users
- packing/unpacking
- compressing/decompressing
- raw data processing for visualization and presentation in human readable format

The information system is a complex software system providing data flux control, data storage and data quality control. In state of implementation is Data Acquisition Quality Assurance System (DAQAS). The system was developed in UFS Zugspitze GAW station for improved data flow control and calibration processes.

11.5 The BEO Moussala and the National Institute of Meteorology and Hydrology (NIMH) Data

Comparison between the BEO Moussala and the NIMH data (http://www.stringmeteo.com/synop/) was implemented in order to validate the BEO Moussala data. The monthly mean temperature and pressure data show total agreement (Figs. 11.10 and 11.11). The measurements of wind speed and wind direction at the peak Moussala are given in the Figs. 11.12 and 11.13 for 2008. The differences occur due to various physical measuring methods. And the relative humidity measurements at peak Moussala are shown in the Fig. 11.14.

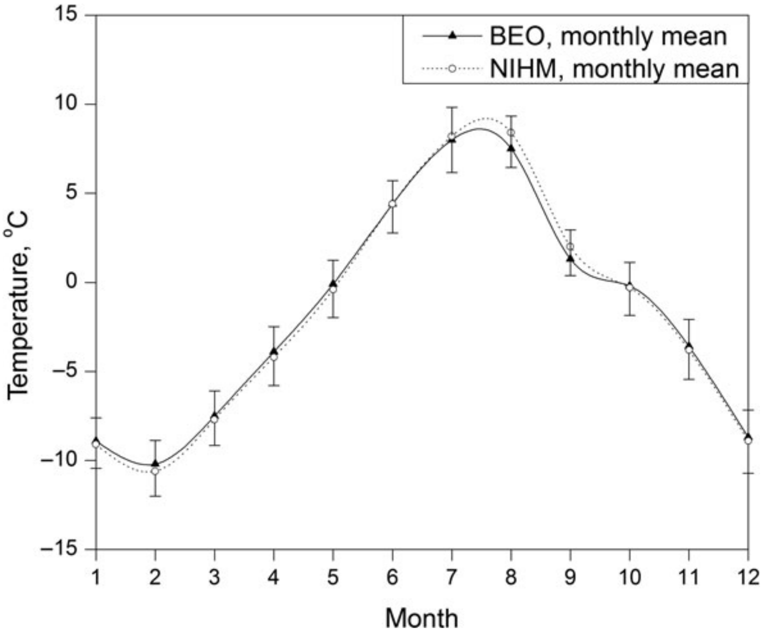

Fig. 11.10 Monthly mean temperature (°C) measured by NIMH and BEO Moussala for 2008

11.6 Environmental and Ecotoxicological Investigations at the Vicinity of BEO Moussala

Since 1990 the annual ecotoxicological studies at Rila Mountain are a part of the scientific applied activity of BEO Moussala and have the aim to evaluate the influence of the atmospheric pollution (chemical elements, radioactivity, etc.) on the local environment, including biota, in the surrounding area of the observatory station.

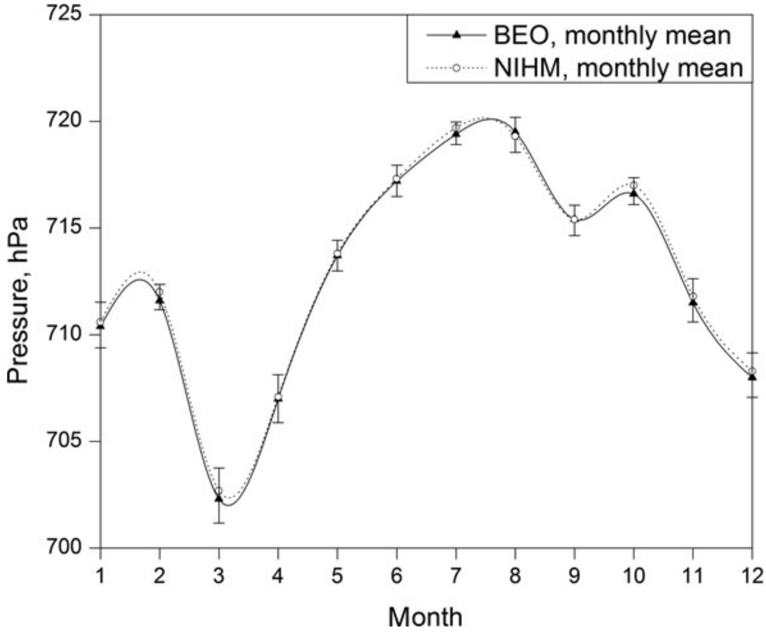

Fig. 11.11 Monthly mean pressure (hPa) measured by NIMH and BEO Moussala for 2008

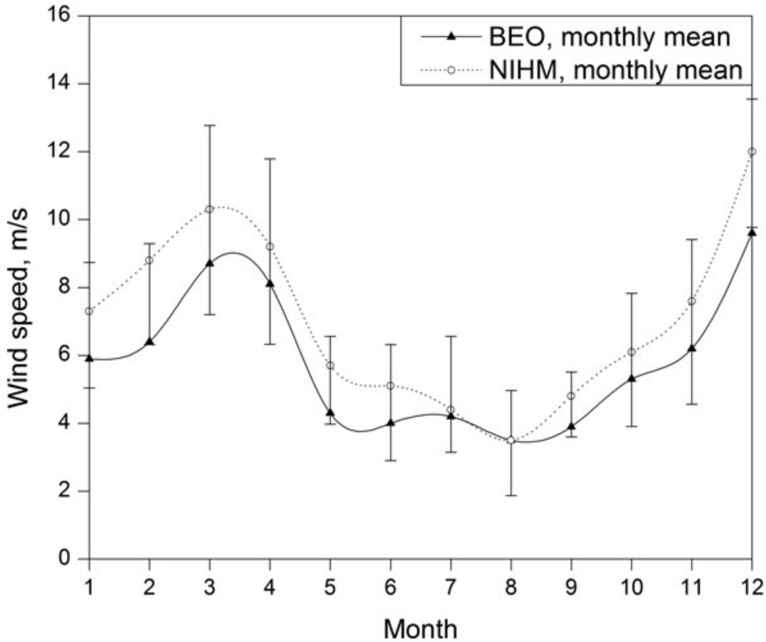

Fig. 11.12 Comparison of the wind speed data (m/s) measured by NIMH and BEO Moussala

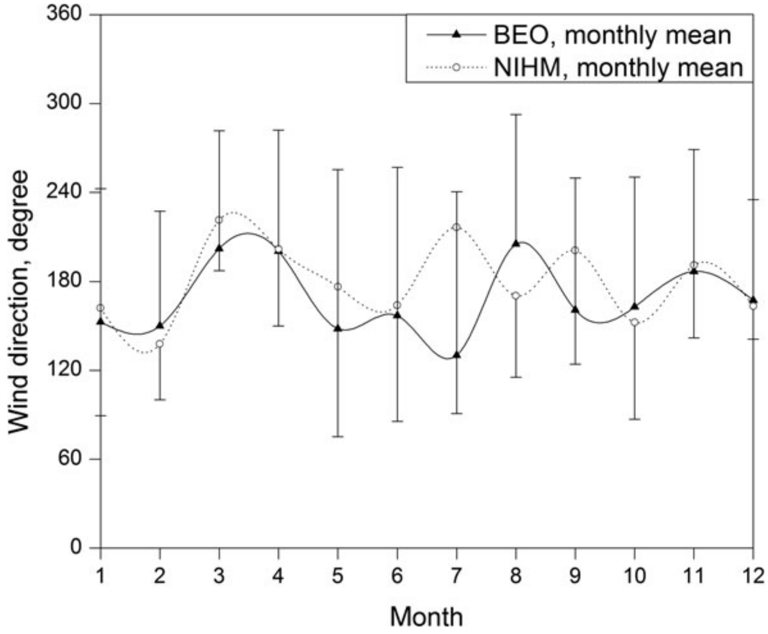

Fig. 11.13 Comparison of the wind direction data (deg) measured by NIMH and BEO Moussala

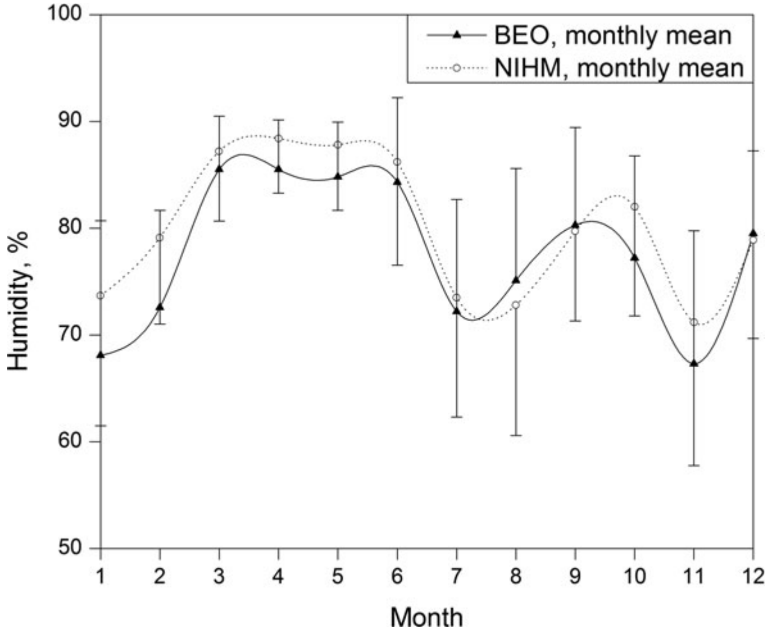

Fig. 11.14 Comparison of the relative humidity data (%) measured by NIMH and BEO Moussala

The environmental studies around BEO Moussala include investigations of chemical composition (Fig. 11.15) and radioactivity (Fig. 11.16) of different components of terrestrial and water mountain ecosystems.

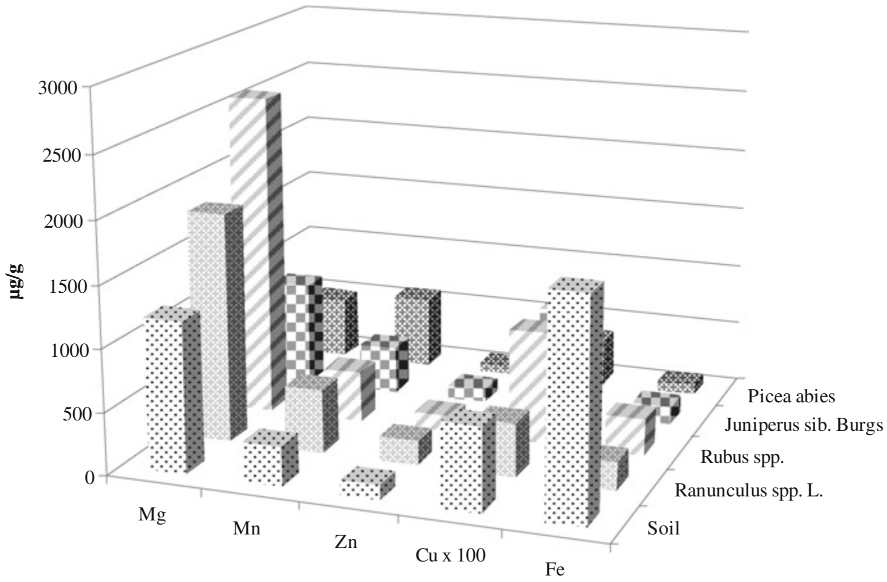

Fig. 11.15 Content of chemical elements (Cu, Mg, Mn, Fe, Zn, etc.) in soil and some terrestrial plants in Rila Mountain (µg/g) 2008

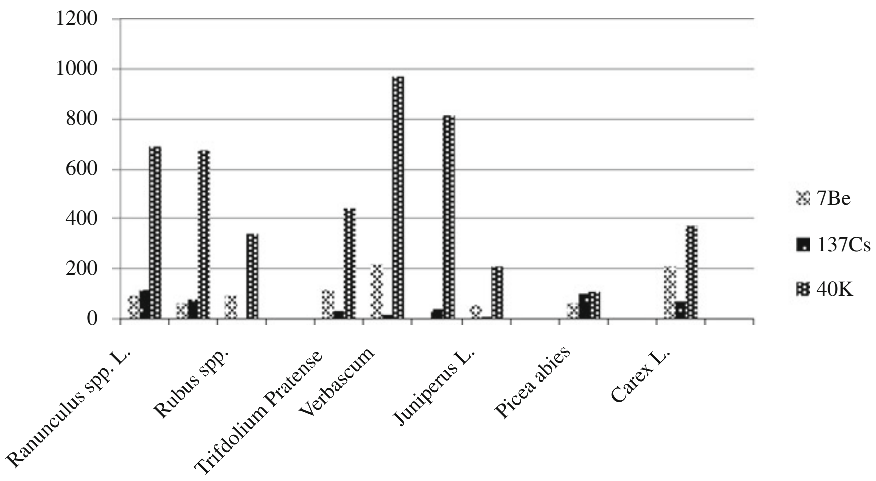

Fig. 11.16 Results for ^{7}Be, ^{137}Cs and ^{40}K in plant samples from Rila Mountain (Bq/kg), 2008

The study of mountain ecosystems simultaneously with the atmospheric and meteorological data measured at BEO Moussala gives the possibility for complex evaluation of the present condition of the mountain environment.

11.7 Conclusion

The peak Moussala is an important reference point for anthropogenic influence assessment in the large South-East European region. BEO Moussala is a facility with modern infrastructure for scientific investigations. Data for 38 parameters are stored for real-time retrieval, retrospective analyses and modelling.

The BEO Moussala is a complex research facility and data quality issue remains a main task which needs persistent and continuous efforts from many institutions.

The devices for cosmic rays research, the AWS, the gas and aerosol measurement systems allow carrying out precise study of the atmosphere parameters and cosmic rays. The connection between the atmospheric events and the cosmic ray flux is prospective field for investigation.

The ecosystems at peak Moussala vicinity are observed for possible local and remote pollution influences.

The BEO Moussala information system including the measurement systems, the high frequency telecommunication system and the database can be used in situ or by remote access of the international scientific community.

The BEO Moussala has a long tradition as a high-mountain scientific facility and its future mostly depends on the process of scientific collaboration and integration in the global research area.

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The following web link included base data archive for weather in Bulgaria provided by NIMH, for peak Moussala - No 15615

http://www.stringmeteo.com/synop/

Chapter 12
Researches of Field Evidence for Late Quaternary Climate Changes in the Highest Mountains of Bulgaria

Emil Gachev

Abstract Bulgarian highest mountains Rila (2,925 m a. s. l.) and Pirin (2,914 m a. s. l.) provide sets of relatively well-preserved glacial landforms from late Pleistocene and Holocene cold phases, several small recent perennial ice features and still well-preserved forest ecosystems at the tree limit that can serve as a source for valuable environmental records. Results of our latest studies show that in Rila valley glaciers reached their largest extent during the Last Glacial Maximum (LGM) stage (23,000–19,000 year BP), when the Equilibrium line altitude of the glaciers was at around 2,150–2,250 m a. s. l. and the longest glacier tongues went down to 1,150–1,200 m a. s. l. There were also found and described traces from several stages of glacier retreat. Another important aspect of environmental change consists of the observation of current environmental phenomena in order to evaluate local climate change during the last decades and at present. This chapter presents some results of research efforts in this field, which have been achieved up to now. One of the aims of this chapter is to propose incorporation of high-mountain environmental change researches from all the interested Balkan countries in a network for regional studies and modelling, and, if possible, to establish a workgroup dedicated to this topic.

Keywords Global change · High mountains · Field indicators

12.1 Introduction

Global climate change has recently appeared to be probably the most debated problem not only among scientific community but also among whole civil society at planetary scale. As a result, environmental reconstructions registered a rapid progress during the last several years. Although there have been developed whole sets of global climate models and scenarios concerning various past and also future

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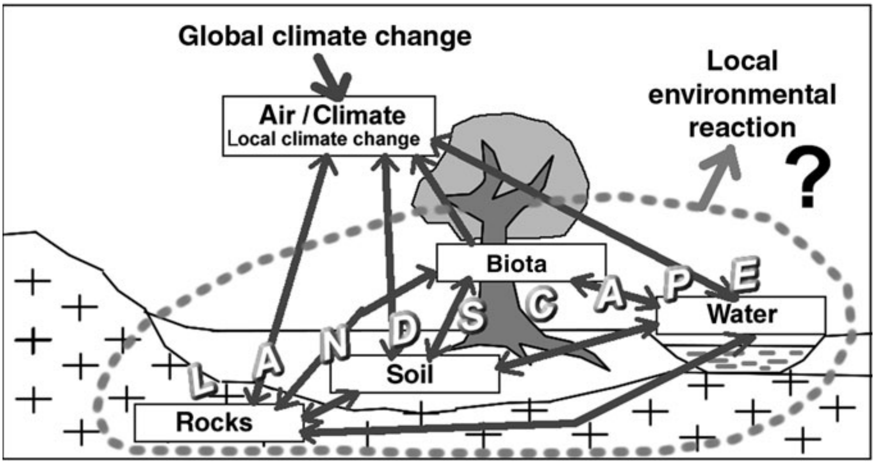


Fig. 12.1 General scheme of the interaction "global change – landscape system"

periods, still a serious deficit of regional and local data is observed in this area of knowledge. And here is the very tricky moment in studying climate – global changes in the state of the atmosphere cause quite different local reactions because of the unique combination of specific topography, biotic environment and human impact at each location (Fig. 12.1). That is why regional and local response to global changes is very hard to predict without knowing in great detail the current regional and local environmental setting. This problem is of a pragmatic importance – understanding the mechanism of local response will give us the chance to correctly suggest, estimate and evaluate future changes in our environment.

This chapter is focused on regional and local environmental change studies in the highest mountains of Bulgaria with the aim to make a short revision of what has been done and what should be done in the future.

12.2 Bulgarian Mountains – A Target Area for Paleoclimatic Researches

The most serious difficulties when trying to reconstruct environmental conditions of the past come from the impacts of human activity. In the context of climate this is a "vicious circle" – we want to evaluate the changes in climate for some of which we suspect the human factor, and at the same time civilization has destroyed the evidence that should tell what the natural conditions in the past were. This is valid for the most part of Europe, where only isolated and hardly accessible areas keep nature preserved enough to tell what climate was like in the past. In this aspect the Balkan region has an advantage that here vast areas are occupied by mountains of various height, lithology and present local climate, and that many of them provide still relatively wild nature.

Although Bulgaria is not as mountainous as some of the neighbour countries are, here are found some of the highest mountain ranges – the most prominent of them are Rila, with Musala peak (2,925 m a. s. l.) – the highest point of all the Balkan peninsula, and Pirin (2,914 m a. s. l.) – the third highest after Mt. Olympos in Greece. These two massifs provide remarkable geomorphic traces of past glaciations from the cold phases during late Quaternary and this namely makes them very appropriate for paleoclimatic researches. Alpine and sub-Alpine areas that are spread above 2,200–2,300 m a. s. l. represent an environment of harsh and marginal nature conditions that is very sensitive and vulnerable to climate changes.

In fact, concerning the diversity of applicable research methods, the target area for environmental change researches in Bulgaria should be broadened to include Rhodope mountains, Central and Western Stara planina, Vitosha and the mountains along Bulgaria's western border (Fig. 12.2). Evidences from past glaciations at lower elevations are quite rare, but in mid- and low-mountain areas the focus should be on forests as indicators of past natural changes, because Bulgarian mountains host the best preserved forest communities in the country.

Another key aspect of environmental change studies concerns monitoring of environment's present state in order to make comparison to nature's states in the past and also to directly measure present environmental change and to mark up the trends in landscape's contemporary development. Here, once again, mountains are in a leading position – especially the Alpine zone, because of the strong activity of present natural processes, highest sensibility to environmental changes and still quite limited human impact.

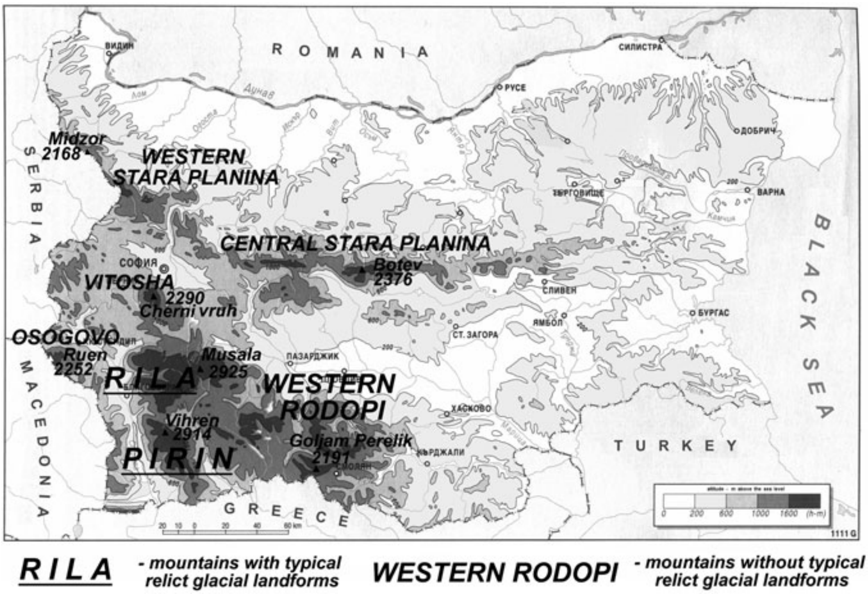


Fig. 12.2 Key mountain areas for environmental change studies in Bulgaria

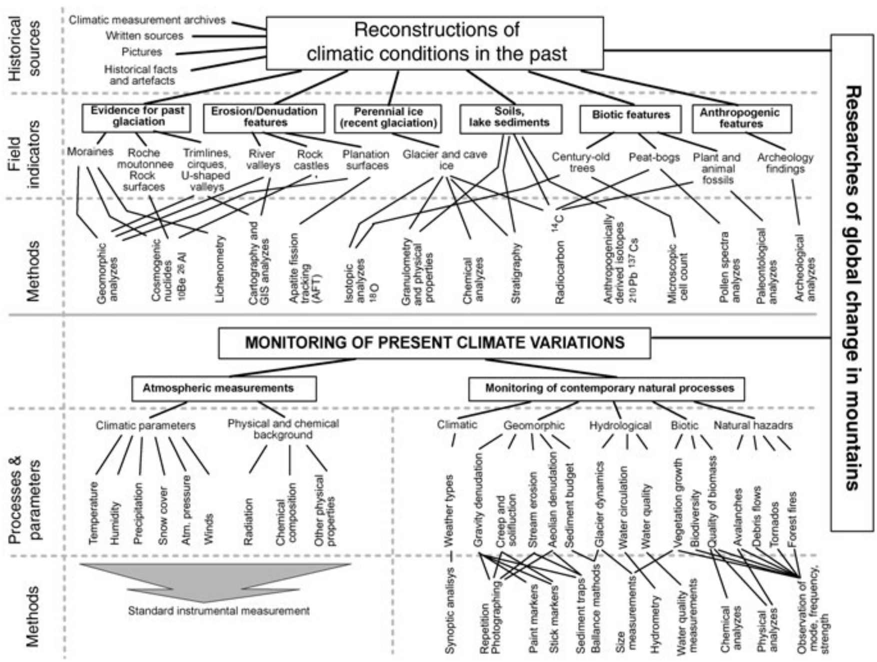


Fig. 12.3 Field evidences for evaluation of environmental change and main methods for their research

12.3 Types of Indicators and Research Methods

Because of the insufficient amount of data from direct climatic measurements in spatial as well as in temporal aspect, environmental change studies in high-mountain areas in regional and local scale are based most of all on the existence of field evidence that indicates different conditions in the far or near past. According to research methods that have been used at present, this evidence can be summarized in several groups (Fig. 12.3).

Of course, instrumental measurements also take an important part in the studies. Climatic changes were recorded in the high-mountain area of Rila dated from 1932, when a meteorological station at Musala peak was opened. However, as can be seen in Table 12.1, the number of climate stations in our country at altitudes above 2,000 m a. s. l. is very small.

12.4 Previous Geographical Studies in Rila and Pirin

High mountains have attracted the interests of naturalists since the beginning of 19th century AD. The first explorer who made natural descriptions of Bulgarian mountains was Boue (1840). Cvijic (1896, 1909) was the first to mention about

Table 12.1 Distribution of climatic stations in high-mountain areas over 2,000 m a. s. l.

Station	Altitude M a. s. l.	Location	Period of operation
Musala peak	2,925	Rila	1933–present
Golemia Kazan	2,450	Pirin	1957–1961
Kalin dam	2,390	Rila	1956–1975
Musala hut	2,389	Rila	1940–1990
Botev peak	2,376	Central Stara planina	1940–present
Cherni vruh	2,290	Vitosha	1935–present

relict glacial landforms in Rila, and Louis (1930, 1933) described and analyzed glacial morphosculpture and planation surfaces in the mountain. S. Leutelt-Kipke (1932), with a team of students from Innsbruck, made the first bathymetry mapping of glacial lakes in Rila (Musala lakes) and measured water quality (temperature, salinity, ion concentration). In the 1950s and 1960s of the past century researches were carried out by Bulgarian geographers. Ivanov (1954) and Glovnia (1958, 1961, 1962) made detailed descriptions and mappings of relict glacial landforms in Rila massif, Peev studied avalanches in Pirin and mentioned about the existence of a "firn glacierette" in Bajuvi dupki cirque in the northern part of the mountain (Peev, 1956). Vladimir Popov from the Institute of Geography – BAS, carried out a 4-year monitoring programme of the cirque Golemia Kazan in Pirin (1957–1961) which was the most prominent study of this type for its time. Along with the detail geomorphic mapping, systematic climatic observations were organized in the cirque and a small building was erected. Popov (1962, 1964) was the first to describe and measure Snezhnika – a perennial snow patch that lies at 2,400–2,450 m a. s. l. He explained the existence of these embryonic glacial features in Northern Pirin with the specific lithology (white karstified marbles) and topography (shading by high vertical rockwalls). In the last decades glacial landforms in Rila were studied by Velchev (1995, 1999), Baltackov and Cherkezova (1991), Baltackov (2004), and in Pirin by Choleev (1982). All these authors relied on relative dating of relict landforms based on geomorphic evidence, standing on the position about the occurrence of two main glacial stages – Rissian and Würmian. An important contribution to the issue was the detailed study and mapping of sub-Alpine and Alpine grassy vegetation in Rila made by Rusakova (1986), and the palinological researches of peat-bogs and lake sediments performed by Bozhilova (1972, 1995), Bozhilova et al. (2002), Bozhilova and Tonkov (2000), Tonkov and Marinova (2005), Tonkov et al. (2002, 2006), through which the basic changes of the vegetation in Rila and Pirin during the Holocene were revealed.

In 1992–1998 a French–Bulgarian project called "OM2" came into force in Rila mountain. The project comprised plenty of monitoring researches in different components and characteristics of environment (radiation background, chemical contamination, biodiversity, etc). Results were published in the journal "OM2 series", issued by the Institute of Nuclear Research and Nuclear Energy (INRNE) – BAS. Main result of the project was the opening in 1999 of the Basic Environmental

Observatory (BEO) “Musala” – a station for complex environmental monitoring situated at 2,925 m a. s. l. on the very top of Musala peak. Although “OM2” project has not been attended by geographers, the field and instrumental data obtained during its performance served as a good basis for geographical studies. BEO “Musala” is governed and managed by INRNE and since 2002 it has been obtaining climatic and air quality data that are available online (Angelov et al., 2007).

In the years since 1994 a team from the Centre for landscape research in Dresden (Germany) has been conducting systematic environmental observations in Northern Pirin. Some of the main activities of the programme have been the dendrochronology studies at the timberline to evaluate recent changes in tree growth of Pinus heldreichii as a result of local climate change; and regular measurements of the size of the glacieret “Snezhnika” in Golemia Kazan cirque (in September – during the stage of annual firn mass minimum), which, for the period of observation, showed variation between 1 ha (2006) and 0.4 ha (1994). In 2006 a group of researchers from Dresden, lead by K. Grunewald, in cooperation with specialists from the Institute for Space Research of the Bulgarian Academy of Sciences (BAS), made three core drills in the firn body and took samples for absolute dating and chemical analyses. A drill in the central part of Snezhnika registered 11 m thickness of the ice mass. At this time, the moraine ridge that surrounds the snow patch was also studies – layers of primitive soil were found on the crest to date from the early Middle ages, while the formation of the ridge in its present configuration is suggested for the Little Ice Age (LIA – 15th – 19th c. AD) when the snow patch must have been quite larger (Grunewald et al., 2008). This monitoring programme is still ongoing and in 2007 two temperature data loggers were installed in the cirque to measure local temperature.

12.5 Our Latest Research – Review of Achieved Results

Following the 50-year tradition, the Institute of Geography has recently started an initiative for a complex research of high-mountain environment in the context of global change. The research is focused on two main aspects – studies of environmental conditions in the past and monitoring of present environmental conditions with an accent on dynamics of geomorphic and hydrological processes. The conceptual framework of these researches was named “Bulgarian programme Himont research”.

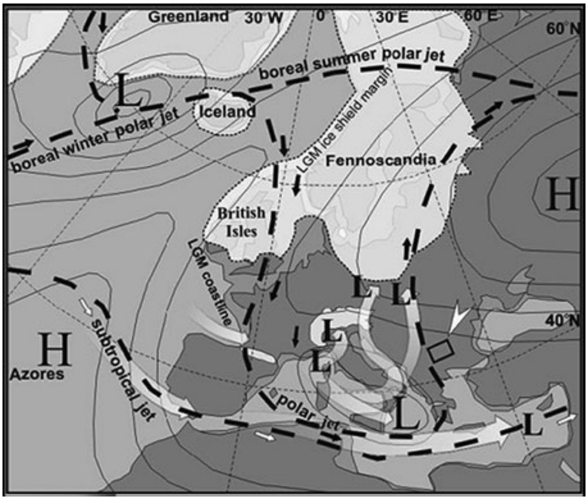
12.5.1 Researching Environmental Conditions of the Past – The Glacial Evidence

Although relict glacial landforms, especially in Rila, were subject to numerous studies, still no common interpretation of their distribution has been done for the whole Rila and Pirin mountains, and results obtained about environmental settings of the past have not been summarized on a regional scale, especially by a comparison with glacial evidence from adjacent mountain massifs. That is why the Institute of Geography participated in two terrain studies in 2007 and 2008, dedicated to a research of former glaciations in Rila. The first fieldwork was initiated and organized by the Geosciences Institute – University of Tubingen, Germany, and led by Prof. Joachim Kuhlemann. For 9 days all main valleys of Rila mountain were searched and moraine features were described and mapped. Samples were also taken for cosmogenic nuclide dating (^{10}Be) to estimate absolute age of glacial deposits. Although some preliminary results were already published (Kuhlemann et al., 2008), acquiring of data from this study is still going on. Results obtained by now indicate that the deposition of the lowest terminal moraine in Rila mountain (that above Beli Iskar village at 1,150 m a. s. l.) was undoubtedly during the period of the Last glacial maximum (Last Glacial Maximum, LGM – 23,000–19,000 years BP) (a sample taken from the first of the four ridges up the valley). The main conclusion from this study is that most landforms from the relict glacial complex are quite new with the oldest moraine features dating from Late Würmian (LGM) and newest probably from the cold phases during the Holocene. No glacial accumulative landforms were registered from earlier glacials (e.g. Riss or Mindel) as some of the previous authors suggested, although there are geomorphic traces of previous glacial stages, such as parallel trough valley trimlines and some old cirque shoulders.

Analysis of the positions of LGM terminal moraines and of the configuration of trimlines in the analyzed river (for which aerial photographs were also studied) showed that the Equilibrium line altitude (ELA) of Rila glaciers during their maximum spread (LGM) had been lying at 2,150–2,250 m a. s. l., with a gradual rise from NW to SE. Considering a temperature lapse rate of –0.6°C/100 m alt., this should mean that average temperatures during the coldest phase of the LGM were about 6°C lower than at present. Compared to the Alps and the mountains of the western and central Mediterranean the LGM Equilibrium line in Rila was situated much higher, and differences between N and S aspects were quite small. These results suggest a considerable smaller moisture supply in Rila mountain during the LGM and support the hypothesis of a compensatory warm advection from the south in the eastern Mediterranean as a response to the cold northerly advections in Western Europe for this period (Fig. 12.4).

To study the newest traces of glaciation, a fieldwork was held in summer 2008. Its task was to research the morphology of the bottom of Ledeno ezero – the highest lake in Rila, situated at 2,709 m a. s. l. On the created detail bathymetry map (second after the one made by the Austrian team of S. Leutelt-Kipke, 1932) a well-outlined crescent-shaped ridge can be identified underwater in the shallow SW part of the lake (Fig. 12.5). The crest rises up to 2 m from the shallow part of lake bottom, its highest point lying 2.1 m under the water level. Geomorphic indications, meteorology records and historical sources give advantages to the hypothesis that this ridge represents a relatively young moraine feature, formed probably by a perennial snow patch (microglacier) during the Little Ice Age (LIA). Today there are no perennial snow patches in Rila, and some small spots of last winter snow may survive the summer only in years colder than average, but historical sources say that

Fig. 12.4 Sketch map of Europe, showing the outline of LGM ice sheets, coastlines and potential cyclone tracks (L) postulated on the base of the new ELA isoline pattern (after Kuhlemann et al., 2008). *The hatched line for a preferential flow of the jet stream in high troposphere is only a hand-fitted tentative estimate. Mediterranean cyclone tracks are marked in white



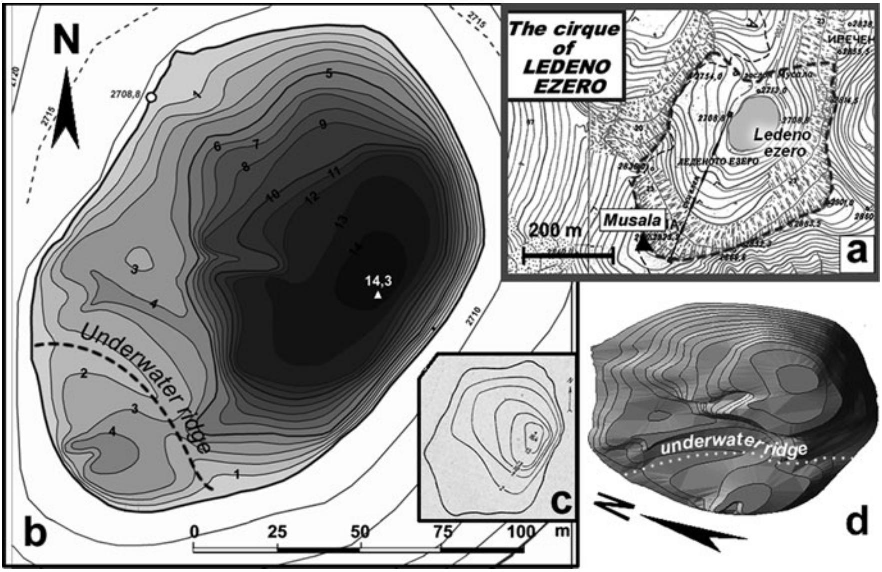


Fig. 12.5 Bathymetry map of Ledeno ezero (the Icy Lake) (Gachev et al., 2008). At the *bottom* to the *right* – the first map made by S. Leutelt-Kipke (1932)

the presence of firn bodies was common in the beginning of the 20th century. Thus Radev (1920) wrote about "a patch of snow that never disappears at the SW end of Ledeno ezero", i.e. just at the location where the ridge was found, and Louis (1930) mentioned "several small glaciers in the high areas of Rila and Pirin". All this comes to tell that climatic conditions in the highest cirques of Rila are marginal in relation to embryonic forms of glaciation (i.e. the present Equilibrium line altitude in Rila is not far above the highest peaks), and a small but continuous drop in temperatures will cause formation of such. However, for the period of instrumental observation (1933–2008) temperatures at Musala peak were ranging between –1.7 and –4.0°C and showed general trend of warming, although there was a shift of four contrasting short-term trends – towards a decrease (in the 1930s and 1940s), an increase (1940s–1960s), a decrease (1960s–1970s) and a period of sufficient increase (since 1980). Average annual temperatures at Musala have shown a cyclic variation in a range of about 0.5–1.5°C with duration of 3–5 years. In general, when looking at sliding averages (10 year intervals) appeared that the rise of temperature for 1998–2008 compared to 1933–1943 has been about 0.5°C, and for 1998–2008 compared to 1958–1968 has been about 1.0°C (Nojarov, 2008).

Although there are no measured data in Bulgarian high mountains before 1933, regional climatic evidence surely indicates that climate was much colder in about 1910 and suggests that long-term average temperatures were more than 1°C lower than at present and this should be considered as a maximum temperature for formation of perennial snow patches in the higher areas of Rila mountain.

Clear traces of bigger extent of the embryonic forms of glaciation can be observed also in Pirin, in Golemia Kazan cirque. Snezhnika microglacier is surrounded by a well-outlined moraine ridge situated at some distance away from the present ice margins even in years when the size of the firn body during minimum is relatively high. As already mentioned (Grunewald et al., 2008), the crest should have been formed in its present shape during the LIA. Such a hypothesis is supported by the state of the lichen cover on the crest (partly but evenly developed), which indicates that at present the ice margin during minimum never reaches the crest (no fresh material has been added), and, on the other hand, no other moraine ridge is observed further down the cirque bottom – the next ridge in sequence is quite old (weathered, corroded and covered entirely by lichen), with undoubtedly a several thousand year old in age (most probably Würmian, as first stated by Popov, 1962). As in Rila, this bigger extent of Snezhnika in the past is a result of climate conditions with lower annual temperatures and probably higher precipitation. The role of each of these climatic factors over extent of glaciation is hard to differentiate, but it is sure that they both are of great importance. The influence of temperature on the dynamics of perennial snow patches can be clearly seen making a comparison between the size fluctuations of Snezhnika in the last several decades and air temperature (Fig. 12.7).

12.5.2 Monitoring of Present Geomorphic and Hydrological Processes

In 2003 the Institute of Geography launched the project "Models of contemporary periglacial morphogenesis", in which a detailed 3-year observations were planned to be carried out on a comparative basis in four key areas – Musala area in Rila mountain, Vihren area in Pirin mountain, Livingston island in the Antarctic, where Bulgarian Antarctic base is operating, and Spitzbergen island in the Arctic (Stefanov et al., 2003). The project was performed in 2004–2007, and due to the *severely restricted funding* by the Ministry of Education's Council for scientific research, project activities were carried out to a very limited extent and were concentrated only in the areas of Musala and Vihren peaks. According to the treaty for collaboration signed between INRNE and the Institute of Geography, all research activities in Musala area have become part of BEO Musala's observation of terrestrial processes. Activities under this particular project included measurements of water chemistry of Musala lakes, detailed environmental mapping in GIS of Musala cirque, setting up of polygons for monitoring of weathering and slope denudation (solifluction).

An important step forward was the incorporation of Bulgarian researches of high-mountain geomorphic processes to the global networks of the International Association of Geomorphologists (IAG/AIG). The research team from the Institute of Geography was accepted to participate in the global network SEDIFLUX (sediment source-to-sink fluxes in cold environments). The network aimed to establish a worldwide observation and quantitative measurements of contemporary geomorphic processes in Earth's high latitudes and high altitudes in order to evaluate current climate fluctuations and trends.

At the fourth science meeting of SEDIFLUX in Trondheim (Norway) in 2006, the Institute successfully promoted Musala area (the upper parts of Musala and Maritsa cirques) to be included in the global network for research of present sediment transfer processes in cold environments that should be built up in 2009–2012 under the coordination of the newly established IAG/AIG workgroup SEDIBUD (Sediment budgets in cold environments). Now Musala area is one of the several high-altitude and high-latitude key test sites worldwide (Fig. 12.6), which should contribute to a special Global change database for cold environments and where observations should be performed following a unified methodology according to the commonly approved SEDIFLUX Manual (Beylich and Warburton, 2007). Musala area is the only place in Southeastern Europe that is included in SEDIBUD network of test sites. For now all sites included in the network should find funding for research by themselves. In present conditions this is still a difficult task, so research comes still in an insufficient rate.

In Pirin, activities under "Models of . . ." project comprised chemistry measurement of karst spring waters, fieldwork in Golemia Kazan cirque (detailed landscape and land cover mapping in GIS, size measurements of Snezhnika perennial snow patch, setting up of transects for measurement of gravity denudation – see Fig. 12.8) and an expedition in Banski Suhodol cirque in order to assess potential for future research.

The perimeter measurement of Snezhnika, made on 14 October 2008 showed surface area of 0.44 ha. Compared to results obtained from the previous researches this value is close to the minimum size ever measured (0.4 ha in 1994 by the scientists from Dresden), which is considered to be a result mainly of the fewer precipitation in the preceding 2-year period (2007–2008). However, this measurement was done in October, which should probably address it as little below 0.5 ha if related

Fig. 12.6 SEDIBUD global network of test sites (preliminary list – 2008) 1. Cape Bounty (Canada); 2. Botn í Dýrafirði (Iceland); 3. Tindastöll (Iceland); 4. Hrafndalur (Iceland); 5. Örravatnrústir (Iceland); 6. Fnjóskadalur (Iceland); 7. Hofsjökull (Iceland); 8. Austdalur (Iceland); 9. Kangerlussuaq (West Greenland); 10. Mittivakkat-Sermilik (Greenland); 11. Zackenberg (Greenland); 12. Petuniabukta-Sermilik (Spitsbergen); 13. Scottelva-Svalbard (Norway); 14. Moor House, North Pennines (UK); 15. Erdalen (Norway); 16. Kidisjoki (Finland); 17. Latnjavagge (Sweden); 18. Bodalen (Norway); 19. Pasterze (Austria); 20. Musala Area (Bulgaria); 21. East Dabka (India); 22.Godley Valley (New Zealand); 23. Potrok Aike (Argentina)

to September – the month accepted for observation by the German scientists. The importance of temperature over the regime of perennial ice bodies is well illustrated by the close relation between air temperature and the size of Snezhnika in periods of minimal ice extent with annual air temperatures (Fig. 12.7). Musala peak is used as a reference parameter for estimating temperature conditions, because there is a strong correlation between temperatures in the highest parts of Rila and Pirin (Nojarov and Gachev, 2007) and temperatures in the bottom of Golemia Kazan are about 2.6°C higher than those at Musala.

The firn body seems to react with a little delay (about a year), probably in relation to higher (or lower) volumes of ice left from the previous melt season. Sadly, the present analysis excludes precipitation factor, because there have not been any instrumental measurements of climate since 1961 and the great differences in regime do not allow using precipitation data from Musala peak. If taking into account the fact that a decrease of annual precipitation in the last 40 years is observed in SW Bulgaria as a whole (Velev, 2002), a suggestion can be made that the observed much smaller sizes of Snezhnika in 1996 and 2005 in comparison to 1959 (as it is seen from Fig. 12.7) were caused mainly by the lower amounts of precipitation, as air temperatures for these particular years differed slightly.

Two transects for measurement of slope mass movement activity were set up in Golemia Kazan cirque in 2006. The 2-year observation (until 2008) showed no activity in transect 1, which is situated on a gentle slope foot in the upper part of

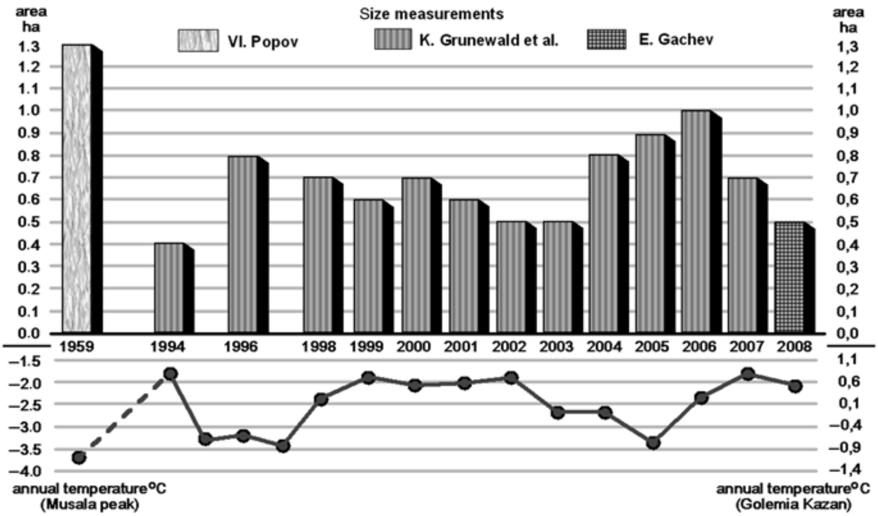


Fig. 12.7 Variation in inter-annual size of Snezhnika microglacier and its relation to air temperature

the cirque, and a movement with up to 3 m for certain blocks in transect 2, set off on in the upper part of an active talus cone in the southern foot of Kutelo peak (Fig. 12.8). Although movement was discrete and affected separate blocks more than the whole stone mass (which made quantification of the mass movement impossible), results obtained are considered useful for relative evaluation and for separation of zones with different potential for geomorphic transport and risk for occurrence of catastrophic events related to talus movement.

From this short review it is seen that monitoring of contemporary geomorphic processes in Bulgarian high mountains as indicators of present climate changes is still in an initial stage. Considering the strategic geographical location of Bulgarian research sites and the conceptual foundations that have already been set up, these activities should be given a high priority. In support of these ideas, a development of an international background has been already in progress. The main problem to solve is to provide funding for research.

12.6 The Future – Prospects and Expectations

Future activities within the framework "Himont research" should follow the conceptual guidelines of global climate change studies. Research in Bulgarian mountains needs to be incorporated in a joint effort extending to regional scale, possibly within the Carpatho-Balkan region. Thus we would like to recommend and initiate building up of a Balkan workgroup for high-mountain environmental studies with a focus

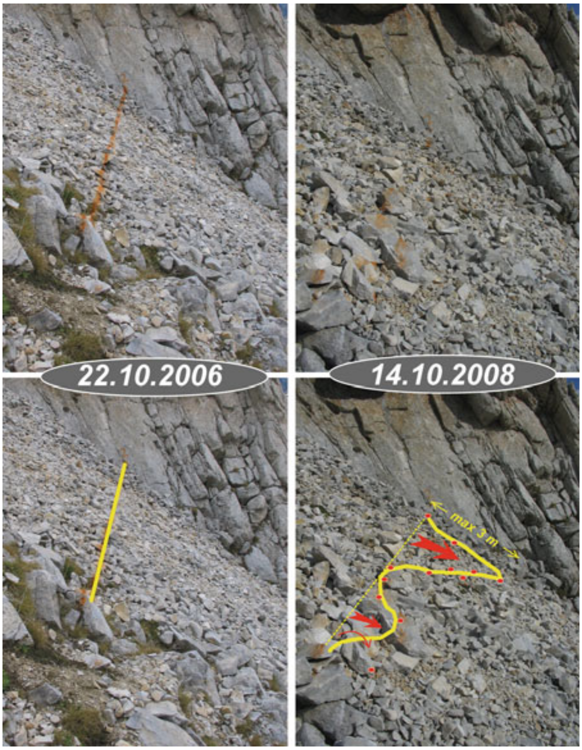


Fig. 12.8 Field measurements of slope gravity processes (Golemia Kazan cirque, Pirin mountains)

on climate change and its local impact on the diverse mountain landscapes of the Balkans. To have a regional look is the only way to properly understand and interpret results from local studies, not only those made in Bulgaria, but elsewhere. Creation of a network of scientists from the Balkan countries will make it possible to elaborate regional climate change models, assessments and forecasts. For this purpose a regional mountain environmental change database should also be established.

Priorities in the future development of research in Bulgaria will be put on a steady broadening of the spatial extent of research and the range of methods used. New activities start from this year in Banski Suhodol cirque in Northern Pirin mountain where the largest perennial snow patch (microglacier) in Bulgaria is located. The initiative begins with a small project for geomorphic mapping of the cirque and establishment of size measurements of the snow patch on an inter-annual basis, funded by the Southwestern University "Neofit Rilski". Another ongoing project concerns calculations of the equilibrium line altitudes of glaciation from late Pleistocene and Holocene cold phases and their mapping in Rila massif. Future ideas include mapping of moraines and ELA calculations in Pirin, dendrochronology studies, etc.

12.7 Conclusion

Bulgarian high mountains Rila and Pirin provide valuable field evidence for estimations of past climatic conditions. Available geomorphic traces from past glaciations suggest that during the coldest phase of LGM average temperatures were at least 6°C lower than at present and during the Little Ice Age – 1 to 1.5°C lower than at present.

Today the Alpine zone represents a marginal environment with intensive occurrence of geomorphic processes which can serve as a tool to assess present climate fluctuations. On this basis Musala area is included in the global network of SEDIBUD test sites for establishment of monitoring of these processes following a standardized methodology.

One of the most sensitive field indicators for current environmental changes are perennial snow bodies (microglaciers). At present marginal position of Alpine zone determines an absence of such features in the highest areas of Rila and their presence in Pirin at lower altitudes, due to specific lithology and topography. Researches in Musala cirque (Rila) and Golemia Kazan cirque (Pirin) show that a very little change towards cooler and damper climate conditions will cause formation of microglaciers in Rila, while further warming and drying will threaten the existence of perennial snow patches in Pirin.

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Part III
Social, Economic and Regional Problems of Mountain Regions

Chapter 13
Demographic Potential and Problems of the Settlements Network in the Mountains of Bulgaria

Chavdar Mladenov

Abstract Mountainous areas cover approximately 47.8% of Bulgarian territory. Those areas are comparatively densely populated and the settlement network is well developed and some 1.938 million people (25.4% of the total population) live there (2007). However, there have been strong trends of population decline due to natural decrease, aging and emigration. The average birth rates are lower than the national average, while the death rates levels and the natural increase are similar to the national average. In many mountainous areas emigration exceeds the admissible proportions and result in inexcusable decrease of the population number as well as deterioration of age structure. Most of the mountainous settlements are small. However, all larger and medium-sized urban settlements, as well as some of the small towns, have comparatively well-developed socio-economic potential, enough arable lands and conditions for tourism and recreational activities, as well as usable housing.

Keywords Mountain regions · Depopulation · Ageing · Regressive reproduction · Migration · Demographic crisis

The issues connected to the utilization of the resources of our mountains are influenced to a great extent by the demographic and settlements' potential and their dynamics. Partial or profound study of mountainous areas in Bulgaria has been conducted in a number of publications (Mičev and Mladenov, 1987; Natural and Economic Potential of the Mountains in Bulgaria, 1990; Geshev et al.,1995; Mladenov and Traikov, 1995; Mladenov, 2000, 2001, 2006, 2007; Geography of Bulgaria, 2002; Ilieva and Mladenov, 2003; Mladenov et al., 2008; Mladenov and Kazakov, 2009). In this chapter, the contemporary demographic processes and demographic problems have been analyzed. The area taken into consideration is delimited by the physical-geographic boundaries of the Bulgarian mountains, which

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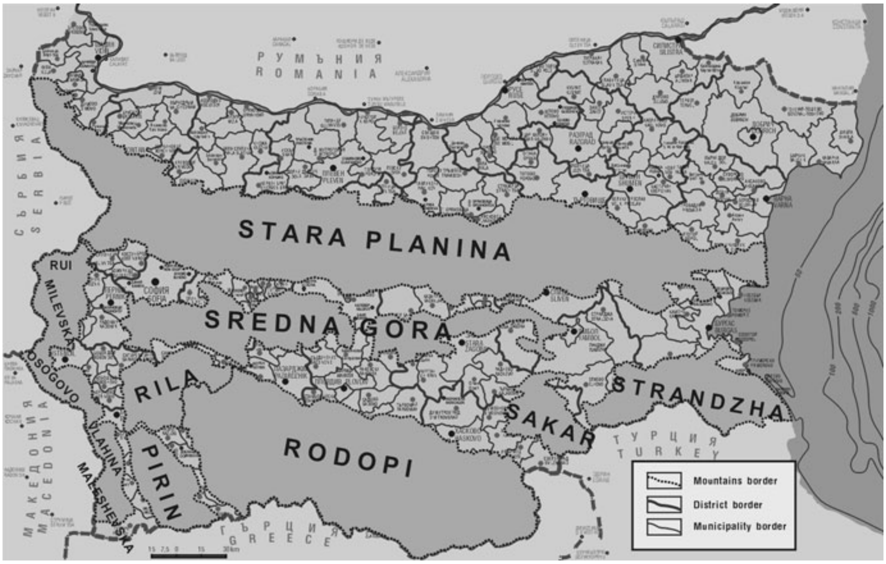

Fig. 13.1 The mountainous areas of Bulgaria

cover approximately 47.8% of the total area of the country. That area is considerably larger than the area outlined in the Directive for selecting criteria for defining unfavourable regions and their span (published in the *State Gazette*, issue February 20/26, 2006). The adopted criteria in that Directive are highly exaggerated and do not respond to the specific conditions for mountainous region delimitation that exist in the country. For example, the climate component has not been taken in consideration, which has led to exclusion of vast areas (Fig. 13.1).

Historically, due to political, economic, religious and demographic reasons, Bulgarian mountains have been comparatively densely populated and the settlements network has been well developed. In 2007 mountains were home to approximately 1.938 million inhabitants or 25.4% of the total population of the country. Due to its natural increase, the number of population in the mountains was increasing till 1975, although its relative share was decreasing due to emigration. In the years that followed, the trends were equalized – both, the number and the relative share, started to decrease (Fig. 13.2).

The density of the population living in mountainous regions in the past was 10% lower than the national average, while in present days it is twice lower than the national average, and in 2007 it was 36.7 inhabitants per sq.km which is three times lower than the population density in non-mountainous regions. The major part of the population in Bulgaria is concentrated in the hypsometric belts up to 500 m above sea level. Basically, that is a result of the concentration of urban population there (approximately 3/4 of that population inhabit those belts). The concentration of population in those hypsometric belts is due to the comparatively low altitude of our

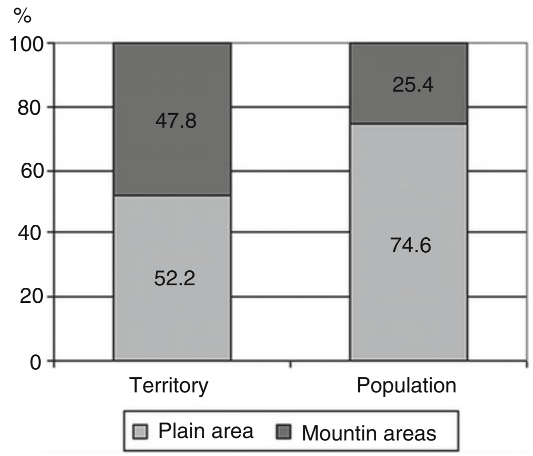

Fig. 13.2 Ratio between mountain and plain areas and population in Bulgaria

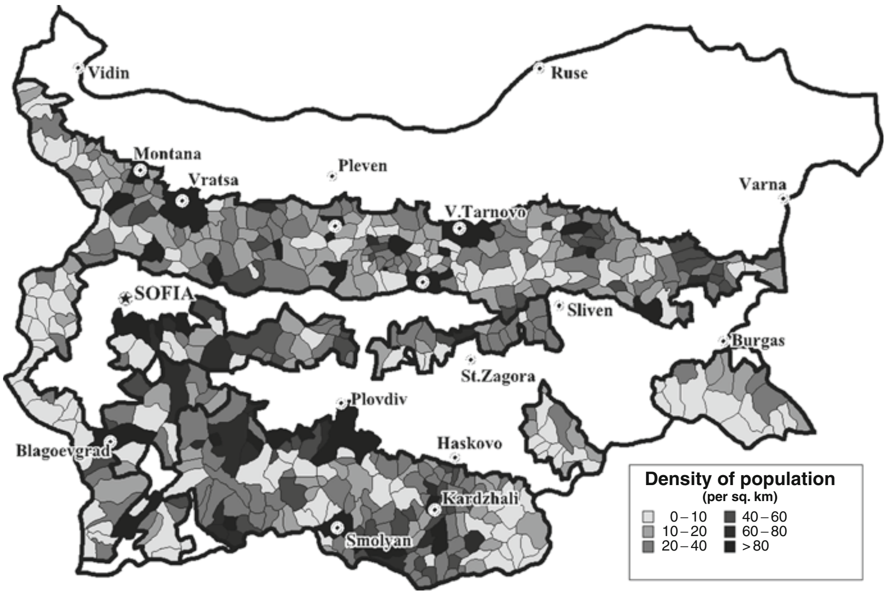

Fig. 13.3 Density of population – 2007

mountains, together with the accepted boundaries of the latter. Altitude by itself has little significance for the distribution of population throughout different hypsometric belts – its effect is revealed mostly by the industry conditions (especially agriculture) and the popular customs of the population (Fig. 13.3).

The dynamics of the number and distribution of the population across the different mountains is shown in Table 13.1. In 2007, 875,300 people lived in Stara

Table 13.1 Dynamics of number and distribution of the population (according to census data)

	1920	1926	1934	1946	1956	1965	1975	1985	1992	2001	2007
Number											
Plain area	2936153	3352140	4109405	4542519	5036106	5541730	5956945	6149501	5875573	5531962	5356839
Stara planina	903266	985700	1030195	1081423	1069485	1093019	1119748	1105843	1040536	942115	875317
Rodopi	476054	581150	616949	719381	840092	975278	1061726	1124062	1019478	946760	924416
Rila & Pirin	92477	107971	121157	143074	160214	171595	188317	205822	210427	202183	194092
Sredna gora	143121	153332	162028	163469	142315	114814	92220	77817	71082	60732	55643
Zapadni planini	212808	224155	253986	266035	252997	230556	225115	209527	196189	184572	175647
Strandzha	42178	46339	53726	60406	64011	55815	46618	45149	43396	38939	39638
Sakar	35329	41247	48485	52519	52405	44431	36351	31121	27225	21638	18646
Mountains	1905233	2139894	2286526	2486307	2581519	2685508	2770095	2799341	2608333	2396939	2283399
BULGARIA	4841386	5492034	6395931	7028826	7617625	8227238	8727040	8948842	8483906	7928901	7640238
Density - per km^2											
Plain area	51,0	58,2	71,3	78,9	87,4	92,6	103,4	106,8	102,0	96,0	93,0
Stara planina	42,7	46,6	48,7	51,1	50,6	51,7	53,0	52,3	49,2	44,6	41,4
Rodopi	34,4	42,0	44,6	52,0	60,7	70,5	76,8	81,3	73,7	68,4	66,8
Rila & Pirin	23,9	27,9	31,3	37,0	41,4	44,4	48,7	53,2	54,4	52,3	50,2
Sredna gora	34,1	36,5	38,6	38,9	33,9	27,4	22,0	18,5	16,9	14,5	13,3
Zapadni planini	37,8	39,8	45,1	47,2	44,9	40,9	40,0	37,2	34,8	32,8	31,2
Strandzha	15,1	16,6	19,2	21,6	22,9	20,0	16,7	16,1	15,5	13,9	14,2
Sakar	26,0	30,4	35,7	38,7	38,6	32,7	26,8	22,9	20,1	15,9	13,7
Mountains	36,1	40,5	43,3	47,1	48,9	50,8	52,4	53,0	29,4	45,4	43,2
BULGARIA	43,8	49,7	57,9	63,7	69,0	74,5	79,0	81,0	76,8	71,8	69,2

Planina, which was 45.2% of the total mountainous population of Bulgaria, 579,200 dilate people (29.9%) inhabited the Rodopi mountains, 194,100 people (10%) lived in Rila and Pirin, 175,600 people (9.2%) in Sredna Gora and 113,900 people (5.7%) inhabited the rest of the mountains.

In many mountainous regions, the trends of population number decrease and its concentration in urban areas is still strong. Decrease in population number is a trend spread out in all mountains as a consequence of natural decrease, ageing and emigration. The significant reduction of the number of population in the Rodopi Mountains is due to emigration of ethnic Turks in 1989 and the years that followed. Depopulation in some mountains has taken staggering proportions, which requires urgent and decisive actions by the state authorities. Within the mountain regions themselves, the scale of depopulation is even larger.

From a quantitative point of view, in most mountainous areas, number of population (and its density) is appropriate, in terms of rational utilization and enrichment of the natural and socio-economic potential of those regions. It is only in the Eastern and Western Rodopi Mountains and in Eastern Stara planina, where the number of population exceeds the current demand – those are the municipalities of Satovcha, Garmen, Borino, Ruen, Kirkovo, etc. From a qualitative point of view (especially when labour force is concerned), the population in mountainous regions is far behind that of the non-mountainous areas. This applies especially for rural areas that lost a significant part of their population in the years after 1975 – central Stara planina region, Western Border areas and Strandzha-Sakar region.

The trends in reproduction of the mountainous population and the population of the country as a whole are generally the same. However, within the various mountainous regions, the population reproduction differs significantly from the general trends, and has its specific features. As opposed to the past, average birth rates of the mountainous population are now lower than the national average, while the death rates and the natural increase (decrease) are similar to the national average. Compared to earlier periods, when the natural increase was much higher, since 1993 a process of natural decrease has begun. The spatial discrepancies in birth and death rates tend to become more and more insignificant. Higher than the national average birth rates are estimated in the Rodopi Mountains, Rila, Pirin and Strandzha (in the latter, this is only due to the high relative share of urban population). The lowest birth rates are measured in Sakar (5.9‰) and the Western Border Mountains (6.3‰). At the same time, in those two regions the death rates are the highest –23.9‰ in Sakar mountain and 21.9‰ in the Western Border Mountains, while in the Rodopi Mountains the death rates are the lowest, due mostly to the younger age structure of the population there. Just the opposite, in Sakar and the Western Border Mountains, due to the considerable ageing of the population, levels of natural decrease are the highest – higher than 15‰ (in other words, natural increase of –15‰), as opposed to that in the Rodopi Mountains, where the natural increase of the population reaches 2.1‰. Demographic ageing, therefore, has a key role in the significant lowering of birth rates and growth of death rates (Figs. 13.4, 13.5, and 13.6).

The mountainous population in Bulgaria as a whole distinguishes for its relatively high migration mobility. While in the past the migration flows were directed from rural mountainous areas to local urban centres and in a lesser extent to other

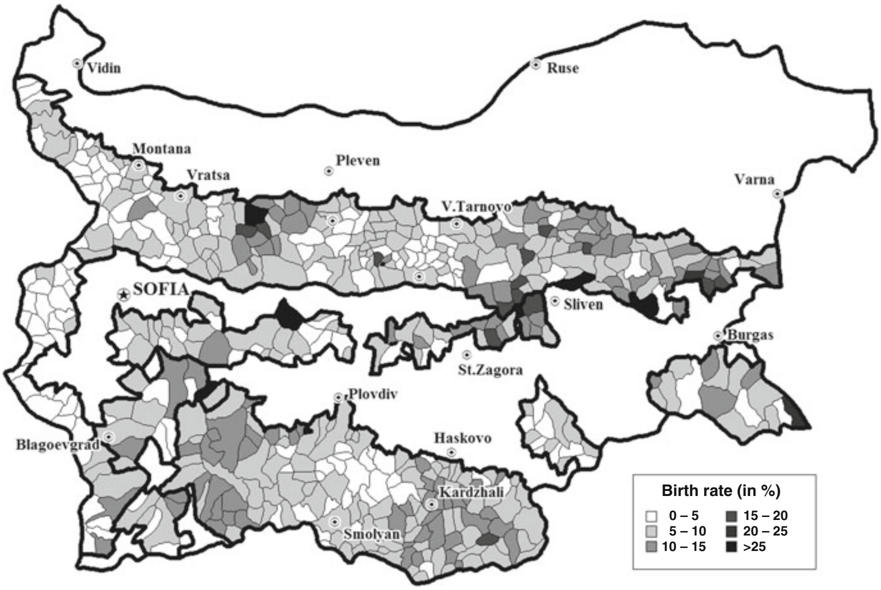

Fig. 13.4 Birth rate – 2002–2007

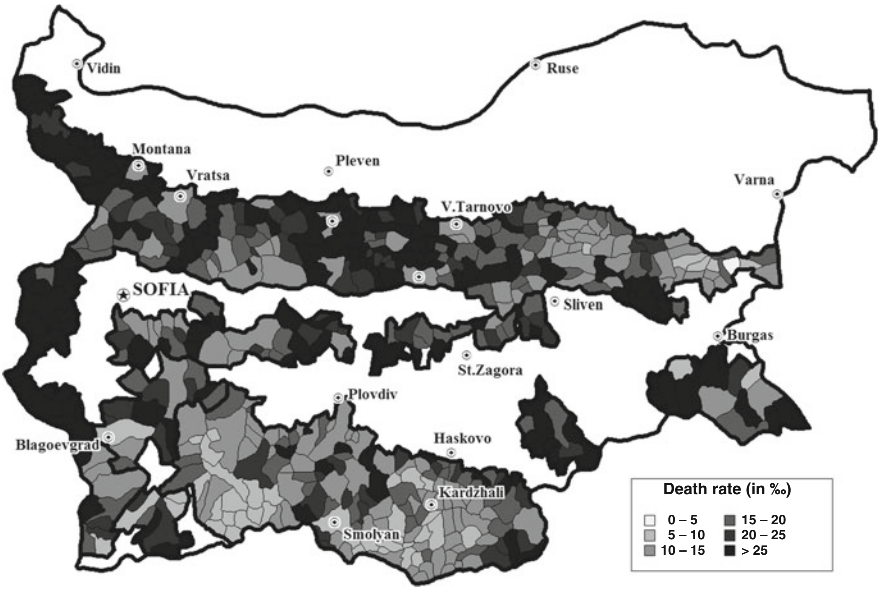

Fig. 13.5 Death rate – 2002–2007

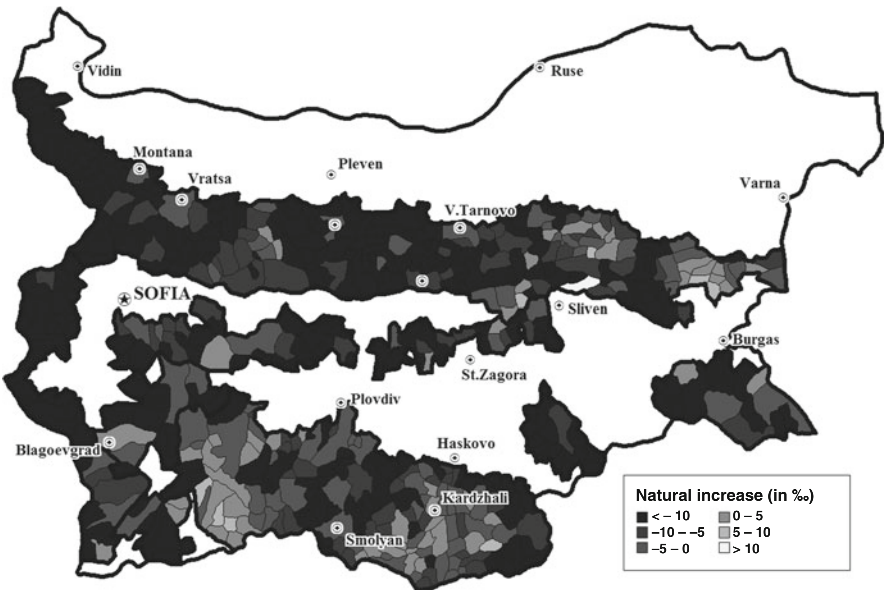

Fig. 13.6 Natural increase – 2002–2007

parts of the country, nowadays migration is directed to the largest cities and tourist centres in the country on the one hand, and to foreign countries on the other. In many mountainous areas emigration exceeds reasonable scale and leads to huge population losses and age structure deterioration. From economic and social point of view, modern-day migration is a necessary process, which, however, has a demolishing effect on demographic structures, reproduction and number of population. The negative consequences for settlements and the network of settlements as a whole are inevitable. As a matter of fact, according to the 2001 census, all uninhabited settlements in the country are located in mountainous regions, as well as the 40 villages erased from The List of Settlements in the Republic of Bulgaria.

In recent years, decrease of the population number in mountainous settlements due to emigration is around 1.7‰ (or migration growth of –1.7‰). To a great extent, this is a result of the combined effect of exhaustion of migration outflows on the one hand, and the thriving of tourism and relative economic stabilization of some mountainous towns on the other (in Strandzha region for example, migration growth of the population is 12‰). The highest population decrease rates due to migration are measured in Sakar Mountain –6.6‰ (or increase of –6.6‰), which lacks any significant natural and economic potential for development. The comparatively higher emigration decrease of the population in Stara planina region is due to the existing population outflow from small towns, which is also triggered by the scarcity of economic potential in those settlements. Growth of immigration rates is detected in those mountains, in which rural population dominates – Sredna Gora Mountain and the Western Border Mountains. Immigration flows in those areas consist mostly by retired, former local residents (Figs. 13.7, 13.8, and 13.9).

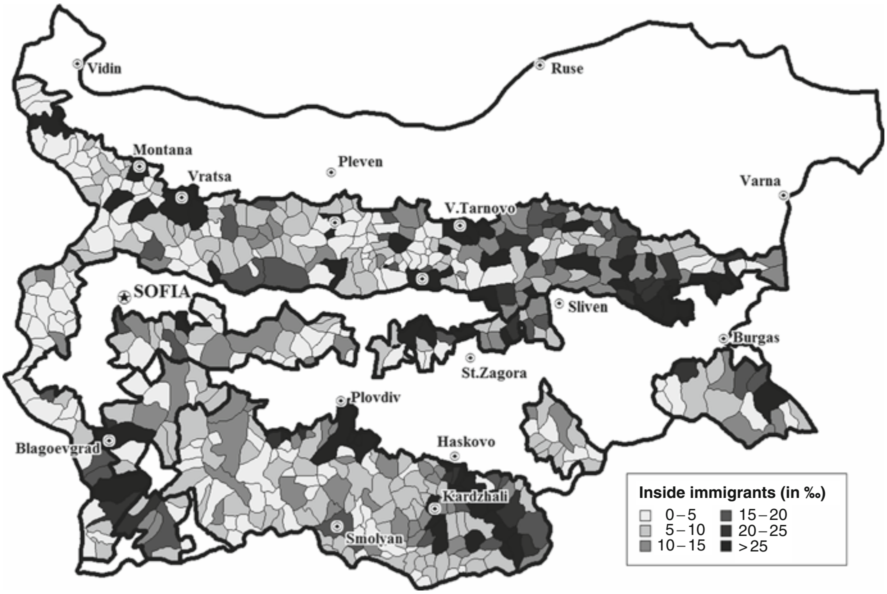

Fig. 13.7 Inside immigrants – 2002–2007

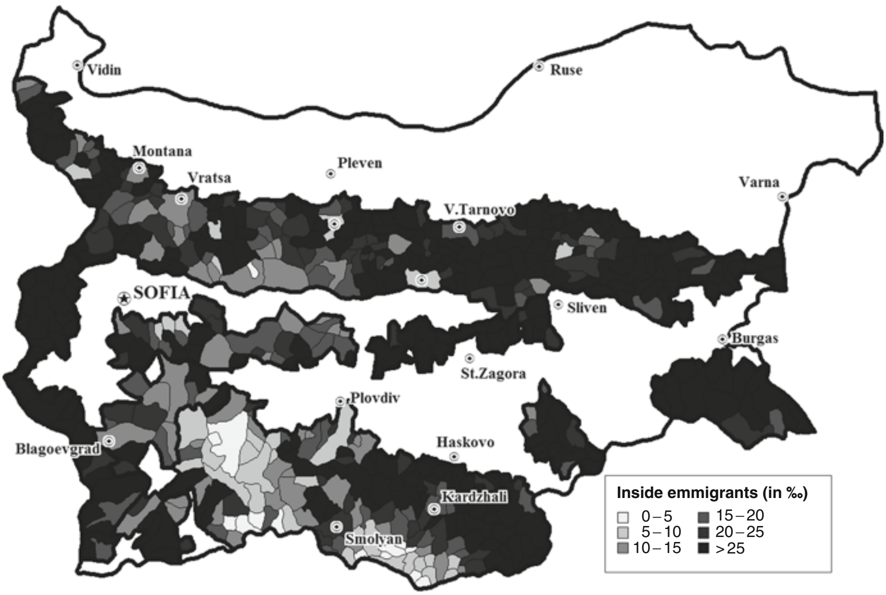

Fig. 13.8 Inside emigrants – 2002–2007

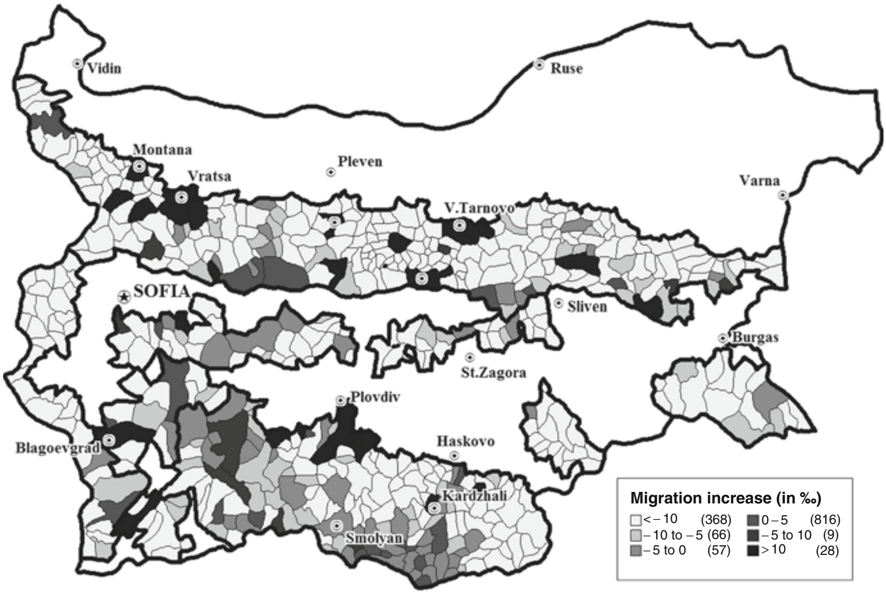

Fig. 13.9 Migration increase – 2002–2007

Age structure has a key role in the demographic development of the population. During the past periods, age structure shaped the general and the regional features of both – the reproduction and the migration processes. Unlike past periods, nowadays the age composition of the population in mountainous regions is worse compared to the national average. This worsening was due to the negative changes in the age structure of the population of the Rodopi Mountains, Eastern Stara planina and, to some extent, in Rila and Pirin. There is trend of constant ageing of the population. This is visible not only at the top, but at the bottom of the sex-age pyramid as well. The increase of the average life-expectancy affects to a great extent the ageing at the top of the pyramid, while the lowering birth rates result in ageing at the bottom of the sex-age pyramid. In both cases, emigration has a major role in the ageing process.

According to the age structure of their population, Bulgarian mountains can be divided into two main groups – a group of mountains with extremely old-age structure of the population and a group of mountains with moderately old-age structure, while there is no group of mountains with young-age structure of the population. The first group is composed by Western and Central Stara planina, the Kraishte region, Sredna Gora, Strandzha and Sakar. The population aged 0–14 years in those mountains is less than 15% of the total, while the share of population over 60 years of age is over 25%. The extreme ageing of the population in those areas is a result only of the intensive emigration of young residents in the past and the extremely low birth rates nowadays (Fig. 13.10).

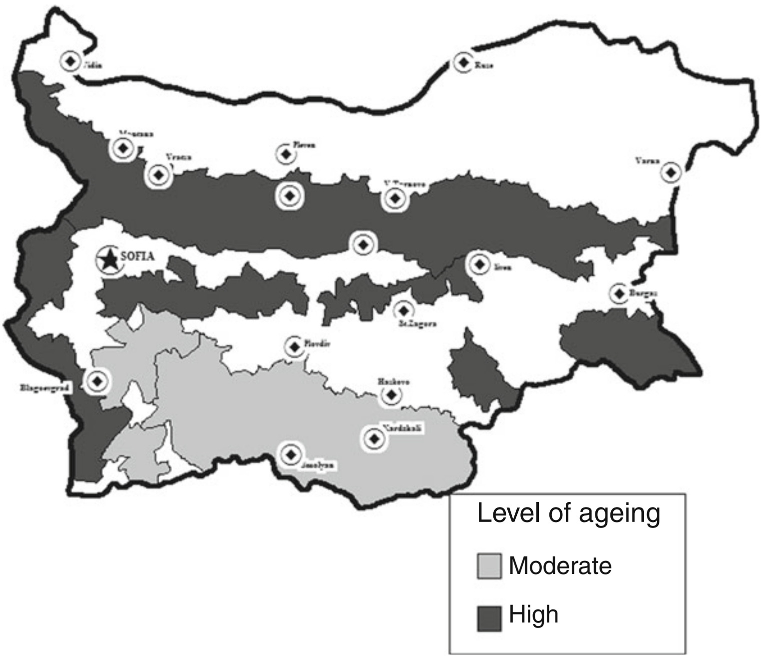

Fig. 13.10 Level of population ageing – 2001

The second group consists mostly of towns in the Rodopi Mountains, Eastern Stara planina and partially Rila and Pirin mountains. This is a result of the maintained higher birth rates in the past, combined with lower migration mobility. However, with the lowering birth rates and the increasing migration mobility in recent years, the age structure of the population in those areas worsens, although only to a moderate level. The share of population aged 0–15 in these regions varies from 15 to 17%, while the share of population over 60 does not exceed 20% of the total. Nevertheless, within the mountainous regions as a whole, age structures differ a lot. In the forthcoming decades, significant negative changes are expected to occur in the age structure of mountainous population. The share of elderly residents will continue to grow (approximately by 2% points), while that of the younger population will decrease (by 2.5% points). Ageing of the population will be defined mostly by the population in Stara planina, the Rodopi Mountains, Rila and Pirin.

At the current stage of demographic development, from economic and social point of view, the age composition of the mountainous population can be generally described as favourable. In order to reduce the negative consequences of the ageing process, a purposeful socio-economic policy aimed at preventing population loss in the areas with moderately aged population is required. Those mountains and parts of mountains in which the population age structure is extremely old would improve their situation only by attracting younger settlers from other regions. The improvement of the age structure by natural reproduction process is possible, however, that is not quite optimal, for there is a great danger of unwanted quantitative changes in the number of population, which would eventually lead to depopulation of vast rural areas.

The natural conditions and resources of our mountains favour the development of settlements network. More than half of the mountainous settlements (51%), including the largest ones, are situated at an altitude up to 500 m, and 91% of the settlements are located up to 1,000 m above sea level. Therefore, the altitude in general does not represent an obstacle for their overall development. Rural settlements are, in their great majority, small and many of them are of the scattered settlements type. Typical small settlements municipalities are those of Troyan, Gabrovo, Tryavna, Kilifarevo and Elena, in the northern slopes of the Central Stara planina range, Shiroka Laka, Madan, Rudozem, Smilyan, Chernoochene and Ivaylovgrad – in the Rodopi Mountains and Tran, Treklyano, Dragovishtitsa, Parvomay, etc. – in other parts of the country. All of the larger and medium-sized towns, as well as a significant part of the small towns, have a comparatively well-developed socio-economic potential. The majority of the villages are provided with enough arable land, conditions for tourism development, and fit-to-live-in houses. Along with those however, there are many small villages with transport-unfavourable location, poor arable land, difficult to get to, poor or lack of infrastructure, highly deteriorated age structure and poor or no reproduction capability of the inhabitants. From economic, social and aesthetic point of view, the existence of such settlements becomes more and more unjustified, and those villages gradually drop out of the settlements network. The majority of the mountainous settlements are located in limited-size terrains, which apprehend their growth, require multi-storey buildings in the larger towns and villages, as well as laying the transit transport infrastructure outside the settlements' limits.

The transport accessibility of most mountainous settlements is good. It is limited in some municipalities of the Central Stara planina region, such as Tryavna, Kilifarevo and Elena. In those municipalities only 42% of the settlements are accessible by asphalt roads, while 20% of the settlements can be reached only by gravel-covered roads, and bus services cover a mere 36% of all settlements. Rural settlements lacking convenient transport accessibility are, as a rule, scarcely populated and the majority of those will eventually drop out of the settlements network. Numerous villages in the Western Border Mountains, Sakar, Strandzha and the Rodopi Mountains also have transport-unfavourable location. More than 40% of the Rodopi Mountains settlements still have no convenient road accessibility (those are settlements located predominantly in Madan, Banite, Nedelino, Smolyan, Kardzhali, Chernoochene, Momchilgrad, Krumovgrad, Ivaylovgrad municipalities, etc.). Improvement of the road network and the transport services is crucial for intensifying the development of mountainous settlements.

The established demographic situation in Bulgarian mountains predetermines the reproduction capabilities of their population. That applies for both the quantitative and the qualitative parameters of human resources. The existing climatic, water, forest and grass resources, in equal other conditions, would help out for sustaining the existing network of settlements and even for the establishment of new ones (such as new tourist centres for examples).

However, because of the lack of affirmed concept and a long-term development programme, implementation of demographic and migration policies aimed at improvement of the demographic structures of the population and its spatial distribution is impossible. Special attention has to be paid to the stimulation of so-called central villages, through activation of their administrative function, economy and their service sector. In villages with rich and fertile arable land, the predominant growing of well-paid agricultural plants should be sought, so that farming becomes the main income source for the majority of the population. Mountain pastures and their rational use in cattle breeding, represent an additional reserve for economic activation of rural settlements. Sustaining of scattered and small-sized villages in mountain areas is inappropriate and unjustified.

Considering the importance of permanent residency, the comparatively well-developed network of settlements in our mountains, together with the settlements' role in the process of optimal nature resources utilization and the further nature productivity growth, the national authorities need to aim their activities at improvement of the demographic situation and the network of settlements in mountainous areas. In order to achieve these goals, the following needs to be done:

1. Development of a complete, scientifically based, demographic strategy for spatial development of mountainous population, in accordance with the goals of regional development of the country.
2. Estimation of the optimal number of population capacity of each hypsometric belt in order to avoid further depopulation of the mountains, especially in the high mountain areas, by providing conditions for rational nature resources exploitation, and protection of nature reproduction potential.
3. Detailed geodemographic research and prognostication of the reproduction abilities of the population, together with pointing out the actions necessary for normalization of the age structure and reaching zero natural decrease or even natural increase of the population, in all mountains and their inner regions.
4. Development of migration policy concept aimed at mountainous population, in accordance with the general migration policy of the country, and in accordance with the specific natural, demographic, socio-economic and environmental conditions in each mountain and inner mountainous regions.
5. Complex evaluation, typology and classification of mountainous settlements, together with a developed concept for settlements network improvement, appropriate to the changes that have occurred and to the further requirements for spatial organization development and the various needs of the population.
6. Creation of a concept for demographic development and support of small towns and central villages with favourable economic-geographic location in order to achieve rational utilization of the residential, public and industrial infrastructure.
7. Development of legislation base and a plan for granting certain mountain villages a status of towns (for example, Tsareva livada, Ruen, Garmen, Satovcha, etc.).

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Chapter 14
Demographic Limits to Sustainable Development of Mountain Regions in Serbia

Vladimir Nikitović

Abstract One of the effects of highly elemental urbanization in Serbia reflects itself in the disturbed sex composition of most vital age groups at the settlement level of the country. As a result, both agrarian zones of young men surplus and urban "oases" of young women surplus jointly reinforce processes of demographic aging and poverty in Serbia despite the goals of policy-makers presented through crucial national strategies regarding sustainable development of the country. The rural zones with young women deficit, which are predominantly border and mountain regions, are the first to face negative effects of the prevailing demographic tendency in the future. Some of the paper findings point to typical positive feedback loop "population-poverty" as the intrinsic mechanism of persistent "high- to lowlands" migration. Finally, population projection of mountain regions in Serbia indicates both decrease of population size and strong population aging as an inevitable and dominant demographic process in the next few decades. These tendencies could be substantial obstacles to the efforts in achieving sustainable development of Serbia's mountain regions.

Keywords Demographic limits · Sex ratio · Population aging · Serbia

14.1 Introduction

Mountain regions in Serbia are located in the southern part of the country, specifically in the east and the west border region. Demographic indicators were polarized in that way for decades. Indeed, most of the population lives in the northern part, predominantly presented by plain (the lowest part of Pannonia, the region of Belgrade City and river valleys of Central Serbia) while the mountain regions are almost deserted, gathering the oldest population in the country. This is the main result of

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continuous “high- to lowlands” migration within country borders that started soon after World War II. Demographic implications of the phenomenon are substantial for the future sustainable development of mountain regions. Dominant demographic process during the next decades will be population aging throughout the whole of Europe. The process that has already started affected especially Serbia due to its half a century long period of below replacement fertility and traditional emigration history. However, demographic polarization between urban and rural that existed for such a long period becomes less and less pronounced as population aging has had the fastest pace in urban areas for the last two decades. It is the effect of permanent, irreversible migrations of the population of the highest reproductive potential from villages toward towns after World War II. Nowadays, the largest part of those generations entered into the group of old-age population, leaving behind considerably smaller generations of descendants than themselves.

Given the essential striving of the process in regard to homogenization of the level of demographic aging across the territory of the whole country (Nikitović, 2006), typical demographic indicators of aging process, such as aging index and median age of population, cannot express essential differences between plain regions (mainly urban)[1] and mountain regions (mainly rural). From the point of the paper topic, substantial information on the capabilities of the future demographic and economic development of mountain region lies in the sex ratio of the population aged 20–39 years. In other words, putting most of the nationally planned pronatalist policies into effect will not be possible if there are no prospects for a significant number of people to find themselves a partner of the opposite sex, as due to the consequences of continuous migrations from mountain regions to low lands. For decades, more young females than males have emigrated from villages to towns. In the beginning of the process, the highest intensity migrations were from mountains to nearby towns while afterwards, when demographic capacities of hinterland subsided, the biggest flows were from small- and middle-sized towns to the largest centers in the country. The proportion of men is roughly equal to the proportion of women in the group aged 20–39 years (1,006)[2] at the level of the country due to a combination of factors: sex ratio at birth, age pattern of mortality, and negligible impact of international migration. However, continuous “high- to lowlands” migration during the last five decades produced disturbed sex composition of the group at settlement level of the country. Generally, regions having more men than women aged 20–39 years are poor, agrarian, mountain, and mainly border, while areas populated by more women than men of the same age group are predominantly urban and low land. The cause of the selectivity of migration by sex is founded in traditional family organization where males were taught to be “tied to land” while females were encouraged to leave their paternal houses. During the strong and fast industrialization of the former SFR Yugoslavia, mountain regions

[1] About 85% of urban population in Serbia lives in plain regions.

[2] According to the 2002 Census of population; 0.998—according to the 2007 Living Standards Measurement Study.

were generally neglected which transformed them into backward areas characterized by low agriculture production and lower economic position in relation to the rest of the country. Simultaneously, fast-growing towns (on account of immigration) during the period took advantage of industrialization and modernization presenting today the only oases of development in the country.

The idea of the chapter is to point out to the correlation between the disturbed sex ratio of the most vital population and economic development across the regions in Serbia. In other words, the surplus of young men in mountain regions and the surplus of young women in low lands could be the fine-tuned indicator of economic level of the area showing simultaneously in which ways national strategies concerning demographic processes in the future sustainable development should be implemented. In that sense, sustainable development of mountain regions is of specific interest for the country since the combination of their bad economic situation and lack of females in reproductive ages will reinforce both demographic desertification of the area and the trend of population concentration in the several biggest centers of the country.

14.2 The Analysis

The analysis is based on the 2002 Census of Population and the 2007 Living Standards Measurement Study in Serbia funded by the World Bank. The 2002 Census provided a possibility for the analysis at the settlement level which was used as a starting point. Settlements were not classified into low or high lands according to their absolute elevation but rather to their position in relation to the frontier between the Plains and the Mountains. The frontier was drawn according to the administrative districts of the Republic. This kind of distinction provided classification that gives more weight to the geographical surroundings of a settlement than to its own absolute elevation. The main advantage of the approach is that it is closer to reality. For example, it does not put automatically a settlement into the high lands category if it is located on an isolated hill inside plain since it is the part of surrounding net of settlements.

The 2007 Living Standards Measurement Study (LSMS) resulted from the questionnaires prepared by the instructions of the World Bank experts as help in formulating the Government Poverty Reduction Strategy. The sample encompassed 17,375 persons who reside in Serbia. Territorial representativeness of the sample was adjusted to the NUTS 2 level of the country. It means that this study distinguishes among six large regions each of which consisted of two or more districts. For the analysis in this chapter, main demographic characteristics of the questioned population were used along with two summary indicators of living standard—the limit of poverty and quantiles of the consumption (SORS, 2003b).

Two of the six regions—the East and the Southeast plus half of the West region—represent the Mountain area as it is defined in this chapter. According to the 2002 Census, the area is populated by 1,565,080 inhabitants, which represents 20.9% of the country population. Slightly more people live in rural than in urban settlements:

Table 14.1 Dependency ratios of two geographical areas by urban/rural distinction

		65/0–19			65/20–64		
	Area	Urban	Rural	Total	Urban	Rural	Total
The 2002 Census	Plains	0.67	0.88	0.76	0.23	0.33	0.27
	Mountains	0.43	0.98	0.70	0.18	0.40	0.28
The 2007 LSMS	Plains	0.76	0.95	0.84	0.23	0.33	0.27
	Mountains	0.53	1.43	0.91	0.20	0.49	0.33

Sources: Statistical Office of the Republic of Serbia (2003a); World Bank (2007).

51.7% against 48.3% while in low lands area this relation is quite opposite: 41.5% against 58.5%.

Table 14.1 shows homogenization of the population aging across the country according to usual summary indicators—age dependency ratios. Results from both sources the 2002 Census of population and the 2007 LSMS are presented.

As it was noted earlier, there is no substantial difference between high and low lands according to the dependency ratios for total population by both surveys. However, it can be noted that old population (aged 65 and over) make somewhat higher pressure in the Mountains than in the Plains if rural settlements are considered.[3] On the other hand, urban places are older in the Plains than in the Mountains. The difference between these two areas in the level of dependency ratios for urban population (aging index particularly) indicates the direction which dominates migration streams in the country during the last five decades. Since the majority of the settlements' population is presented by migrants who settled down during the 1960s–1980s period, these places are now facing strong population aging caused by entering of big immigrant cohorts into old ages.

While the direction of internal migrations in Serbia is still generally from the Mountains to the Plains, the most attractive targets of migrants are the biggest cities in the country, now. Since the industrialization almost exhausted population stock of rural areas, particularly in the Mountains, small- and middle-sized towns became new sources of population influx for several large urban oases in Serbia. Consequently, this directed more detailed analysis of the sex ratio at the most dynamic part of migrating population, those aged 20–39 years, which represents the population of the highest reproductive potential at the same time. Table 14.2 shows the ratio for this population segment depending on its geographical location and type of settlement.

According to the 2002 Census, both geographical areas are characterized by male surplus of the group if rural population is considered while surplus of females is common feature for urban centers of the two areas. Furthermore, the 2007 LSMS shows that only urban areas of low lands are populated by more women than men

[3] The difference is more pronounced by the 2007 LSMS, which can be accounted for continuation of the process and, to a certain extent, for the variation of the sample.

Table 14.2 Sex ratio of the population aged 20–39 years according to its geographical location

		Males/Females		
	Area	Urban	Rural	Total
The 2002 Census	Plains	0.955	1.072	0.999
	Mountains	0.959	1.130	1.036
The 2007 LSMS	Plains	0.911	1.116	0.981
	Mountains	1.039	1.136	1.079

Sources: Statistical Office of the Republic of Serbia (2003a); World Bank (2007).

of the group confirming what the 2002 Census already indicated by aging index (Table 14.1). Comparison of the two surveys shows the increase of young male surplus in rural zones of the Plains while towns in mountain regions started to have lack of females of reproductive ages. This clearly confirms accumulation of young women in urban centers of the Plains which reflects even in the difference between the Plains and the Mountains for sex ratio of the group irrespective of settlement type. The sex ratio of those aged 20–39 at regional level (NUTS 2) gives a more precise look at the spatial distribution of the indicator inside the two basic geographical areas (Table 14.3).

Belgrade city has the biggest surplus of young females in the country. Compared to the other five regions, it is obvious that the capital represents the most attractive destination of internal migration flows. It can be noted that only Central Serbia (according to the 2002 Census) and East Serbia (according to the 2007 LSMS) has female surplus of the group. In the former case it can be explained by the fact that Central Serbia belongs to the Plains given the distinction adopted in the chapter, and in the latter by the traditional emigration flow to the West European countries—"citizens working abroad" (consisted mainly of males), which was most typical for

Table 14.3 Sex ratio (males/females) of the population aged 20–39 years according to NUTS 2 level

	The 2002 Census			The 2007 LSMS		
NUTS 2 level	Urban	Rural	Total	Urban	Rural	Total
Belgrade City	0.931	1.029	0.948	0.821	1.062	0.857
Vojvodina	0.990	1.074	1.024	0.986	1.043	1.009
Central Serbia	0.940	1.067	0.998	1.054	1.153	1.096
West Serbia	0.931	1.108	1.031	1.124	1.181	1.156
East Serbia	0.976	1.096	1.031	0.844	1.082	0.948
Southeast Serbia	0.968	1.134	1.044	0.932	1.269	1.064

Sources: Statistical Office of the Republic of Serbia (2003a); World Bank (2007).

Eastern Serbia[4] (Grečić, 1998). Rural areas of all regions suffer from lack of females of reproductive ages but more difficult situation is in the Mountains compared to the Plains, while the Southeast region (which is economically least developed in the country) stands out as the worst. Unfortunately, the latter survey (the 2007 LSMS) indicates that even traditional industrial centers of the West and Central Serbia lack young females. If we take a closer look (municipality level) to the spatial differentiation of sex ratio of those aged 20–39, the distinction between the Plains and the Mountains in regard to this indicator is clearly pronounced (Fig. 14.1).

Almost all of the "islands" of young female surplus belong to the Plains. Only four of them are located in mountain regions, which could be easily explained. Two of these "islands" represent industrial centers based on mining while the other two are predominantly populated by Muslims whose male population considerably participates in the country's emigration stock in Western Europe, called "citizens working abroad." Thus, it is quite obvious that regional centers of the Mountains lacked female population of reproductive ages already according to the 2002 Census. In other words, there is a tendency toward young females congregating in regional centers of the country but unfortunately almost none of them is located in the Mountains. As it can be noted in Fig. 14.1, frontier between the Plains and the Mountains, almost sharply split up the country into two parts: Northern with islands of young female surplus and Southern—almost compact zone that lacks females of reproductive ages. This frontier could be a huge obstacle in achieving aims planned by the government pronatalist strategy but also the long-term limit to sustainable development of mountain regions in Serbia.

Apart from war conflicts, economic factors are dominant stimuli to migrations. Given the nature of industrialization process in Serbia during the last half of the 20th century, it was expected that mountain regions would be the less developed part of the country today. That situation shaped the general direction of internal migration in Serbia—from the high lands to the low lands. As a result, the Plains got more working-age population having higher living standard compared to the Mountains. But this process has no tendency to allow the areas to exchange their positions. It is more likely that distinction between them will be more pronounced in the future. The question is—why? The analysis of indicators of disturbed sex composition at lower spatial levels pointed to profound economic and social factors (analyzed through poverty indicators) as a driving force of internal migration in a typical positive feedback loop "population-poverty." The mechanism of this feedback loop behaves as follows: people will migrate from poor regions to the wealthier ones leaving behind worse population structure than it was, but improving demographic composition of wealthier areas. In other words, the less young people stay in the Mountains, the poorer mountain regions will be. And the opposite, the more young people come to the urban centers, the better living standard in the Plains.

[4]East Serbia has lower surplus of young males compared to other mountain regions of Serbia (West and Southeast) for rural population according to both surveys and even for urban population according to the 2007 LSMS.

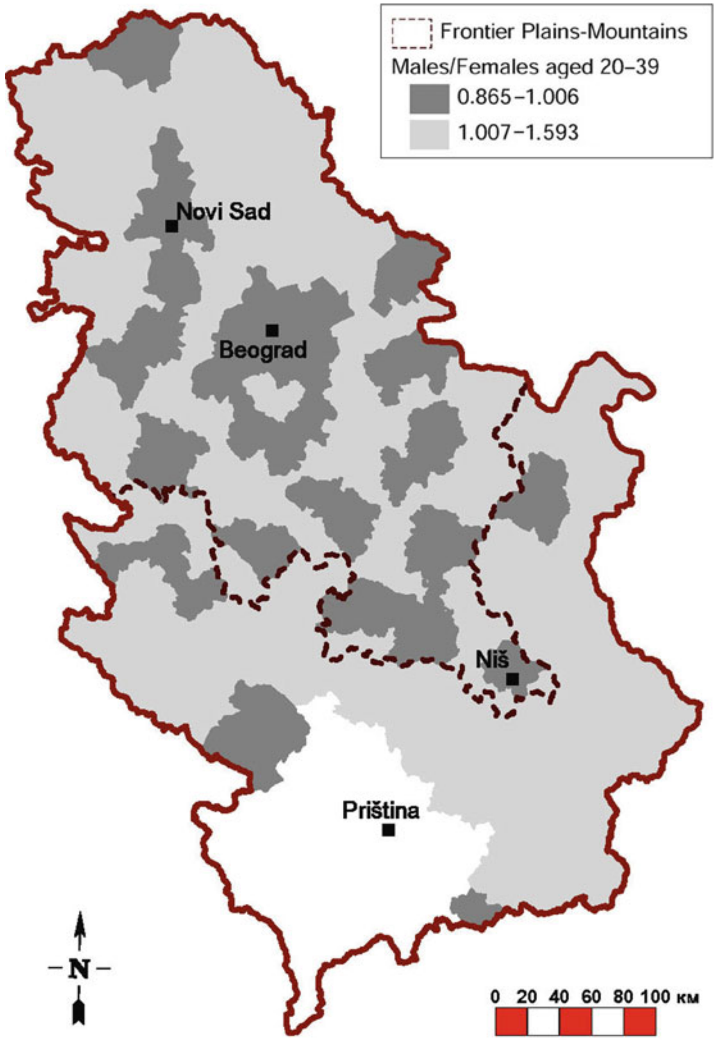

Fig. 14.1 "Islands" of young women surplus against zone of young men surplus

> In system terms these structures are called "success to successful" feedback loops. They tend to be endemic in any society that does not consciously implement counterbalancing structures to level the playing field. (Meadows et al., 2004, p. 44)

One of advantages of using a questionnaire about the living standards of Serbia's citizens instead of common GDP refers to the fact that size or wealth of the economy is not such an important predictor as it is the extent to which economic improvement actually touches the lives of all families, and especially the lives of women. In this chapter, quantiles of consumption were used as a basic indicator of the living standard of people. The spatial distribution of the sex ratio of those aged 20–39 years, as shown at Fig. 14.1, already indicated potential positive correlation between female surplus of the age group and higher consumption level across the small territorial units. Since the 2007 LSMS results are representative at NUTS 2 level, statistically based inferences about the correlation could have been estimated across the six large regions only. The Pearson product moment correlation coefficient is 0.72, which confirms hypothesis about sex ratio of the most vital age group as a fine-tuned indicator of the living standard of an area. This relatively strong correlation points, above all, to socially very established way of personal dealing with inherited problems of highly uneven development across the regions in Serbia, which can be generalized by intrinsic opposition between the Plains and the Mountains. Consequently, the aims presented in government strategies on pronatalism, poverty reduction, and population aging imply counterbalancing of strong regional differences. If this prerequisite is absent, the well-established migration flow from high (poor) to low (higher standard) lands will further deteriorate sex structure of the most vital population group across the regions of the country. This analysis recognized some of the not-so-obvious demographic limits to sustainable development of mountain regions pointing to already significant amount of "frozen" reproductive potential which is of no effective use on account of its spatial dispersion. Resulting opposition between backward agrarian zones of young men surplus and urban "islands" of young women surplus will reinforce processes of demographic aging and poverty throughout the country despite the goals of policy-makers. This could be easily illustrated by the population projection.

14.3 The Future

Probabilistic population projection specially prepared for the purpose of the chapter presents some of possible ways to exceed current demographic limits to sustainable development of Serbia and its mountain regions particularly. General hypothesis on demographic components coincide with assumptions used for making population projection included in government Strategy on spatial development of Serbia up to 2020. In addition, projection horizon has been extended up to 2050 in this chapter in order that long-term implications of current demographic trends could be considered. Precisely, the projection does not assume any dramatic improvement of fertility, similarly to the hypotheses in the recent probabilistic projections of European countries (Lutz and Scherbov, 1998; Alho, 2002; Statistics Netherlands, 2005), but takes into account both polar cases—implementation of officially proclaimed pronatalist aims and decreases of total fertility rate to the lowest level recorded in Europe. It was generally assumed slow increase of life expectancy where target values are close to current levels of countries with longest life span. Migration as a component of population change has generally the lowest predictability (Matysiak and Nowok, 2006), especially in countries like Serbia (Nikitović, 2010). On the other hand, its importance could be immense in traditional low-fertility countries where fertility impact on improving age structure is limited (Nikitović and Lukić, 2010). This projection took into account both possible integration into EU in the near future, which could transform Serbia's net migration balance from a negative one to positive one under certain conditions, and intensifying emigration character of migration due to an unfavorable political and economic situation. It was assumed that the direction and intensity of internal migration is perfectly correlated to the predicted character of international migration.

The probabilistic forecast shows that Serbia will face significant population aging with no chances to revert the process during the projection. With respect to decreasing trend of population size, fertility increase is one of two indispensable conditions if Serbia wants to restore its current size. The other is huge immigration that could be accomplished if the country experiences fundamental political and economic changes in the forthcoming period. Even then, there is only 9% probability that Serbia's population size in 2050 will be higher than it is today.

In that context, population projection for the Mountains shows that current demographic situation could be improved if positive trends in migration occur in the next period. In addition, mountain regions will be probably somewhat younger than low lands due to accumulation of migrant population in the Plains during the last several decades. That stock will enter the old-age group during the projection horizon (Table 14.4).

The median, or the most probable forecast, shows a decrease of total population in the Mountains by almost one fourth in 2050 compared to the 2002 Census. But if the aims of the government pronatalist strategy failed and emigration intensified, population size of the area could be even reduced by one third according to the lower limit of the 80% forecast interval. On the other hand, not even positive winds, especially immigration into the Area in synergy with fertility improvement, could stop decrease of population size of the Mountains in the long run. Indeed, those improvements are of limited capacity given the actual age structure of the population and growing spatial dispersion of the most vital age group.

Anyway, forecasted dependency ratios show that population aging will most probably be stronger in the Plains than in the Mountains, which is expected given the accumulated stock of working-age population from actual and earlier periods. But, it is not so encouraging for the future of the Mountains because its demographic

Table 14.4 Population projection results for 2050—median and 80% forecast limits

	Total	OADR	AI	0–19	65+	80+
MOUNTAINS	*(1,565,080)*	*(0.284)*	*(0.695)*	*(23.92)*	*(16.63)*	*(1.96)*
Upper limit	1,369,850	0.458	1.898	19.66	26.67	8.05
Median	**1,200,869**	**0.394**	**1.426**	**16.51**	**23.58**	**6.44**
Lower limit	1,044,433	0.340	1.081	13.71	20.70	5.04
PLAINS	*(5,932,921)*	*(0.271)*	*(0.755)*	*(21.88)*	*(16.52)*	*(1.93)*
Upper limit	5,561,897	0.580	2.275	19.42	31.28	9.74
Median	**4,871,665**	**0.496**	**1.708**	**16.24**	**27.73**	**7.86**
Lower limit	4,225,684	0.427	1.305	13.38	24.57	6.22

Source: Author's calculation; Notes: OADR—Old age dependency ratio (65+/20–64), AI—Aging index (65+/0–19); Values in parenthesis—the 2002 Census indicators are not much favorable compared to the Plains. Besides, these general figures hide spatial isolation among places in the mountain region, which could easily place real future values of demographic indicators closer to the unfavorable forecasting limit rather than to the most probable forecast (median) or desirable forecasting bound. At the same time, population settled in the Plains could achieve at least most probable forecast (median) values using benefits of its high spatial concentration given the same migration conditions across the country. In other words, even if Serbia experiences large population influx in the next decades, it would be much easier to achieve desired demographic development with population at most vital ages that is not spatially dispersed and differentiated according to sex.

14.4 Instead of Conclusion

Only synergy of substantial improvement of fertility and huge immigration could stop population desertification of the mountain regions in the long run. Recognized demographic limits to sustainable development of the Mountains will be further deteriorated if causes of spatial barriers between two sexes in the most vital ages remain. Thus, basic prerequisite for the future sustainable development of mountain regions in Serbia is diminishing strong regional differences; above all, between the Plains and the Mountains.

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Chapter 15
Regional Differences and Regional Planning of Economic Activities in Bosnia and Herzegovina

Rahman Nurković and Haris Jahić

Abstract In this chapter regional differences as an indicator in regional development of Bosnia and Herzegovina have been studied. In this regard, economic development of new economic activities and contemporary activities, particularly development and structure of work function were discussed. Unequal regional development in Bosnia and Herzegovina is a regularity of economic development, which is particularly expressed, at certain developmental stages, in polarisation of population and income.

Keywords Regional development · Socio-economic structure · Population · Number of employed people · Bosnia and Herzegovina

15.1 Introduction

Unequal regional development is a common regularity of economic development, which is particularly expressed, at some developmental stages, in polarisation of economic activities, population and income. At the same time, certain parts of the country remain on periphery, weakly or insufficiently included in general development. Thus, all the countries are characterised by spatial–developmental disproportion, regardless of social arrangement and degree of development. As a rule, problems of regional development are more discussed when multiplicative effects of lagging the periphery behind start burdening more expressively development of country as a whole. That development, therefore, had been increasingly monitored and directed by the plans of regional development in the past decades.

Methodology of exploring the differences at the level of regional development has evolved in accordance with understanding of that idea. At earlier stage, when it had been mainly identified with spatially differentiated economic growth, the regional development was expressed through social product or national product per capita, respectively as one-dimensional process.

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By recognising the understanding of regional development as natural–geographic and social–geographic process of transformation of regional structures, new research approaches developed, based on bigger number of indicators for measuring the development of spatial units. Among them, a distinguished place belongs to systemic approach and multi-regional plans, on which current regional development in Bosnia and Herzegovina is substantially grounded.

As regional development is, first of all, manifested by unequal spatial distribution of population and activities, function of work is particularly important as an indicator of differences in development of the spatial units of the same type. It is even more important because it is, at the same time, a basic factor of spatial plans and, especially of their natural–geographic characteristics. Namely, by connecting the active population and natural resources in process of their economic evaluation, the oriented work is directly seen in dynamics, at the level of economic development of spatial plans. An objective of this chapter was to determine regional differences in Bosnia and Herzegovina against the European Union.

15.2 Methodology of Research

Regional differences and regional planning of economic activities in Bosnia and Herzegovina have been analysed in the chapter. Within that, development of economic activities as an indicator of the differences in modern regional development of Bosnia and Herzegovina was more closely discussed. The data on population numbers, share of investments, share of active population and share of employment, the reached level of socio-economic transition, respectively structure of work, share of employed people in activities of the primary, secondary and tertiary sector, were used as the indicators of polarised development. Regional development of Bosnia and Herzegovina was analysed at two levels of spatial analysis. The first one is existing regional structure, and the second is an envisaged regional structure against the European Union. Suitability of regional structure as spatial plans for exploring the regional development was determined, first of all, by the fact that the regions are spatial units of medium rank of managing-territorial hierarchy and their inclusion mainly corresponds to notion of nodal-functional regions. Hence they are proportionally stable analytical units for statistical research and, at the same time, spatially planned units of regional coordination. It should be noted that polarisation and regional development were discussed in this chapter from natural–geographic and social– geographic point of view, which means that its objective is not quantification of differences in social–economic development, but connection of relevant developments of spatial plans (Černe, 2005, p. 24).

15.3 Socio-economic Transformation and Regional Development of Bosnia and Herzegovina since the Mid-20th Century

The most dynamical economic development of Bosnia and Herzegovina are ongoing under influence of industrialisation after the Second World War. Industrialisation of the country was followed by transformation of the overall economy and population, as well as by significant urbanisation growth. It is the period in which Bosnia and Herzegovina experienced a significant economic growth and huge structural changes, in which it has grown from predominantly agricultural country into a medium developed industrial country, with significant sector of export services. Generally, dynamical economic development by mid of the second half of the 20th century did not reflect so much on growth of physical volume of the function of work, as it reflected on change of socio-economic structure of population. This is proved by absolute and relative lagging behind of increase of number of active population against the total population of Bosnia and Herzegovina in period from 1991 to 2008. At the same time, it was evident that as an indicator of variable development of function of work, relatively the highest activity was recorded at the beginning of that period, while the highest number of active population was recorded at the beginning of the1990s.

By the end of the war, the volume of economy of Bosnia and Herzegovina reduced to around 35% of annual production. After the Dayton Agreement had been signed, focus of activities of governments at all levels was on reconstruction of economy and society, by extensive international financial and technical assistance (US$ 5.1 billion). Consumption of the government and donor funds was directed to reconstruction of infrastructure and housing projects, and to establishment and strengthening of key bodies and institutions of governments of the state and entities, so that they might bear responsibility for implementation of basic economic, political and social reforms. In period from 1996 to 2000, high rates of economic growth were achieved, which in some countries exceeded 20%. However, due to socio-economic structure, which is dominated by industry and mining and the undeveloped primary sector, such rates were not sustainable over the long term. Since 2000, the transition process of Bosnia and Herzegovina has been accelerated, mostly due to monetary stabilisation (low inflation, stable currency, and low external public debt), price liberalisation and reform of financial system. In Bosnia and Herzegovina economic development in 2007 in real conditions was 6.2%, which is the highest growth in GDP in the past 5 years, while its average growth rate in this period was 5.2%, in Bulgaria 5.6%, in Serbia 5.5%, in Romania 5.2%, in Albania 5.0%, in Croatia 4.6% in Macedonia 4.0% and in Montenegro 4.0% (Table 15.1 and Fig. 15.1).

Despite an absolutely and relatively slow growth of number of employed people, more complex economic development has generated a strong socio-economic

Table 15.1 Regional comparison of GDP growth rate in 2007

Country	Growth Rate of real GDP %	PPP/Per Capita GDP (USD)
Bosnia and Herzegovina	6.2	7,168
Bulgaria	5.6	8,026
Serbia	5.5	5,348
Rumania	5.2	8,413
Albania	5.0	4,929
Croatia	4.6	12,336
Macedonia	4.0	6,767
Montenegro	4.0	–

Source: World Economic Outlook 2006/MMF

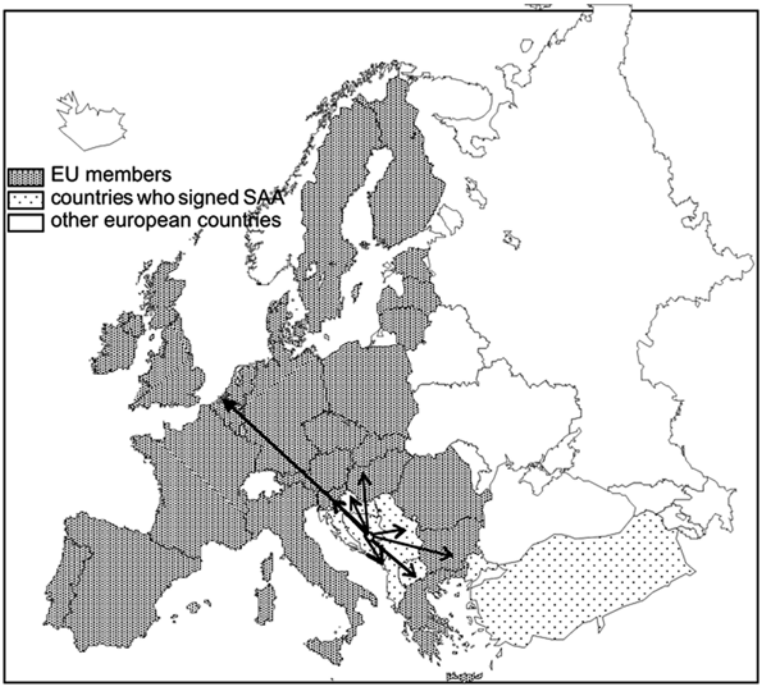

Fig. 15.1 Bosnia and Herzegovina and the United Europe

transformation. On the one hand, it is reflected by intensive process of deagrarisation, and on the other hand, by corresponding increase in number and share of the employed people in activities of the secondary and tertiary sector. Fundamental "push factor" of social restructuring of the farmers was a stagnation of agriculture, which can also be seen from the lowest average annual growth rate of primary sector (1.6%), twice lower than the average of total economy of Bosnia and Herzegovina (3.7%) in period 1991–2008. On the other hand, superfluous agricultural population was obviously attracted by more dynamical growth of propulsive non-agricultural activities. This is proved by the data on average annual rates of national income, secondary (4.0%) and tertiary sector (4.4%), in period 1991–2008.

Compared to its regional partners, economy of Bosnia and Herzegovina has the highest rate of real GDP in the region. However, the EBRD data on GDP, calculated according to purchasing power, show that GDP of Bosnia and Herzegovina per capita was US$ 7.168 in 2007. Method of parity of purchasing power is more useful in comparison with standard of living between the countries, since it takes into consideration both costs of living and inflation. Within the context of the regional development, Bosnia and Herzegovina is behind Croatia, Romania and Bulgaria.

There are big changes in population structure and level of urbanisation of Bosnia and Herzegovina. Accordingly, almost 2,000,000 inhabitants abandoned agriculture in period 1953–2008, with corresponding consequences on economic and social, respectively socio-geographic development of the country. Thus, according to the 1991 census, Bosnia and Herzegovina had 16.7% of urban population, and in 2008, share of urban population was around 38.2%. By means of the mentioned models in Bosnia and Herzegovina, in 1991, and by using the census data, five urban settlements in which about 45% of population live, were separated. Total of 34 urban settlements with up to 4,999 inhabitants were prevalent in structure of the urban settlements, according to size. There were 48 of medium-size urban settlements from 5,000 to 19,999 inhabitants, whereas two urban settlements had over 100,000 inhabitants. At the same time, 16.72% of urban population, respectively 38.2% of total population lived in five of the largest urban settlements of Bosnia and Herzegovina (Table 15.2).

In general, if we analyse the particular towns of Bosnia and Herzegovina as a unique urban system, we will reach edifying results. In order of size of urban settlements indicating hierarchical features of urban system, certain irregularity is noticed, which was also present in urban development of Bosnia and Herzegovina in previous periods. The first thing which is noticed in order of size of urban settlements of Bosnia and Herzegovina is that Sarajevo, Banja Luka, Tuzla, Mostar and Zenica, as the biggest urban settlements, are oversized against the others. There are unequal dynamics of increase in total population and urban population, as well as differences between single central settlements and the communities of municipalities in Bosnia and Herzegovina (Vrišer, 1981, p. 129).

The highest growth of total population in period from 1981 to 1991 had Sarajevo +74,912 or 12.4%; Zenica + 32,458 or 65.5%; Banja Luka + 15,678 or 15.4%; Tuzla +18,679 or 28.6% and Mostar +12.438 or 19.6%. In 1991, large industrial centres of work were dominant in Bosnia and Herzegovina. Stronger centres of work had a special importance for development of continuous urbanised zones. According to our analysis these are the centres with 20,000 or more employed people. There were five such centres in 1991. Sarajevo is the biggest centre of work, with more than 184,674 or 46.9%; Banja Luka 65,026 or 16.2%; Zenica 54,991 or 13.7% and Tuzla 51,852 or 12.9% of total employed population in Bosnia and Herzegovina.

Table 15.2 Structure of urban population of Bosnia and Herzegovina in 1991 according to size of urban settlements

Size of urban settlements	Number of urban settlements	% of total	Population	% of urban population BiH	% of total population BiH
100,000 and more	2	2.1	279, 400	16.7	6.3
20,000–99,999	10	10.6	743, 985	44.4	16.9
5,000–19,999	48	51.0	541, 651	32.3	12.3
2,000–4,999	34	36.1	107, 819	6.4	2.4
Total	94	10,000	1,672,855	10,000	38.2

Source: Statistical yearbook of Bosnia and Herzegovina, Sarajevo 1991

15.4 Modern Regional Development of Bosnia and Herzegovina

Regional developmental differences are the problem of the whole world. The European countries are also more and more unevenly developed, thus developmental differences exist among different regions. Regional developmental differences in Bosnia and Herzegovina are characterised by regional polarisation of population and function. If we discuss importance of share of active population by sectors of activities in regional centres, we will be able to notice considerable differences. These differences originate from a number of factors, the most important of which are level of development and orientation to particular activities, which depend, in part, on stocks of particular natural resources. This is best shown on examples in Bosnia and Herzegovina in which coal ensures more than 50% of total energy consumption. It may be expected that the future regional development will be carried out through the spatial plans.

Transition, respectively the processes of economy and society restructuring in Bosnia and Herzegovina, as a whole, are ongoing very intensively, but also under significantly deteriorated and special conditions. The standard transition package, applied more or less in most of the post-communist countries, was completed by the World Bank and the International Monetary Fund in line with the principles of neoclassical economic ideology. In transition from the post-communist to market system, Bosnia and Herzegovina uses its significant natural–geographic, traffic, as well as demographic advantages. However, these processes were significantly slowed down and deteriorated by The Balkans war crisis from 1991 to 1995. In this context, the first private accumulation of capital is developing the fastest in fields of commerce, tourism and catering, finances, intellectual services and alike, with considerably slower restructuring of industrial production, where a very strong dominance of the state ownership and control is still present at the transition stage. In such economic circumstances, processes of deagrarisation, urbanisation, deruralisation and restructuring of population towards tertiary and quaternary activities have been considerably slow in the past years (Table 15.3 and Fig. 15.2).

Socio-economic orientation of Bosnia and Herzegovina was presented through analysis of employment by sectors. In 2006, the biggest share of active population in Bosnia and Herzegovina was in tertiary sector: 61.1%. The secondary sector

Table 15.3 Share of active population (in %) in primary, secondary and tertiary activities according to census from 2006 to 2008 in Bosnia and Herzegovina

	2006	2007	2008
Sectors	%	%	%
Primary sector	3.1	2.7	2.7
Secondary sector	36.8	32.2	33.4
Tertiary sector	60.1	65.1	63.9
Total	100	100	100

Source: The State Agency for Statistics of Bosnia and Herzegovina in Sarajevo, March 2008.

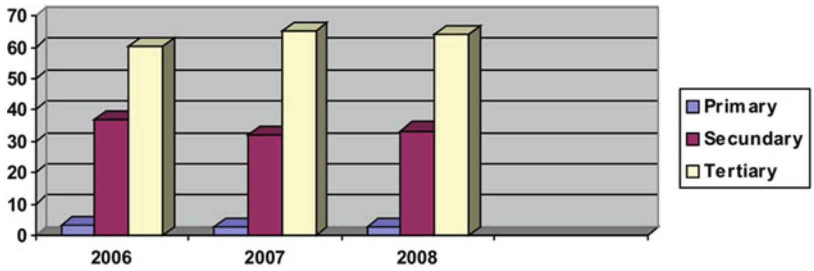

Fig. 15.2 Active population share (in %) in Bosnia and Herzegovina in primary, secondary and tertiary activities according to census from 2006 to 2008

followed with 36.8%, and primary sector with 3.1%. In 2008, there were 488,976 or 63.9% of active population in tertiary sector in Bosnia and Herzegovina, in secondary sector 1,990,060 or 33.4%, and in primary 19,160 or 2.7% of total active population. The secondary sector also represented the most developed activity in all municipalities of Bosnia and Herzegovina, although the share of employed population reduced by 3.23% against 2006, and in tertiary by 1.5%. In 1999, tertiary sector recorded increase in the active population share in the Tuzla valley by 7.1%, the highest in municipality of Banovići by 19.3%, then Lukavac 15.4%, Živinice 7%, Tuzla 3.3% and Kalesija by 2.8%. Economic crisis, which started after 1981, reflected most expressively on industry, which still had a primacy over all activities. At the end of 1991, closing down industrial firms and dismissal of workers in mines and chemical industry of Tuzla, Lukavac and Živinice occurred (Nurković, 2004, p 16).

Focus of the polarised development is the urban agglomeration of Sarajevo, respectively the broader socio-economic region, in which dynamical processes of social–geographic transformation are ongoing under the influence of the leading Bosnian urban centre. Sarajevo region with more than 20% of total population concentrated in it, 18% of the employed people and 67% of all investment in long-term state property is above other regions in Bosnia and Herz. The spatial plan of Bosnia and Herzegovina was prepared on the basis of methodology which has envisaged, among other, the sector, home and regional line. Regionalisation in Bosnia and Herzegovina did not exist, and in preparation of the plan the so-called planned regions were used. No special models were used in preparation of the plan, except some standard methods and techniques like Lorry's and Gravity models. It has been determined in the research that natural–geographic features had the biggest influence on spatial arrangement of Bosnia and Herzegovina (Fig. 15.2).

In 2000, Bosnia and Herzegovina started to differentiate functionally as well. This relates, first of all, to expansion of tertiary activities and infrastructure in suburbanised settlements. In their development in period 1991–2008, urban cores of Bosnia and Herzegovina obtained the character of relative decentralisation. Suburban settlements express faster tendency of increase in number of population. These settlements experience stronger and stronger functional transformation because of expansion of the industrial firms. According to the mentioned model, more and less intensely urbanised settlements and rural settlements have been separated. All settlements that do not meet the mentioned criteria in the model have been included in a separate group. Status of town gained the settlements with over 2,000 of inhabitants, below 10% of agricultural population, and with over 50% of workers in place of living, although it has less than 10,000 inhabitants. After adoption of the spatial plan of Bosnia and Herzegovina in 1991, a very broad process of preparation of spatial plans for municipalities was opened and a certain number of spatial plans for special areas were prepared as well (Fig. 15.3).

Apart from Sarajevo, the leading centres of polarisation are also the macro-regional centres of Banja Luka, Mostar and Tuzla, of which these towns are functional foci. Similarly, even more expressed disproportion between number of population, investments in long-term property and number of employed people is also present at the regional level. Thus, according to demographic concentration and investments, four regions are distinguished in spatial plans: Sarajevo, Mostar, Banja Luka and Tuzla. At the same time, a positive correlation between the analysed indicators of polarised development of the regions and demographic development of the main core settlements is obvious. So the leading centres of the regions prevalent in polarisation of population and functions in most cases are the demographically developed regional centres. By polarised development of population and function,

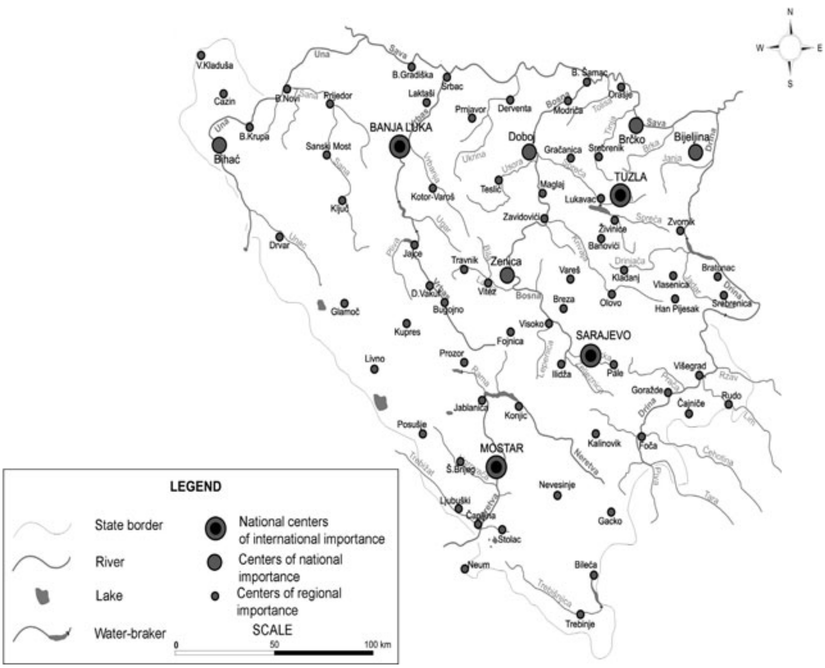

Fig. 15.3 Modern regional development of Bosnia and Herzegovina

specificities of regional development are seen in different functional orientation of regions, maintained by social–economic structure of employed population (Vresk, 1981, p 203).

15.5 Conclusion

Transition, respectively the processes of economy and society restructuring in Bosnia and Herzegovina, in general, are ongoing very intensely, but also under significantly deteriorated and special conditions. Standard package of transition, applied more or less in most of the post-communist countries, was completed by the World Bank and the International Monetary Fund, in accordance with principles of neoclassical economic ideology. With transition from the post-communist to the market system, Bosnia and Herzegovina uses its substantial natural–geographic, traffic, as well as demographic advantages. However, these processes were significantly slowed down and made difficult by the Balkans war crisis from 1991 to 1995. The beginning of reforms of socialist economy in Bosnia and Herzegovina has started by establishing of macro-economic stabilisation, which was positioned as a strategic precondition for further reforms. It anticipated the problems of inflation, on which IMF particularly insisted and introduced a set of monetary financial measures: restrictive monetary politics, convertibility of currency, financial discipline and firm budgetary restraints. In period 1996–2000, high economic growth rates were achieved, which in certain years exceeded 20%. However, due to socio-economic structure, dominated by industry and mining and undeveloped primary sector, such rates were not sustainable in a long term. Since 2000, transition process of Bosnia and Herzegovina has been accelerated, mostly because of monetary stabilisation (low inflation, stable currency and low external public debt), price liberalisation and reforms of financial system. In 2007, economic development of Bosnia and Herzegovina increased, in real conditions, by 6.2%, which is the highest increase in GDP in the past 5 years, while its average growth rate in this period was 5.2%, in Bulgaria 5.6%, in Serbia 5.5%, in Romania 5.2%, in Albania 5.0%, in Croatia 4.6%, in Macedonia 4.0% and in Montenegro 4.0%.

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Chapter 16
On the Sunny Side of the Alps: Slovenian Mountains and Their Perspectives

Dušan Prašnikar

Abstract Slovenia lies in the south-eastern part of the Alps. Most of the country is defined as a mountainous area. Because of the structure of mountainous areas in Slovenia, the sustainability is adapted in most of the state policy, legislatively and in practice, and there is almost no specific policy for mountainous areas. Therefore, Slovenia generally does not have many problems of adapting its legislation with the Alpine Convention. In most of the country there is a dispersed type of settlement, although more than a half of the state is covered with forests. Today Slovenia faces the challenge to keep the countryside cultivated and alive. Large protected areas are one kind of the state measures, while their aim is not only to protect the nature but also the landscape and to support the settlement of mountainous areas as well.

Keywords Slovenia · Mountains · Sustainable development · Mountain policy · Alpine Convention

16.1 The Characteristics of the Mountain Areas in Slovenia

Slovenia lies at the crossroads of the Europe. Its position is one of the most interesting in Europe. Although Slovenia measures only 20,000 km^2, it is a part of four big European regions – the Alps, the Mediterranean area, the Balkans and the Pannonian Plain. Diversity of everything (environment, climate, culture, etc.) is one of the highest per km^2 in Europe, which makes Slovenia very attractive, and the Slovenians are proud of this diversity. Despite different regional variations Slovenia is an alpine – mountain country. The country lies in the south-eastern part of the Alps and despite its position at the margin of the Alps it has characteristics of an alpine country. Concerning regionalisation, Slovenia is divided into four main regions and the Alpine region is the most extensive one. It measures 42% of the Slovenian territory and it is a place for 47% of the Slovenian population.

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Also the Dinaric region reflects mountain characteristics – especially by level of surface inclination and average height above the sea level. The Alps and Dinaric mountains both together represent 70.2% of the Slovenian territory, which gives the impression that Slovenia is a mountainous country. Owing to environmental characteristics, most of Slovenia is mountainous but in the mind of the Slovenians real mountains are only the Alps with peaks over forest line and their valleys.

There are some facts, which reflect Slovenian relation to the mountains. The highest Slovenian peak Triglav has the central position in the state emblem. There are over 60,000 members of Alpine Association of Slovenia in more than 200 mountain clubs throughout Slovenia. Tourist slogan in the late 1980s and early 1990s, when patriotism was at the highest, was "On the sunny side of the Alps". Article 71 of the Slovenian Constitution defines that the state cares about economical, cultural and social development of mountain regions (but there is no criteria what mountain regions are). Most of the Slovenian rivers have nival-fluvial regime. Slovenia has two small glaciers of which Ledenik pod Skuto is the most south-eastern glacier in the Alps. Their extent is measured in hectares but there are much larger areas which used to be covered with glaciers and therefore have typical glacial geomorphology.

	Slovenia	Alpine region	Alps and Dinaric mountains
Area (km^2)	20,272	8,541 (42.1%)	14,247 (70.2%)
Population – Census 2002 (in thousand)	1,966	924 (47.0%)	1,232 (63.7%)
Average elevation (m)	557	732	672
Average inclination (^{o})	14.1	19.6	16.6

Source: Geographical Institute Anton Melik, Slovenia

16.1.1 Definition of the Mountain Areas in Slovenia

Most of Slovenia is mountainous but generally only the Alps are considered as the real mountains. And criteria for the mountain areas are stricter in Slovenian national legislation. The mountain area defined in this chapter covers a larger part of the Slovenian territory than the mountain area defined by the Ministry of Agriculture.

There is no administrative map defining mountain areas in Slovenia. The only official definition of mountain areas was prepared by the Ministry of Agriculture, Forestry and Food in 2000 (Decree on criteria for determination of areas with limited conditions for agricultural activity). Mountain areas are defined as areas above 700 m or areas with a slope over 20% or areas above 500 m and a slope of at least 15%. This definition is important for the implementation of the stimulation measures for countryside areas.

In Slovenia no administrative regionalisation has been done yet. Statistical units are basic level for regional development policy. But among 12 statistical units there is no special "mountain" unit. New regions proposal is based mostly on economic and historical differentiation, which again does not separately define mountain areas. In the past there were some regionalisations made on scientific level. The last one was made by the Slovenian Geographical Institute and includes the most integrated methodology to define the regions. One of the regions is the Alps and short description is given at the beginning of the chapter. There also is an area of the Alpine Convention in Slovenia, which includes one third of the Slovenian territory. Border incorporates central Alpine areas but it was defined more or less politically and is mostly adapted to municipal borders.

16.2 Mountain Policy in Slovenia

As the majority of Slovenia is mountainous, most of national strategies and legislation affect mountainous areas but generally there is no explicit mountain policy in Slovenia. Slovenian regional policy has three main periods: stimulation of underdeveloped areas (1971–1991), stimulation of demographically endangered areas (1991–1999) and stimulation of harmonised regional development (from 1999 on). From the 1970s on there has been an effort to implement polycentric development although Slovenia shifted very late to the endogenous principles of development in comparison to other EU countries. Until the last period, regional policy had been orientated towards selected problematic areas. Harmonised regional development tries to cover the whole national territory but the priority is still given to the areas with special developmental problems.

Mountain areas combined with economic and demographic indicators are used in definition of areas with special developmental problems (Ministry of Economy) for use in regional development policy implementation. Polycentric development policy in the 1970s directed state subsidies in less-developed areas. In many cases bigger enterprises open small units in the countryside, which artificially maintain social conditions. Because these units were economically unstable, most of them were closed at the beginning of the 1990s, which caused depopulation of these areas.

Although there is no explicit mountain policy in Slovenia, there are some issues, which are the subject of debate on the national level and are related to mountainous areas. These issues are targeted through different strategies and laws prepared by different ministries.

- Depopulation of marginal areas, agriculture abandonment, and decay of cultural landscape – most of these processes are taking place in the mountains. This issue is targeted by the Strategy of Countryside Development, Agriculture Act, Act on Harmonized Regional Development and Rural Development Programmes.
- Sustainable development – mountains play an important role in terms of water resources, energy resources, tourism and recreation areas, which contribute to high quality of life in most of Slovenia. This area is covered with the Alpine Convention, National Sustainable Development Strategy, National Environmental Protection Strategy, Environmental Protection Act, etc.
- Tourism development – mountains (especially the Alps) are considered one of the key areas of tourism development.

There are some particular mountain policies based on the regional level (referred to fixed areas and not to statistical regions): Act on Triglav National Park (the Julian Alps), Law on closure of the coal mines and restructuring of the Zasavje region, Law on closure of the mercury mine in Idrija, Law on closure of the lead and zinc mine in Mežica, Act on reconstruction of the Soča Valley after earth quake.

Regarding level of implementation of policies and measures, the principal levels are the ministries and subordinated agencies and municipalities. Some of the national agencies have regional units with varied geographical divisions, but most of these divisions are valley-centred. The only structure based on a massif so far is the Triglav National Park that covers most of the Julian Alps. In the Julian Alps there also exists a tourist association marketing the massif as a tourist product. In the last years, municipalities grouped in 12 statistical regions established Regional Development Agencies, whose main scope so far has been the preparation of Regional Development Programmes, and are to be involved in managing EU-supported projects in the future.

16.2.1 Agriculture

The majority of agriculture in Slovenia is mountain-based. The main products are milk and meat in hilly areas and wine and fruit in the south-west and east. Family farms are prevailing with the average size of 6.3 ha, but are based on various landownership patterns (single farms, villages, common ownership of pastures, etc.). Agricultural activity is usually combined with forestry and employment of one or several family members in industry or other activities.

After 1990 the process of transition brought land restitution to owners whose land was nationalised after the Second World War and approximation of agricultural policy to the EU CAP. The focus of the national policy was to support large family farms. Also programmes of integrated rural development were introduced as a part of the agricultural policy. In the 1990s in most of Slovenia small-scale programmes integrated development of countryside and renovation of villages were made. Programmes were important since they evaluated development possibilities and future orientations. They were guided by experts and made in close connections with local people. Quite a few supplementary activities in less-developed areas were introduced.

With the accession to the EU Slovenia follows the EU agriculture policy. An important direction of the policy is environmental and landscape management of the agriculture. For the implementation of this policy subsidies are one of the most important measures, also in Slovenia. Subsidies represent up to 50% of income for the farms with difficult conditions for farming and this income is especially important for mountain farms.

The number of people employed in farming continues to drop (from 14.2% in 1995 to 10.5% in 2004), as well as the share of agriculture in GDP (from 3.6% in 1995 to 2.2% in 2004). The number of organic farms is on the slow but steady increase, from 41 in 1999 to 2000 (2.4% of farms in Slovenia) in 2007.

16.2.2 Forestry

Since land privatisation in the mid-19th century the forest area in Slovenia has grown from 35 to 56% and this percentage is now one of the highest in Europe. Forestry has been directed sustainable for more than two centuries, especially after the Second World War with systematic planned management. Forestry has always been strong economical pillar of mountain farms. Today most of the timber is sold to foreign markets. One of the reasons is that wood processing industry, which was strong in the 1970s and 1980s (but economically not very effective), almost collapsed at the beginning of the 1990s. Despite the emergence of high-quality SMEs, there still is a big lack of wood processing chains, which could guarantee better economical situation of less-developed (mountain) areas.

Traditionally, people have the right to walk in the forest regardless of forest ownership and this right is guaranteed also by the 1993 Act on Forests. Recreation has become an important service of the forests and more and more attention in forest management is dedicated to social and ecological functions of forests.

16.2.3 Mining

Mining has played an important role in the development of mountain areas in the past. Most mining has stopped or is in decline due to falling market prices, except for granite and limestone quarrying. First to close was the mercury mine in Idrija, followed by lead and zinc mine in Mežica and uranium mine Žirovski vrh. Most of the mining regions face economical and environmental problems. The mining closure acts provide subsidies for reemployment, planned closure works and wider economic restructuring of the affected regions. One of the good examples is Idrija, where closure of the mercury mine was followed by successful economic restructuring. The town of Idrija developed around the second largest mercury mine in Europe under direct control of the imperial court in Vienna. Mining had been profitable until the 1970s, when the closure process started. Significant funds were invested in the closure by the state. At the same time, other local companies (main ones are Rotomatika and Kolektor) developed with attracting international investors and becoming important players on the international markets. Today Idrija is one of the richest municipalities in Slovenia despite its remote location in a deep mountain valley. In this process an important role was played by the local intelligentsia and the city museum.

16.2.4 Tourism

Mountain tourism is one of the three main branches of tourism in Slovenia. Two others are spas (many spas are actually in the mountains) and the seaside. Statistically mountain resorts are the most important resorts for the foreign tourists. Tourism is economically very important in the mountain areas but it is nowhere the only economic activity. At the state level tourism presents 3.5% of GDP. There is a steady growth of summer visitors of the mountains while the skiing industry is in decline because of lack of snow in recent winters, unfavourable topographic conditions (elevation, ruggedness of limestone slopes) and lack of capital to invest in competitive infrastructure and services. All bigger ski resorts invest more and more in promotion of summer activities. In the National Strategy of Tourism Development (up to 2006) mountains were seen as one of the key areas of tourism development. New Strategy 2007–2011 defines no priority areas but its objective is strengthening of destination management with better involvement of supplement activities of the environment to a tourist offer.

One of the fresh ideas in tourism, which has succeeded, is International Wild Flower Festival. It is organised at the end of May and at the beginning of June in Bohinj, which is one of the top locations in the Julian Alps. Already the second festival brought enormous raise in tourists. Festival proved that tourism based on natural resources and attractions can have much wider positive effects than tourism with hard infrastructure. Besides good economical effects it also prolongs summer season.

16.2.5 Protected Areas

Slovenian nature protection policy defines different protected areas (not directly linked to IUCN categories): national park, regional parks, landscape parks, forest reserves and natural monuments. Protected areas cover 11% of the Slovenian territory (35% together with Natura 2000 areas). The parks are designated mainly for nature protection and protection of the cultural landscapes. Recently, sustainable development at the local level is becoming a more important objective. There is a trend of increased understanding that protected areas should be closely linked to providing opportunities to the local population.

The only national park in Slovenia is Triglav National Park (TNP) in the Julian Alps. It measures 880 km^2, which is 4% of the Slovenian territory. Within today borders it was established in 1981 but first protection legally started in 1924 what places the park in the position of one of the oldest in Europe. It plays an important role as a tourist attraction on the national level. Although public institution, as managing authority, primarily cares for nature protection, there are some good examples of successful cooperation. With the help of funds from the Act on reconstruction of the Soča Valley after earthquake and TNP funds the info centre in the Trenta Valley was constructed, which is not only an info point for tourists but also has a strong social role to keep the remote valley alive. With the help of TNP a remote depopulated village Čadrg was revitalised at the end of the 1990s, which is now the best practice for mountain areas how cooperation between inhabitants and public authorities can lead to good results.

One of the best practices, known to the whole Alps, is the Logarska Valley (Logarska dolina). Logarska dolina is an Alpine valley in the Kamnik-Savinja Alps at the border with Austria. In 1987 it was declared as a landscape park, although the idea for its protection appeared as early as the 1930s. In 1992 the company Logarska dolina was established and in the same year it got a concession by a municipality to manage the park. At that time it was the first example of private–public partnership in nature protection. The company is run by an assembly of land and building owners, all together 14 partners. In 17 years it has brought the park to one of the most successful stories in Slovenia. Logarska dolina got a first prize in 2005 at CIPRA Competition Future in the Alps as the best managed protected area in the Alps.

Ministry for the Environment plans to establish even more large protected areas in the mountain areas.

16.2.6 Natural Hazards and Measures

The main natural hazards in the mountain areas are floods (most rivers in Slovenia have a torrent character), earthquakes (smaller earthquakes occur frequently), landslides (frequency of landslides started increasing in the recent years with increased intensity of rainfall events, partly due to climate change), avalanches and storms (storm wind causes damage to forests and buildings).

There are very few systematic policies related to hazard control, but on the other hand disaster relief has a long tradition. Basically, most of the disaster relief is done by the state either from regular funds or, if the efforts are larger, by passing a separate law. One of the very important measures on the regional level is Act on reconstruction of the Soča Valley after earthquake. It has not just helped to reconstruct buildings but has also supported new public infrastructure and different kinds of development programmes.

16.2.7 Traffic

Basic road infrastructure exists to all settlements. In the mid-1990s the National highway programme was adopted, aiming at building all the highways in Slovenia until 2010. This programme mobilises most of the resources for road construction, meaning that some national roads to mountain areas remain without new investments. On the other hand, the highways are crossing the mountains, bringing more visitors but also more transit traffic and related degradation. Beside transit traffic mountain resorts face big problems caused by individual motor traffic. There are discussions with the Ministry of Transport that local communities can manage tourist traffic on the national roads during the high season. There is also a big issue on snowmobiles and four-wheel motorcycles. It is not allowed to drive them in nature but there are trespasses all over Slovenia, especially in the mountains. Until now the Ministry has found no solution.

The role of the Alpine Convention for the mountain areas in Slovenia Alpine Convention (AC) is a tool for measurements of sustainable development on the regional and local level. AC was signed in 1991 by the Alpine countries and includes ten protocols and four additional are in preparation. Slovenia ratified all of the protocols in 2004. Because of the structure of mountainous areas in Slovenia, the sustainability is adapted in most of the state policy, legislatively and in practice, and there is almost no specific policy for mountainous areas. Therefore, Slovenia generally does not have many problems of adapting its legislation with the Alpine Convention. Problems sometimes appear with the implementation.

16.2.8 NGO Participation in the Mountain Areas

There is only one environmental NGO in Slovenia, which is focused on the mountain areas. CIPRA Slovenia is a member of CIPRA International (International Commission for the protection of the Alps). With its focus on sustainable development, CIPRA's objective is to exploit the potential of the Alpine space at many levels and to preserve its cultural and natural diversity. CIPRA Slovenia works mainly in the field of traffic policy, nature protection and promotion of sustainable development in mountain areas.

Short-synthetic SWOT analysis of the Alpine areas in Slovenia stress:

S – Natural beauty, tourism industry,

W – Decline of grazing, transport infrastructure,

O – High quality experience tourism, good business location,

T – Long range air pollution, visitors in the summer.

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Chapter 17
Impact of Macroeconomic Changes and Property Rights on Forest Degradation, Land Use and Environmental Situation in Albania

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Abstract Over the past 20 years Albania has moved from being a predominately rural society to one in which the majority of population lives in urban areas. This population movement fuelled the rapid urban development and at the same time led to absentee landownership in rural areas. Albania has among the lowest amount of agricultural land per capita (0.22 ha) in the region. Only 24% of Albania consists of agricultural land, while 36% is forest, 16% is meadows and pastures and 24% is unproductive land, as urban land and inland waterways. Environmental changes are linked to land reform. Conversion of agricultural land to residential plots has increased in Albania as a consequence of land privatization and decentralization. The land reform in Albania was constructed at the national level. The decision of the Albanian government to redistribute the land on a per capita basis was framed by political and economic considerations. From a global perspective, the effects of forest degradation and forest-cover loss on biodiversity may be significant, as Albania is located within the Mediterranean Basin that is recognized as a global biodiversity hotspot in terms of endemic flora and fauna species. The loss of cropland and forest cover in Albania indicates that the transition and the associated macroeconomic recession led to dramatic changes in the landscape. The main objective of the proposed chapter is to identify the relationship between land reforms, land tenure and macroeconomic changes on forest degradation and land use and environmental impact in Albania. The chapter provides a conceptual framework for understanding the relationship between land tenure, property rights, land reform, environmental impact as well as forest quality in Albania during the post-socialist period. A system approach is used to describe land-use changes in Albania, addressing the complex and dynamic nature of the relationships among the subject matter areas.

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17.1 Historical Land Tenure in Albania

There are two outstanding characteristics of the development of land relations since 1991 in Albania. The first is the creation of a nation of smallholders-owners of small farms held in freehold tenure brought about by Law 7501. Whatever the deficiencies of the content and implementation of this law, the fundamental socio-economic revolution brought about by this law should not be underestimated. The second characteristic and one that is directly related to the first is the exuberant urban development and rapid growth of land market that has taken place. Prior to the Second World War, the distribution of land in Albania was unequal. The most productive agricultural areas were owned by a few families. Under socialism, Albania was the only country in CEE that effectively nationalized all land, based on its 1976 Constitution (Agolli, 2000; Civici, 1994; Cungu and Swinnen, 1999). After the demise of socialism, Albania implemented a comprehensive land redistribution program that established private property on virtually all cropland under use during the socialist period. Land redistribution was a politically feasible strategy; restitution to former owners would have resulted in less than 5% of the population owning the most productive land. The Albanian land reform of 1991, the Land Law 7501, was intended to redistribute all collectivized land to former members of the cooperatives on an equal per capita basis. Other rural residents who were not members of the cooperatives were also awarded land but in smaller quantities (Law 7501, Art. 6). Land to be redistributed was stratified by variations in distance to the farmstead, soil fertility and irrigation capacity. Village-level land distribution councils were formed to allocate plots, often in distant locations within the village territory, to each farm family proportional to their household size, including the elderly and small children. While this urban development has not been universal throughout the country – there has been more in Tirana and the south of the country than in the north – it is a striking testimony to the effect of private ownership of land, the existence of a market for land and access to the necessary financial resources to bring about urban development (Bloch, 1998; Cungu and Swinnen, 1999). These two interrelated characteristics – widespread private ownership of land, rapid development and its corollary, development of a land market, must be seen in the context of a major social change in the country – the rapid movement of population to urban areas and overseas to find work.

17.1.1 Privatization of Agricultural Land

The land privatization process began in 1991 with the approval of Law 7501 *On Land*. The law divided agricultural land among the inhabitants of the cooperatives and workers in the state-owned farms according to the quality and productivity of the soil and the number of people in the family registered in the civil registry in August 1991. Using a per capita basis, each family received equal amounts of arable and non-arable land, fruit trees, vineyards and olive trees. Scarce amount of agricultural land in Albania (at average 0.22 ha per capita of population) and high proportion of rural population (64%) were an argument in favour of the implementation of the land law. Another argument was the long time and great changes that had occurred in Albania during 1944–1990 which complicated the task of identifying old land boundaries, documentation on previous property ownership, etc. The most important aspect of this law, apart from its pivotal role in announcing the new legal regime of land tenure, management and use, is that there has scarcely been any law enacted over the last 12 years to address the afore-mentioned topics. These, in turn, would have provided the detailed legal regime foreshadowed by these provisions (Kelm, 2000).

17.2 Main Land Tenure Issues

The agricultural structure comprises some large farms and a millions of micro-farms, with an almost complete absence of intermediate-sized competitive, commercial farms. The larger farms, sometimes covering thousands of hectares, are operated by the state, commercial companies, private associations or cooperatives. In contrast, farms less than 1 ha account for 70% or more of the total number of farms in Albania. Most farms are subsistence farms that produce little for the market, but they are often an important source of income and food security for many rural residents. Assessing the effects of land privatization in Albania, it needs to be underlined that this process was associated with two negative phenomena. On one the hand, privatization has limited the farm size, while on the other hand it has increased land fragmentation.

17.2.1 Land Fragmentation

Land fragmentation has been identified as one of the main obstacles to the development of the agricultural sector in Albania. Law 7501 was drafted in order to ensure a fair division of land among agricultural families. However, one of the ramifications of this policy is highly fragmented land plots. Families own several non-contiguous parcels spread over a wide territory which makes farming at an economic scale next to impossible. As a result of this process of privatization, over 90% of agricultural land is now in private ownership (Kelm, 2000; Stanfield and Kukeli, 1995). The complete break-up of the agricultural collectives in Albania led to fragmentation of land ownership. In 2005, 440,000 farm families operated on approximately 1.8 million parcels. An average farm household possessed 1.5 ha, spread over three to five parcels (Ministry of Agriculture and Food, 2007; World Bank, 2003, 2006). The inactive land market with few land sales and rentals hinders land consolidation.

17.3 Effects of Land Reforms on Land Use in Albania After 1991

Protection of natural resources and nature as a whole has been for decades an important argument for the whole civilized world. This is proved by the large number of Conventions/agreements signed by most of the countries including Albania. Albania faces many of the same environmental issues with which other countries in Eastern Europe are being confronted. Both air and water pollution are serious issues as a result of the lack of facilities and controls. Most of the environmental damage that occurred in rural areas during the socialist period has not been repaired. Large-scale cultivation destroyed field roads, water courses, vegetation belts and other landscape features suitable for individual farming. Environmental degradation has sometimes increased during the transition period, for example, through deforestation of valuable species, inappropriate tillage of soils and a failure to maintain a balance of nutrients in the topsoil. The degradation of natural resources in Albania is an important long-term constraint to sector development. The main problems include: uncontrolled deforestation, large livestock numbers and consequent overgrazing of pasture land, particularly in mountain areas, soil erosion and degradation through production on marginal land, especially on steeply sloping land in hill and mountain areas and before the collapse of the old regime, loss of scarce and productive arable land through rapid urbanization, depletion of marine fishing resources, degradation of water resources and watersheds and increased vulnerability to flood damage.

17.3.1 Land Cover

Nationwide land use in Albania has changed little since the distribution of agricultural land to farmers' households in 1991. According to the MoAF (Ministry of Agriculture and Food, 2007), the broad categories of arable land (24%), forests (36%), pastures and meadows (15%) and of other land (25%) remained stable between 1991 and 2006. According to preliminary results of the Albanian National Forest Inventory (ANFI), the first nationwide analysis of remote sensing data for the years 1991 and 2006, broad land-cover categories indeed changed relatively little. ANFI results for 2006 show cultivated area at 21% and forests cover at 32% (Fig. 17.1)[1].

However, a significant amount of land-cover modifications are observed as manifested in a change from forest to woodland of 2.8% and from forest and woodland into bush, shrubs and grassland of 1.4%. This amounts to a significant degradation of forest cover of 4.2% between 1991 and 2006 with a corresponding decrease in

[1] As ANFI is a land-cover data set, no land-use assessments are involved. Therefore, it is not possible to calculate pastures and meadows. Major parts of the bush, shrub area as reported by the ANFI project are possibly used to graze livestock.

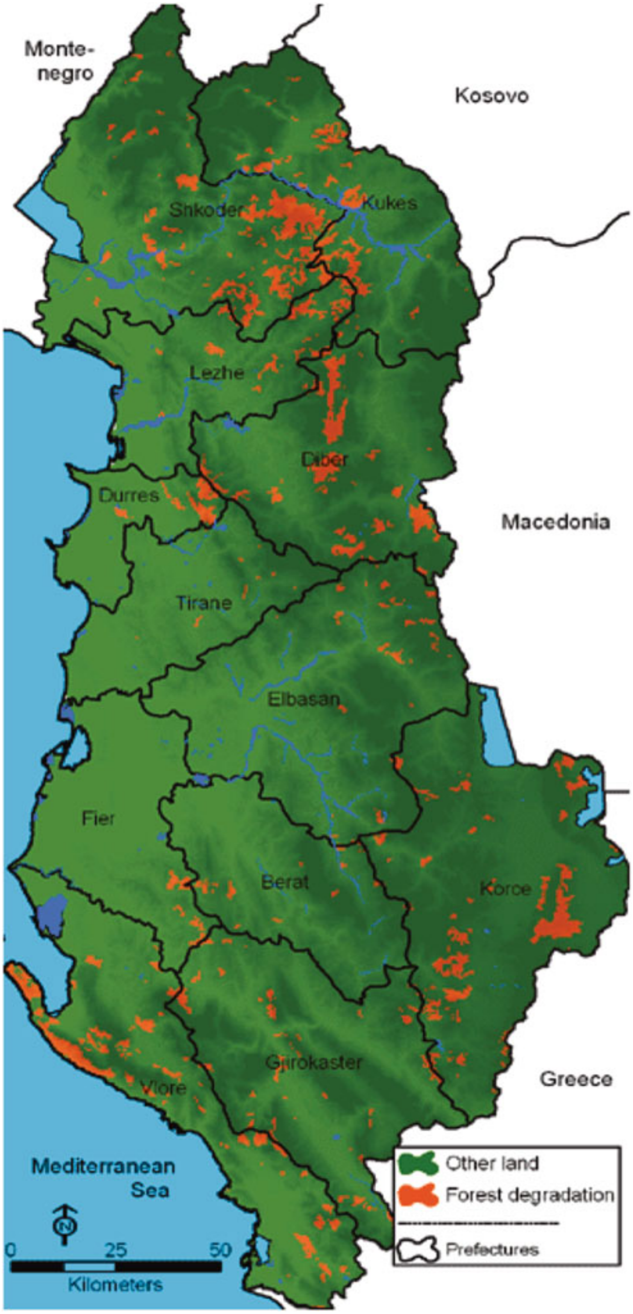

Fig. 17.1 Major land-cover modification, 1991, 2001, 2006

tree density. The spatial representation of selected major land-cover modification shows a significant decrease and degradation of forest in the Northern mountainous areas and, to a lesser extent, in the Southeast (Fig. 17.2). Agricultural land area increased by 1.4% according to ANFI data in this period, without pronounced hot spots of change across the country. Another major land-cover change factor in this period is the expansion of urban areas on former agricultural land by almost 1%, mostly around Tirana city.

17.3.2 Forest Degradation

Forests and pastures make up a heritage with values not only for Albania but also for the whole region. This heritage should be protected and managed in that way so that to secure a higher growth development in the future by contributing to the decrease of poverty level without destroying the natural and biotical balance. In the past, including transition years as well, forests were evaluated for their economic importance thus underestimating their multi-functional aspect. Their harvesting does not lead only to profits but also to losses (when they are not harvested properly) as those of capabilities for future development which is a result of the degradation and desertification of forestry and pastoral environment. Forests, pastures, agricultural land and coastal areas are undergoing degradation due to poorly defined private responsibility and a lack of public oversight and enforcement (Figs. 17.3 and 17.4).

The emphasis on privatization of property has neglected the need to define the responsibilities of private owners, concerning particularly the protection of resources. Forest resources are comprised of State, local and private forests. Local forests are those under the state ownership but allocated to villages for common use by the permanent residents who are entitled to take from the local forest a surface area from 0.4 up to 1 ha per family. Private forests include all groups of trees and forests that are created or exist within the boundaries of private immoveable property. The current situation is characterized by rapid deforestation (or harvesting) of standing timber stocks and degradation in the productive potential of the forest and pastoral ecosystems. Forest resources have decreased significantly over the last 10 years as a consequence of the country's transition to a market economy. In some areas, the total forest cover has decreased by an average of 15% over a period of 5 years, with varying degrees of reduction in the different forest types (Ministry of Agriculture and Food, 2002). During the period 1988–2006 total forest coverage remained stable with the ever-changing rural landscape in Albania. However, 6% of the natural, old-growth forest of 1988 was cleared by 2006, and both old-growth and secondary forest regenerated on former bush and grassland, as well as on 94 km^2 of abandoned cropland. About 40% of the landscape was forested in 1988; 202 km^2 or roughly 14% of the land that was forest in 1988 was cleared by 2006. Substantial changes in forest integrity stem from the continuing reliance on forest biomass for heating and cooking. In addition, forests and other communal resources can suffer greatly when collective systems are replaced with market-based ones due to new collective action problems that arise in transitional periods. The loss of cropland and

Fig. 17.2 Major land-cover modifications, 1991–2006

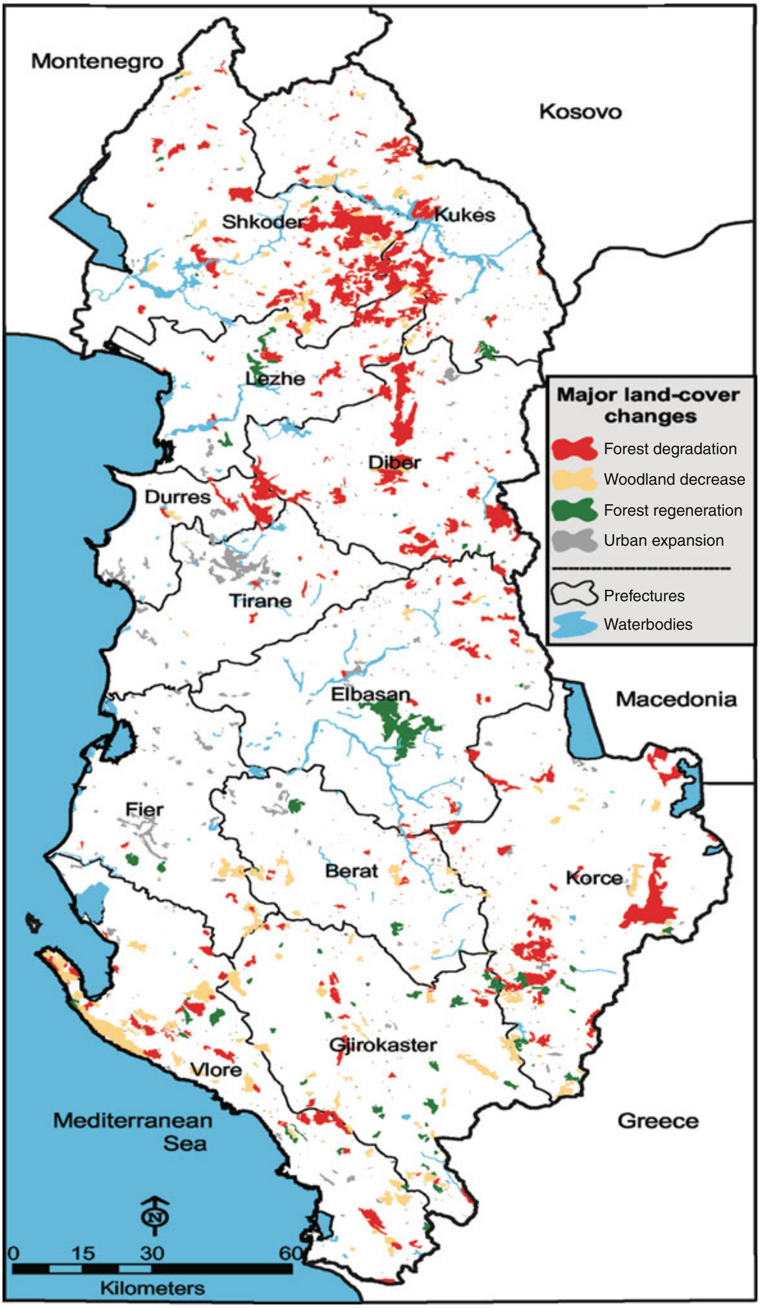

Fig. 17.3 Forest degradation during the period 1991–2006

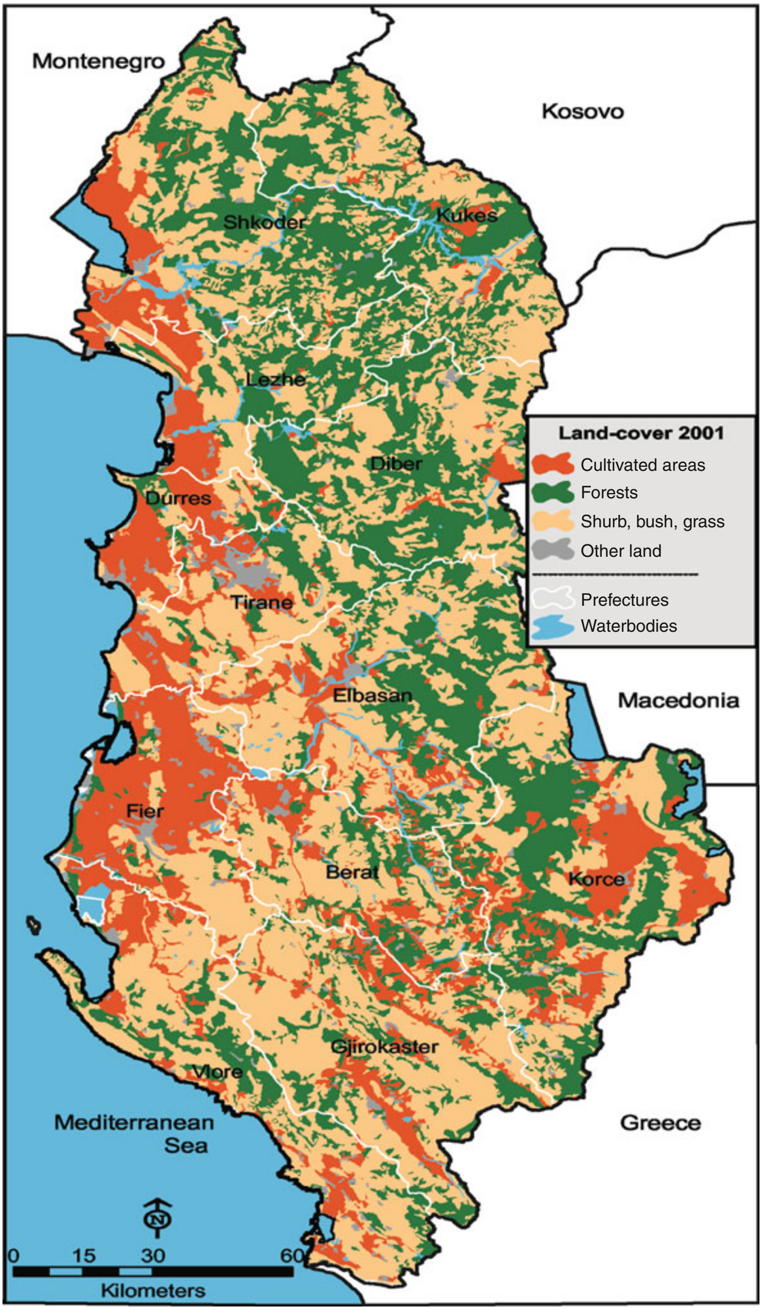

Fig. 17.4 Urban expansion

forest cover in Albania indicates that the transition and the associated macroeconomic recession led to dramatic changes in the landscape. Declining revenues from agriculture were accompanied by new livelihood strategies in a rapidly globalizing world. This sparked demographic changes and pushed people into other sectors of the economy, leaving large tracts of cropland idle (De Soto et al., 2002; King, 2005; World Bank, 2003). The resulting land-use changes are associated with interesting patterns such as the persistence of land fragmentation and the realignment of agricultural production as, over time, predominantly more remote and less-productive areas fall out of cultivation. Forests have been threatened by the transition because a new delineation of rights to forest uses remains to be implemented. In addition, many households still rely on forest resources. This resource degradation, which includes uncontrolled woodcutting and overgrazing, is particularly intense in areas near villages and communities, exerting human pressure upon forest resources the major cause of their deterioration. In parallel with degradation of forests and pastures, investments in forest management diminished considerable after mid-1980s and were eventually discontinued in the 1990s due to dwindling resources allocated to the forest administration. Since the early years of the transition period, considerable quantities of wood have been illegally harvested. Forest health is a concern for local livelihoods that strongly depend on forest resources in the absence of other energy sources. The sustainable management of forest and pasture resources should be focused upon an efficient management and utilization of resources in order to restore and maintain biodiversity, production, regenerative capacities, forestry vitality and other diverse potentials both for the present time and for the future with the view to fulfilling the ecologically economic and social functions at the local, national and global level without causing further damage to other ecosystems.

17.3.3 Pasture Degradation

Land use and land reform have also affected the development of pasture sector in Albania. Approximately 60% of pasture area is in the process of being transferred to the communes (Ministry of Agriculture and Food, 2002). The strategy for the development of forestry and pasture sector is an action plan which aims at achieving an optimal contribution to this sector, to the general economic growth as well as to the sustainable development of the country. This process implies a good management and utilization of pasture in a way which secures production, regenerative capacities, vitality and pasture potential for the present and the future, ecological, economic and social functions at local and national level. At present, the main concerns in relation to pasture management are: degradation of pastures from overgrazing or the high pressure on them. So, it implies overgrazing of pastures beyond their regenerative capacity, without taking into account the technical criteria such as the increase of cattle to be grazing prior to the grazing season. Lack of investments and improvement operations in pastures have caused problems concerning the decrease of their holding capacities and their relevant qualities. During the last period, the animal husbandry is having a vigorous development, which for the present condition of our country and even for the future, is one of the most profitable branches of the national economy. This development, in order to keep this pace in conformity with people needs for animal products, requires a far more organized, studied work for the maintenance of the livestock production. According to the cadastral data, natural pasture area is estimated to be 415,911 ha or 14% of the whole territory, extended in 36 districts.

17.4 Conclusions

Although Albania is faced with many political, economic and social problems, important steps have been taken. The commitment of Albanians to abandon five decades of state ownership and control and the steady progress made in completing substantive and procedural privatization laws are laudable. In this chapter we analyzed the impacts of heterogeneous land-use incentives upon land cover which allows us to examine land-cover transitions following the large-scale policy shifts in the wake of transition along with the subsequent realignment of land-use incentives due to land reform. The agricultural abandonment in Albania is strongly mediated by both the biogeophysical environment and transportation infrastructure. District-level effects provide some evidence that abandonment is more likely in relatively remote areas, or when other economic opportunities, such as tourism press themselves forward. Forest-cover loss was highly sensitive to the time period. Forest clearing tended to shift from subsistence orientation in the first years after the collapse of socialism to more commercial extraction in later stages. The abandonment of large areas of cropland partly reflects the adjustment of the rural sector to the evolving market conditions and leads to a concentration of cultivation on more productive areas. In Albania further abandonment of cropland may continue well into the future given the fact that the younger generations will continue to secure their livelihood depending more and more on internal and international migration. This will become more worrisome with the elderly farmers declining faster and faster. Future abandonment in Albania may be aggravated by the projected reductions in crop productivity caused by high temperatures and drought in a region already vulnerable to climate variability. The impact of the successional vegetation on biodiversity, soil conditions or the carbon sequestration potential depends on the prevailing natural conditions and will therefore vary across regions. Rural landscapes will continue to evolve and change. Land reforms, particularly the establishment of private property rights, are based on the logic that efficiency gains in agricultural production will occur as a result. Nevertheless, impediments to a fully functioning land market remain. Issues such as restitution and compensation, illegal occupation of land and other land disputes continue to cloud legal title. Rural conditions throughout the region in Albania have deteriorated during the transition period. There is growing inequality between rural and urban areas, with most of the poor now living in rural areas. These areas are characterized by declining populations which are mainly represented by women and the elderly. Rural infrastructure has often deteriorated considerably and many rural roads, irrigation systems and erosion control measures are in poor condition. An effective incentive to production and conservation of land and water resources in Albania is the right to secure tenure to land and other natural resources. Security of tenure is a major concern of the land-user in deciding whether or not to invest in measures to promote conservation or sustainable production on a long-term basis. Land rights must be robust, allowing the user effective control over the resource, and the right to exclude others who might adversely affect its management. An important part of Albanian government policy should be to reduce disparities between urban and rural areas by improving the rural situation.

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Chapter 18
Sustainable Development in the Eastern Black Sea Mountains: Present State and Perspectives

Mehmet Somuncu

Abstract The Eastern Black Sea Region of Turkey, with a mountainous coastline of 39,203 km^2 (5.1% of the country) and population of 2.6 million (2009 census) has the highest peaks (above 3,900 m) in the central part of the region. Annual rainfall in the coastal areas ranges from 2,000 to 2,500 mm resulting most dense forests in the region. Natural features in the Eastern Black Sea region make living conditions harsh; In addition, the area is difficult to access due to its distance from developed areas and insufficient infrastructure. The mountain areas in this region suffer lack of adequate basic services such as transportation, communication, education, and healthcare (Somuncu and İnci, 2004). Mountains in the Eastern Black Sea Region are less-developed areas. As a result of the inadequacy of incomes and the limited availability of basic services such as transportation, health services and education, local people have been continuously migrating from mountains since 1950s. Sustainable development is needed to reduce and stop emigrations from the region.

Keywords Sustainable development · Mountainous area development · Eastern Black Sea Region

18.1 Introduction

Mountains cover a significant portion of the land area of many countries in the world, and their resources are playing crucial role in sustainable development. But the specific challenges of development in mountains are rarely reflected in national policies. Only a few countries have adopted coherent policies that address these challenges from a mountain perspective.

Mountains play a key role in sustainable development, and their importance will increase in future. As water towers of the world mountains will play a crucial role in providing fresh water for a growing number of people, for industrial development,

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and for agriculture and irrigation in mountain and downstream areas. Food security, poverty alleviation, and, ultimately, political stability will thus be critically linked to mountain resources, and hence to the development taking place in mountain areas. Mountains will also continue to play an important role as hotspots of biodiversity. Increasing urbanization within mountains will put additional stress on scarce resources such as water. At the same time, mountains are characterized by specific development challenges. Typically, these include difficult access, economic, and political marginality, out-migration, environmental sensitivity, diversity of livelihoods, and cultural diversity. These challenges need to be addressed by specific policies, laws, and institutional arrangements at the international, national, and local levels (Mountain Agenda, 2002).

Turkey is situated in the Northern Hemisphere near the junction of the continents of Europe, Asia, and Africa, between 36 and 42° North latitude and 26 and 45° East longitudes so that it occupies a unique geographical and cultural position at crossroads between Europe and Asia (Fig. 18.1). Turkey is a vast country with an uneven topography. It consists of a land area of 814,578 km^2 and an average height of 1,132 m (Table 18.1). Mountain crests exceed 2,000 m in many places, particularly in the east, where Turkey's highest mountain, Mount Agri (Ararat) reaches 5,137 m close to the borders with Armenia, Nahçivan (Azerbaijan), and Iran. Steep slopes are common throughout the country, while flat or gently sloping land makes up barely one sixth of the total area.

In this chapter, the Eastern Black Sea Regional Development Plan (DOKAP) of Turkey is analysed in terms of sustainable mountain development. The Plan is

Fig. 18.1. Location map

Table 18.1 Elevation groups in Turkey

Elevation groups (m)	%
0–250	8.0
251–500	9.5
501–1,000	27.0
1,001–2,000	45.5
2,000+	10.0

very important for Turkey and global ecosystem, because mountainous area of the region is one of the least-developed areas in the country. Also, the rich flora in the Eastern Black Sea Region is an important contribution to the world's biodiversity. The region is in the Caucasus Hot Spot.

18.2 The Eastern Black Sea Region

The Eastern Black Sea Region is in the north-eastern corner of Turkey (Figs. 18.1 and 18.2). The region consists of seven provinces: Ordu, Giresun, Trabzon, Rize, and Artvin, facing the Black Sea, and Gumushane and Bayburt, situated away from the coast. Total population of this region is 2.6 million, accounting for 3.6% of the national population, and total area is 39,203 km^2, accounting for 5.1% of the national area.

Within the Eastern Black Sea Region, high mountain ranges run parallel to the Black Sea coast in the north with undulating plateau on the southern foot of the mountains. High ridges trending east–west rise abruptly from the Black Sea coast, and the coastal plain has narrow openings at few places. The mountain ranges get higher, narrower, and steeper towards the eastern area. Less than 75 km from the coast, the Eastern Black Sea Mountains rise to more than 3,700 m, with a maximum

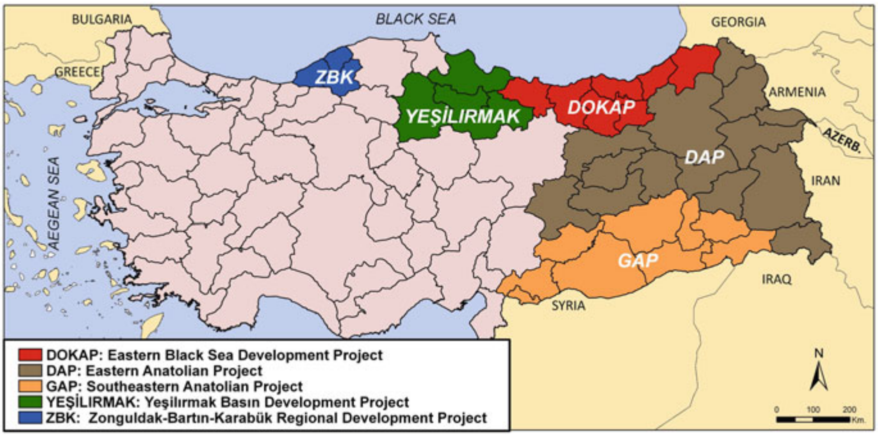

Fig. 18.2 Regional development projects in Turkey

elevation of 3,932 m in the Kaçkar Mountain, one of the steepest topography in the world (Fig. 18.1) (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000; Somuncu, 1989).

Extensive glacier and water erosion have given these mountains their craggy, rugged look, and they are known for the complexity and power of the streams and rivers which rush down to the lower altitudes. In fact, this range is the third most important glacial region in Turkey following the Mount Agri and Cilo-Sat Mountains. Today, there are five large glaciers in the Kaçkar Mountains National Park. Therefore, the region is characterized by harsh topography. Steep and high mountain ranges near the coastal area limit flat land, making both ordinary life and development activities difficult and costly. This may be one reason for emigration from the region.

The region is far from the major population centres in Turkey. The economic activity in the region is concentrated along the coast. There are physical limits to the growth of these areas due to harsh topography. Concentration along the coast is associated with differences in incomes between these areas and the less-developed inland and mountainous provinces, which has led to severe environmental degradation of the Black Sea coast (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000).

18.2.1 Settlement System

Major urban centres are located along the Black Sea coast, while there are a small number of centres in the inland, which are small compared to the centres along the seacoast. Rural or small-scale settlements are widely dispersed in the whole areas of region, and the residents are moving to urban areas (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000).

18.2.2 The Economy

In mountain areas, agriculture is the main economic activity in which crop production is accompanied by livestock husbandry. Western part of the coastal areas in the region, with relatively low elevation and precipitation, is planted predominantly with hazelnut, while the eastern part, having higher precipitation, is planted with tea. Inland dry areas are planted with field crops (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000).

High mountain ranges with steep slopes and limited flatlands restrict agricultural activities. As mechanization is difficult under these conditions, crop cultivation depends largely on man power. Dry climate in inland areas with an annual precipitation ranging from 400 to 600 mm limits crops that can be cultivated under rained conditions. Low temperature is another constraint limiting crop species in most inland areas with high elevation. Annual rainfall in Rize and parts of other coastal provinces amounts to over 2,500 mm with some 170 cloudy days annually. Large amount of rainfall leaches nutrients and makes soils acidic, which lowers crop productivity. Lack of sunshine also adversely affects crop performance. Monoculture of tea is attributed to this climate and soil condition. Livestock in the region is also a very important for economic activity. In particular, cattle, dairy, and honey production are of national importance (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000).

As a result of the inadequacy of incomes and the limited availability of basic services such as transportation, health services and education, many mountain residents have abandoned their mountain abodes since 1950s. Sustainable development is needed to reduce and stop out-migration in the region.

18.3 The Eastern Black Sea Regional Development Plan (DOKAP) and Sustainable Mountain Development

In Turkey, regional development policies have been developed in the quest to eliminate regional disparities, to accelerate local and regional economic development and to enable sustainable development (Kayasü, 2006). Regional development projects have been designed, mainly for the less-developed regions, and regional development policies have been developed as part of the National Development Plans, which have been also prepared by State Planning Organization (SPO). The Eastern Black Sea Regional Development Plan (DOKAP) is one of them (Fig. 18.2).

The regional development plan for this region is identified as the DOKAP, abbreviating its Turkish name. The Eastern Black Sea Regional Development Plan has been prepared for the Eastern Black Sea Region, one of the underdeveloped regions of Turkey and one from which large number of people emigrate according to the 1990, 2000 census. Currently, DOKAP is a regional development plan that covers seven north-eastern provinces extending over the mountainous area in the Eastern Black Sea Region.

The Eastern Black Sea Development Plan was designed not only as a rural development plan but also as an economic initiative intended to have positive social and political consequences for urban areas. The project's main objectives were to improve living standards and income levels so as to eliminate regional development disparities, and to contribute to such national goals as social stability and economic growth by enhancing productivity and employment opportunities in the rural sector (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000).

Sustainable rural development is one of the major components of the Eastern Black Sea Regional Development Plan which was prepared in 2000 by State Planning Organization and Japan International Cooperation Agency. The main objectives of the Eastern Black Sea Regional Development Plan are:

- To develop an integrated regional development plan, providing short- and long-term development of the Eastern Black Sea Region so as to eliminate regional discrepancies between the DOKAP region and the other regions of Turkey,

- To define priority sectors and investment projects, and to cooperate with the relevant personnel during the course of this study for the purpose of developing their planning capabilities.

Under the scope of the preliminary studies, researches have been conducted on the natural structure, social structure, urban impact areas, industry, and geographical information systems.

Within the framework of the first site study under DOKAP, the existing socio-economic and topographic conditions of the region have been analysed and the development strategy has been established. Furthermore, a draft integrated regional development plan has been prepared.

Under the scope of the second site study, project profiles for the selected priority projects/programmes have been prepared and related studies have been initiated for the formulation of an action plan. The Final Report prepared within the framework of DOKAP studies consists of a Master Plan, Sectoral Reports, Institutional Development, Project Reports, and an Executive Summary. The DOKAP Master Plan includes 10 programmes and 52 projects. The studies on the project have been completed and have been implemented since 2001 (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000).

18.3.1 Legislative Basis

The Government of the Republic of Turkey requested the Government of Japan for technical cooperation to prepare a multi-sectoral regional development master plan for the Eastern Black Sea region. In response to this request, the Government of Japan decided to implement this technical cooperation and entrusted the implementation to Japan International Cooperation Agency (JICA). The Scope of Work for this technical cooperation was contracted between the State Planning Organization (SPO) of the Turkish Government and JICA, and signed by respective representatives on December 17, 1998 (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000).

18.3.2 Design

The region covers seven provinces of Black Sea Region including Ordu, Giresun, Trabzon, Rize, Artvin, Gümüşhane, and Bayburt.

18.3.3 Objectives, Rationale, and General Description

Objectives for the DOKAP regional development are defined to address the most critical problems in economic, social, and environmental aspects, which are described below and aimed:

- To strengthen the economic structure, responding to emerging opportunities, to diversify employment opportunities, raise income levels, and contribute to capital accumulation within the region.
- To promote regional integration or social cohesiveness through minimizing intra-regional disparities and out-migration.
- To restore and sustain resource and environmental capacity as a basis for diversifying socio-economic activities.

The basic strategy consists of the following four elements:

1. Upgrading of main infrastructure,
2. Multi-purpose water resources development and management,
3. Land tenure improvement,
4. Strengthening local governments.

The DOKAP regional development to the year 2020 is supported by a set of development projects and programmes and related institutional measures. A total of 52 projects and programmes in different sectors were included in the DOKAP Master Plan. They were packaged into 10 broad programmes:

a. Spatial Structure Strengthening
b. Local Alliance Urban Development and Management
c. Comprehensive Water and Land Resources Management
d. Industry and Trade Support
e. Diversification of Rural Economy and Intensification
f. Applied Research
g. Strengthening of Local Administration
h. Sustainable Human Development
i. Enhancement of Living Environment
j. Special Programme to Establish DOKAP Identity

18.3.4 Financing

The investment requirements for achieving the projected socio-economic development in the DOKAP region over 2000–2020 have been estimated. The total investment requirement is estimated as US$46 billion over 2000–2020, of which US$18 billion is for public investments.

18.3.5 Administration of the Plan

To facilitate the DOKAP Master Plan implementation through effective planning, coordination, and monitoring, it was proposed to establish a regional agency as a union of DOKAP local governments (Japan International Cooperation Agency and State Planning Organization the Republic of Turkey, 2000).

18.4 The Project Achievements

18.4.1 Accessibility and Mountain Development

There is a common belief that underdeveloped regions with major accessibility problems have insufficient resources for development. However, social and economic development in these regions can be realized through proper planning and resource management (Somuncu and İnci, 2004). The DOKAP Project focusing on social and economic development through protection of biodiversity in northern Turkey is a good example.

The DOKAP region is served by only one east–west artery road along the coast, and north–south lateral access capacity was limited. An important element of the basic strategy for the Eastern Black Sea regional development is to strengthen the main transport and communication infrastructure. In particular for the transportation system, a multi-modal artery network was developed. The Eastern Black Sea Highway Project with 542 km was completed. The total cost of the project is estimated to be US $4.2 billion. The existing east–west artery along the coast was strengthened as a backbone axis, from which links to other areas of the DOKAP region and neighbouring regions and countries could be extended. Some sections of the existing coastal highway were improved with lane expansion, minor realignment, and re-surfacing. Also, the north–south lateral access capacity was expanded.

Village and *yayla (Yayla: a temporary settlement in mountain pastures; plural: yaylas)* roads are an extremely important part of the rural infrastructure services both in terms of meeting the social needs of the people living in the rural areas and in terms of transporting the agricultural products to the market in time. In the scope of DOKAP project asphalt roads and bridges have been constructed. Consequently, more easy accessibility to mountainous areas is possible in the region. Therefore, rural tourism has developed in the region. If a mountain community or region wishes to encourage flows of visitors, not only attractiveness, but also relatively easy access is usually necessary. Improved accessibility by road, air, and/or rail may include either new technologies or improvement of existing routes. These may contribute to either intentional or unintentional tourism (Price et al., 1997).

18.4.2 Tourism and Mountain Development

Tourism has become a primary source of revenue for many mountain areas, providing a rare opportunity for mountain people to participate directly in the global economy. There are many opportunities for the development of tourism in mountain regions. Tourism offers a great variety of opportunities. Tourist activities include swimming, walking, visiting cities and national parks, skiing, snowboarding, bird-watching, diving, and a number of sports including bungee-jumping, river-rafting, paragliding, and mountaineering – just to mention a few. Many activities are specific to mountain areas, which provide a variety of natural and cultural settings. Mountains are highly diverse. Climatic zones are condensed over distances of a few kilometres. On a single mountain, one can experience a tropical climate at the base, a temperate zone at medium altitudes followed by alpine conditions higher up, and finally an arctic environment with snow and glaciers on the highest peaks (Mountain Agenda, 1999).

The Eastern Black Sea Region's mountainous areas have a strong potential for tourism owing to its natural beauties and cultural features. This area is Turkey's greenest region with outstanding natural beauty and has its lush green mountains and valleys, glaciers, glacial lakes, and clear gushing mountain streams. With their mountain meadows adorned with colourful wildflowers, the highlands of the region are characterized by their spruce forests. The verdant appearance and lush green slopes of the region are due not only to the abundant rainfall but also to the humid and foggy weather. The humidity and the foggy weather gives way to a brilliant sunshine and oxygen-rich fresh mountain air as one ascends from the coastal areas high up to the mountains.

The region has four national parks, one biosphere reserve, one natural park, and four areas for preservation of nature in the mountainous areas. The area is also sprinkled with early Byzantine and Genoese monasteries and castles, rising impressively from the steep hill sides, and is renowned with their strong cultural traditions.

Tourism in mountainous areas has recently begun to diversify to fill different niches, including: hiking, trekking, climbing, water sports, air sports, bird-watching, and to meet the needs for local produce, and handicrafts (Karadeniz and Somuncu, 2003; Somuncu, 2007).

Sustainable rural tourism is one of the major components of the Eastern Black Sea Regional Development Plan. Sixteen tourism centres were created in mountainous area in the region by Turkish Government. Sustainable Rural Tourism Development Plans were prepared for these centres by Ministry of Culture and Tourism. Transportation, electricity, communication, and accommodation facilities were developed in the centres. Today, the mountains of the Eastern Black Sea Region have become well-known and popular tourist destination and are visited by a growing number of foreign and Turkish tourists. Tourism has contributed greatly to rural development in the region. The rise of tourism as a business has brought great benefits to the mountain areas in the region. Tourism has provided local people with additional income and employment, opened new career opportunities, and created markets for both high-quality traditional products and local products from mountain areas. Tourism is also opening new ideas and cultural exchange to the mountain region (Karadeniz and Somuncu, 2003; Somuncu, 1997, 2007).

18.4.3 The Kaçkar Mountains National Park: A Model for Sustainable Mountain Development

The Kaçkar Mountains National Park is situated in Rize Province in the Eastern Black Sea Region. The Park was created in 1994 and covers 51,500 ha. There are 11 villages and 44 *yaylas* in the National Park. Villagers mainly keep cattle, sheep and goats, or live off the forest, and to lesser degree they farm. Tea is the leading crop of the coastal strip, Rize being Turkey's one and only producer and processor of this leaf. In the mountains there is not enough land for extensive agriculture, so livestock breeding takes its place. Livestock farming as a household activity has significant place in the local economy. In early summer, rural families move to summer pasturage with their stock. Taking place in the Alpine layer above 2,000 m in average, summer pasturage has significant functions for purposes of both animal husbandry and of passing the summer in a cooler environment (Karadeniz and Somuncu, 2003). Rural families live in wood cabins in *yaylas* to return again to their villages with the approach of autumn.

The Kaçkar Mountains National Park has become one of the important points of attraction for tourism because of its natural features and cultural structure. Tourist activities in this area include climbing, trekking, camping, photography, flora, fauna and natural beauty-seeing, meeting the local people who live in *yaylas*, and learning about their lifestyle. Due to these activities, the local people earn from accommodation, transportation, souvenir sales, guidance services, etc., which further add to rural economy. The accommodation potential of the park amounts about 1,000 beds. The characteristic feature of tourism here is its seasonality having its peak during summer months. The average number of tourists per year is over 100,000 (Somuncu, 2007).

Economic and social effects of tourism in the Kaçkar Mountains National Park may be summarized below:

- The tourism of National Park provides money inflow and increase in income not only for low-income villagers who live within borders of the National Park but also for the towns and villages around the National Park.
- Since tourism is a service-based sector that requires more manpower, the development of tourism creates new job opportunities for local people.
- Another positive effect of tourism is related with the employment of women. Along with the development of tourism in the national park, local women have begun to work in touristic enterprises. Thus, the role of women, who were engaged in housework and agricultural activities, has changed.
- Parallel to development of tourism, host–guest relationship has begun to change in a positive direction (Somuncu, 2007).

18.5 Conclusion

Eastern Black Sea Regional Development Plan has provided substantial contributions to the sustainable development of the Region and Turkey till now. The progress of the transportation system and accessibility to the mountainous areas has importantly contributed to mountain development in the region because accessibility to the mountainous areas has made growth of the rural tourism possible. Rural tourism in the mountainous areas is continuing to grow. This plan has also more expected contributions in the future. The contributions of the plan are not only developments in the region but also protection of natural resources. The development of the Eastern Black Sea mountainous region is very important for Turkey and global ecosystem. Development in the region will play a prominent role in Turkey's expanding relations with the countries of Caucasus, Central Asia, and Black Sea Economic Cooperation countries by fostering foreign trade and social/cultural ties. Protection of biodiversity of the region also depends on sustainable development of the mountainous areas.

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Chapter 19
Changes in the Ethnic and Demographic Profile of the Population in Eastern Stara Planina Region

Nadezhda Ilieva and Boris Kazakov

Abstract The chapter focuses on the ethnic groups of the population in Eastern Stara planina region—changes in their spatial distribution and number of population through the period between 1965 and 2001. The region is one of the regions in Bulgaria with a significant concentration of ethnic Turks and Roma population, which hugely affects the demographic, social, and economic profile of the region. The region is also important from NATURA 2000 point of view, because vast areas in Eastern Stara planina Mountain are protected areas according to (in most cases) both NATURA 2000 directives. The specific features of the ethnic and cultural development of ethnic groups influence their reproduction and migration behavior in various ways. The dynamics and spatial distribution of the ethnic Bulgarians is revealed as well. The main factors for the changes in number of the population are outlined. The chosen period is locked between the three most representative, in terms of ethnicity, censuses in Bulgaria—1965, 1992, and 2001, which define important sub-periods of changes in the ethnic structure of the population in Bulgaria in the last decades.

Keywords Ethnicity · Ethnic groups · Ethnic composition of the population · Demographic profile

19.1 General Notes

The 1965 census has been chosen as a beginning of the discussed period because that was the last census, where ethnicity was impartially observed—during the 1975 census such data were gathered, but was immediately classified, while during the 1985 census ethnicity was not observed at all. The 1992 census revealed the changes that had happened right after the so-called "revival process" (a process

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Table 19.1 Natural reproduction of the three major ethnic groups in Bulgaria for the period 1946–2000 (%)

	Crude birth rate			Crude death rate			Natural increase		
Ethnic group	1965	1975	2000	1965	1975	2000	1965	1975	2000
Bulgarian	13.6	15.6	6.9	8.3	9.8	15	5.3	5.8	–8.1
Turkish	29.3	29.6	13	7.2	8.1	10.5	22.1	21.5	2.7
Roma	24.2	33.3	26.7	5.2	8.2	7.5	19	25.1	19.4

Source: The calculations for 1946, 1956, 1965, 1975 are based on Central State Archive data, and for 2000 – by Tomova (2005)

in which the Muslims in Bulgaria were forced to adopt Christian names instead of their Turkic–Arabic names), while the 2001 census showed the beginning of the demographic crisis and all the changes that occurred during the early years of the transitional period in Bulgaria (Table 19.1, Figs. 19.1 and 19.2).

The differences in the reproduction process of the three ethnic groups are quite distinctive during the whole period. The decline of Roma birth rate in the recent years is due to socio-economic and cultural changes, such as increase of the educational level, decrease in the infant mortality, etc. Despite those factors, the decline of Roma birth rates is slow—at the end of the discussed period it is nearly four times higher than the Bulgarian birth rate, and two times higher than that of Turks. As a result of healthcare improvement, Roma mortality rate declined, which process neutralized to some extent the decline of birth rates and thus the natural increase remained unchanged. Just the opposite, Bulgarian death rates began to grow during the mid-1970s, as a result of aging. The Turks and especially the Roma have much better overall demographic situation of the Bulgarians, due to different start of the demographic transition of the three groups as a result of their cultural differences. Another factor is the lower "rural to urban" migration rate of the Turks and Roma in the past periods. In the 1960s and the 1970s, the natural increase of the Turks and

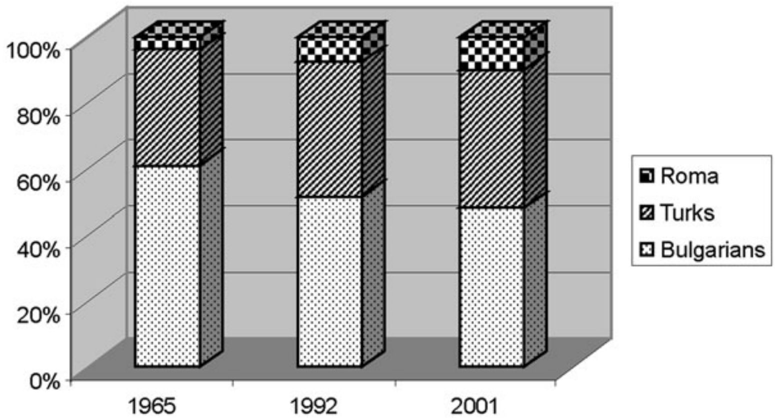

Fig. 19.1 Changes in ethnic structure of the population in Eastern Stara planina region

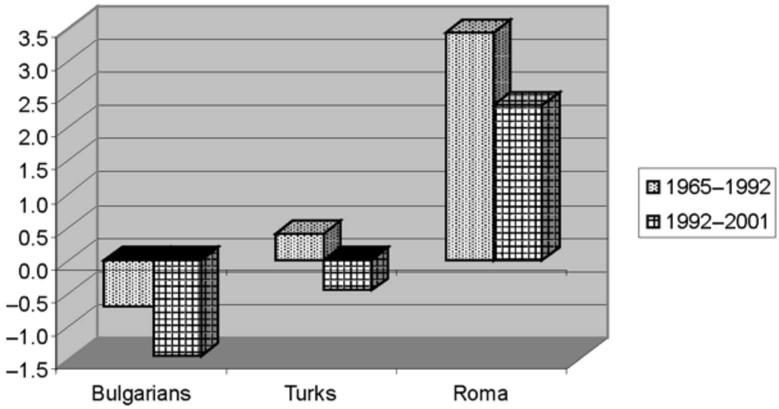

Fig. 19.2 Average annual increase of the population number of the main ethnic groups in Eastern Stara planina region (1965–2001)

Roma was approximately four times higher than that of the Bulgarians. In recent years however, the demographic behavior of Turks began to resemble more and more that of Bulgarians, while that of Roma remains quite conservative. The economic stabilization which began after the 1996–1997 crisis period, together with tolerant policy toward minority groups, limited migration to Turkey etc. resulted in reduction of Turkish birth rate growth in recent years. Despite that, an insignificant growth of the natural increase is observed in only few of the municipalities of the Eastern Stara planina region.

19.2 The Turkish Ethnic Group

The Turkish ethnic group is the second largest after the Bulgarian group in the observed region and in the country as a whole (according to the official data). During the period between 1965 and 1992, unlike the rest parts of the country with Turkish population, the number of Turks grew in the Eastern Stara planina region. This is a result of a smaller scale emigration to Turkey in the period 1969–1978 and in the late 1980s, compared to that in other parts of the country, such as the Eastern Rodopi and the North-eastern region. Thus, the Turkish population in Eastern Stara planina had an average annual increase of 0.4% per year during the period 1965–1992 and from 76,000 in the beginning of that period, reached 84,000 by 1992. The growth in number led to a growth of the relative share of Turks by 5%, which by 1992 reached 40.5% of the total population in the region. An exception of that dynamics were the municipalities of Kotel, Smyadovo, Omurtag, and Varbitsa, where an insignificant decline of the number of Turks was observed (–0.5% average annual decrease). During that period of time, the Turkish population grew in both rural and urban settlements of the region.

The ethno-cultural specifics of Turkish population, together with the mountainous features of the region, the lack of a significant urban (industrial) center and urbanization level, determine the lower migration rate of Turks, compared to that of Bulgarians. Unlike Turks, ethnic Bulgarians emigrated out of the region much more intensively and as a result, the decrease rate of their population number was three times higher than that of Turks. All that led to growing shares of Turks in all municipalities in the region—with more than 5% points in Ruen and Byala municipalities, and with more than 10% points in the municipalities of Sungurlare, Dolni Chiflik, Dalgopol, and Pomorie in the period between 1965 and 1992. This trend, although not so strong, continued in the next decade.

The Eastern Stara planina region was not quite affected by Turkish emigration in the second sub-period (1992–2001) and again, unlike other parts of the country, the decrease in number of Turks was insignificant. In the beginning of the 21st century the ethnic Turks in the region were 80,830. In the different municipalities, the rates of population number change were different—between –2% in Varbitsa municipality and +3.6% in Dolni Chiflik municipality. The Turks decreased their number in those municipalities, where they were the largest ethnic group—Ruen, Omurtag, and Varbitsa, while in the rest of the region their number grew. However, because of the decrease in number of Bulgarians, the share of Turks kept rising, as well as their spreading across the region. A specific feature of Turkish distribution in Bulgaria is their traditional concentration in rural settlements. Those were home for nearly 90% of Turks in the region by 2001.

In the beginning as well as at the end of the discussed period, more than half of the Turks in the region lived in just two municipalities—Ruen and Omurtag. Through the whole period, the concentration of Turks decreases as their distribution eastward becomes more and more even across the area of the region. By the end of the observed period, their number grew significantly in the municipalities of Pomorie, Nesebar, Dalgopol, Dolni Chiflick, and Sungurlare, which in some cases led to dramatic change of the ethnic structure of their population.

A typical feature of the municipalities populated predominantly by ethnic Turks (Ruen, Omurtag, and Varbitsa) is the existence of many entirely Turkish villages, which constitute 2/3 of all settlements in those municipalities. In the majority of those settlements, the number of population remains almost unchanged compared to the beginning of the discussed period. That group of villages is the strongest in its range and broadens by including other villages, in which Bulgarians used to live, but eventually left or passed away. Along with the group of entirely Turkish villages, there is another quite significant group of mixed settlements, in which the population is predominantly Turkish. Unlike the previous group however, in this second group the number of Turks declined through the discussed period, but at the same time the number of that type of villages actually grew.

In the municipalities, where the majority of the population is Bulgarian, the villages with entirely Turkish population are rare, although such villages do exist. However, in the predominantly Bulgarian municipalities, the main part of the Turkish population inhabits mixed, bi-ethnic (Bulgarian-Turkish or Turkish-Bulgarian) settlements. In the majority of those, the number and share of Turks grew

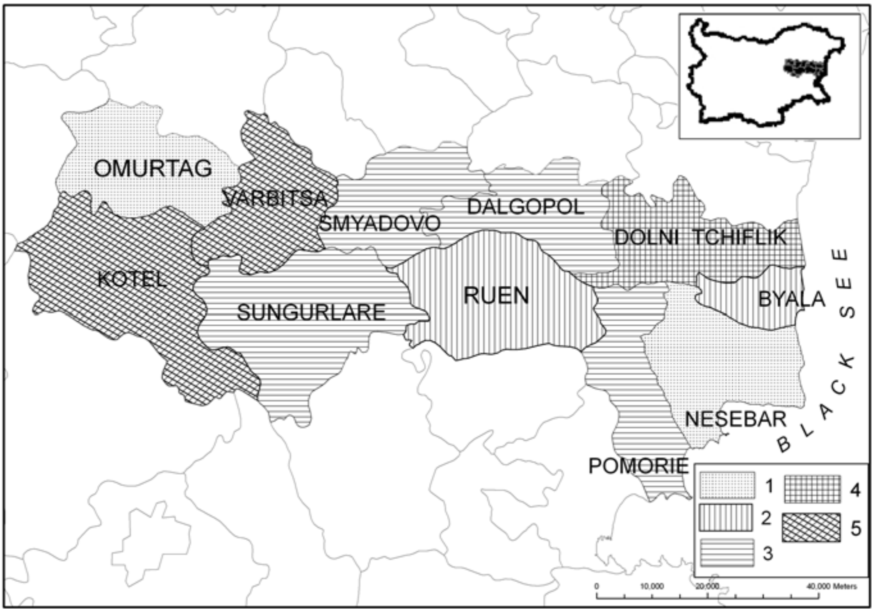

Fig. 19.3 Changes in the relative share of the Turkish ethnic group in Eastern Stara planina region in the period between 1965 and 2001 (in percentage points): I. *Increase*. 1 – 0–5; 2 – 5–10; 3 – 10–15; 4 – more than 15; II. *Decrease*. 5 – 0–15

through the observed period, which eventually led to transforming some settlements from Bulgarian-Turkish into Turkish-Bulgarian (Fig. 19.3).

19.3 The Bulgarian and the Roma Ethnic Groups

In the beginning of the period, the number of ethnic Bulgarians inhabiting the Eastern Stara planina region was 131,000 people, which was around 60% of the population. The last census of 2001 showed that their number had been reduced by 38,000 and had fallen to approximately 93,000 people, which was only 70% of the number registered in 1965. The share of Bulgarians, therefore, was reduced from 60 to 47% of total population of the region. Nevertheless, Bulgarians remained the largest ethnic group in that traditionally mixed region of the country. However, while in the beginning of the observed period ethnic Bulgarians doubled the number of the second largest group—that of Turks, by 2001 that difference had melted down to a mere 6% points, or 12,000 people. The fact that Bulgarians remained the largest ethnic group, despite the significant reduction of their number, is due to a great extent, to the several emigration waves of Turks to Turkey (although, as mentioned earlier, on a smaller scale compared to other regions) (Figs. 19.4 and 19.5).

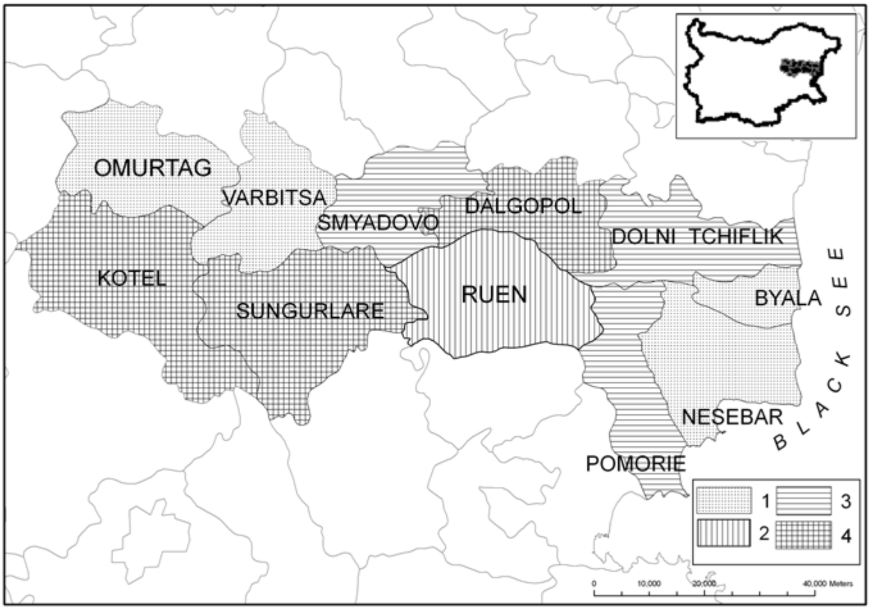

Fig. 19.4 Decrease in relative share of the Bulgarian ethnic group in Eastern Stara planina region in the period between 1965 and 2001 (in percentage points): 1 – 0–10; 2 – 10–15; 3 – 15–20; 4 – more than 20

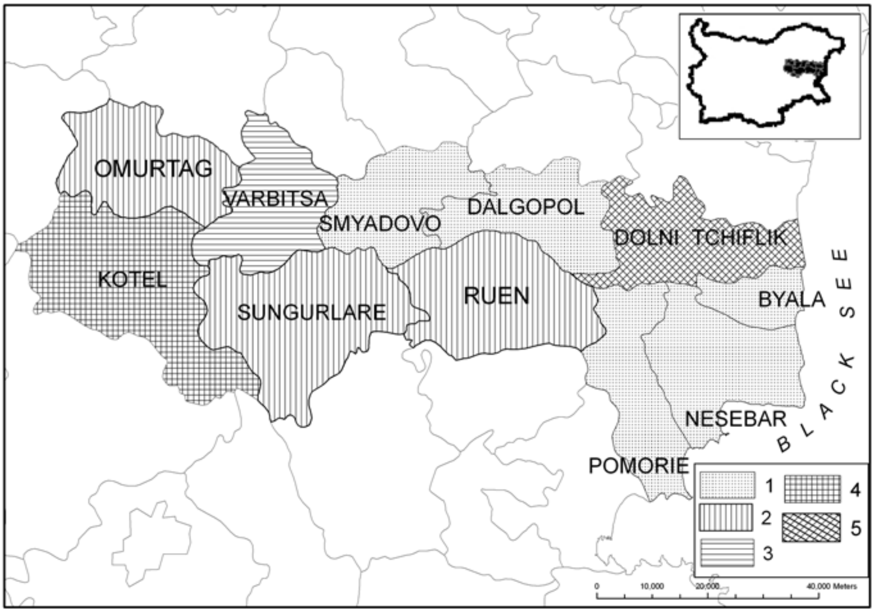

Fig. 19.5 Changes in relative share of the Roma ethnic group in Eastern Stara planina region in the period between 1965 and 2001 (in percentage points): I. *Increase*. 1 – 0–5; 2 – 5–10; 3 – 10–15; 4 – more than 15; II. *Decrease*. 5 – 0–15

The largest absolute population loss was observed in Sungurlare and Kotel municipalities, where the number of Bulgarians was reduced by 50% of their number in 1965, while in Ruen municipality the relative loss was the highest (60%).

In the beginning of the period the Bulgarian population was predominantly concentrated in the municipalities of Pomorie, Sungurlare, Kotel, and Dolni Chiflik, where more than half of all Bulgarians in the region lived. By 2001 however, the majority of Bulgarians lived in only three municipalities—Pomorie, Nesebar, and Dolni Chiflik, moreover, a significant part of the population was concentrated in the towns of the region—especially Pomorie and Nesebar. The urban concentration of the ethnic Bulgarians is quite distinctive, having in mind that urban Bulgarian population in the region practically has not changed during the discussed period, but in the beginning it comprised only a third of the total Bulgarian population, while in 2001 more than half Bulgarians lived in urban settlements. Despite the fact that urban settlements in the region traditionally have predominantly Bulgarian ethnic composition of the population, one of the municipal centers is an important exception—the town of Varbitsa is ethnically mixed, which is not unusual, however it was the only town in the country (by 2001) where the share of Roma population exceeded that of Turks and Bulgarians, being the smallest of the three ethnic groups (Ninov, 1999). On the other hand, almost entirely Bulgarian remained the towns along the Black Sea coast—Nesebar, Sveti Vlas, Obzor, and Byala, where over 90% of the population is Bulgarian. The towns of Nesebar and Sveti Vlas grew significantly during the observed period, and those are the two settlements with the highest relative increase of Bulgarian population as well (by 100–140%). However, the relative share of Bulgarians, like in all other towns in the region, decreased. Nevertheless, all towns in the region, with the exception of the earlier mentioned town of Varbitsa, are predominantly Bulgarian by ethnic structure of the population. The lowest share of Bulgarians have the towns Kotel and Dolni Chiflik, where Bulgarians comprise only 60% of the population, while the rest are mostly Roma (town of Kotel) or Turks (Dolni Chiflik). The latter is an interesting case of altering its ethnic profile from Bulgarian-Roma in the beginning of the period to Bulgarian-Turkish at the end of the period. Such profound changes, however, should be looked at quite suspiciously, for the Roma residents have a notorious tendency to self-proclaim themselves for Bulgarians or Turks—usually depending on the ethno-confessional environment they are in. Thus, some Bulgarian-Roma settlements "turn" into Bulgarian-Turkish sometimes without actual occurrence of such transition. Estimating the exact number of Roma population, therefore, is almost impossible on a regional and national level (as well as on an international level).

Predominantly, or entirely Bulgarian by ethnic composition settlements have a dispersed distribution across the observed region. It is only in its eastern part where those settlements clearly dominate (municipalities of Nesebar and Byala). It is only in the almost entirely Turkish municipality of Ruen where Bulgarian villages practically do not exist.

Unlike towns, none of which has a 100% Bulgarian population, such villages traditionally exist in the region. Entirely Bulgarian, or with a share of Bulgarians over 90% of the population, were 71 settlements in 1965. Their number fell to 56 by 2001, or by 20%. That group of settlements comprises towns, very small villages as well as some of the largest ones—the resort villages of Aheloy (the largest village on the Bulgarian Black Sea coast), Ravda and Sveti Vlas (which was granted a town status in 2006).

Beside that group of Bulgarian settlements, another group is traditionally typical for the region—that of the bi-ethnic settlements, in which Bulgarians live together with Turks or Roma. The majority of those settlements are Bulgarian-Turkish or Turkish-Bulgarian. Their number, however, declined through the observed period, in favor of tri-ethnic settlements, some of which have a significant share of Roma population. Again, the distribution of those settlements is fairly even across the region.

In the beginning of the period in observation, the majority of settlements where Bulgarians live together with Roma population were settlements in Dolni Chiflik municipality, including the municipal center, while by 2001 such settlements had spread throughout the whole region. Another significant change in the settlements network is that if in the beginning there were no settlements in which the Roma had the largest share, by the end of the period such settlements, although not too many, already existed. One of those settlements—the village of Gradets, Kotel municipality—had turned from almost entirely Bulgarian to almost entirely Roma.

The total number of Roma population in the observed area grew from 8,000 to 19,000 during the discussed period. But as mentioned earlier, that number could be twice higher. Nevertheless, the growth of the Roma population number is significant, as well as their spreading across the region. In the beginning of the period the Roma lived predominantly in Dolni Chiflik and Omurtag municiplities, while by 2001 they were concentrated mostly in Kotel municipality (1/3 of all Roma in the region), Omurtag and Varbitsa municipalities. The largest Roma population groups are found in the towns of Kotel and Varbitsa, as well as in the village of Gradets, Kotel municipality.

Unlike the mixed, Bulgarian-Roma or Roma-Bulgarian settlements, which are typical for the area, settlements in which Roma live together with Turks are rare, despite the fact that their number grew from 1 to 7 during the period between 1965 and 2001. A representative of that group of settlements is one of the municipal centers in the region—the village of Ruen. By 2001 there were no settlements in the region (and the country) inhabited by Roma population only.

19.4 Classification and Grouping

One of the final stages of a geographic research is the group arrangement (classification) of similar geographic objects (in this case—settlements). Settlements have been assigned to various groups according to their ethnic structure. Each group consists of settlements with a similar structure. Because the share of the three main ethnic groups can vary a lot, the formation of a certain group, its range, and name is up to the researcher, and therefore a subjective process. That applies especially for the groups consisting of settlements with mixed population. In order to avoid an excessive variety of groups, compromise with their accuracy had to be made.

For example, “monoethnic” were considered settlements with share of population belonging to one ethnic group 90% of the total or more. Thus, settlements with 100% monoethnic population and practically bi-ethnic settlements, in which the minority group is sometimes almost 10% of the total population, find themselves

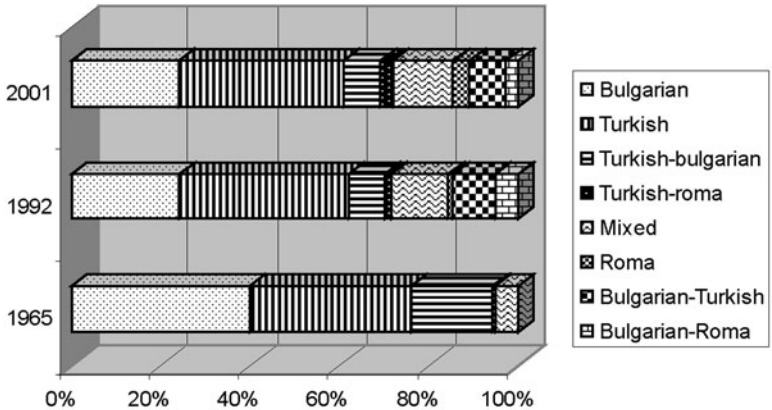

Fig. 19.6 Share of settlements of various types of ethnic structure in Eastern Stara planina region (1965, 1992, and 2001)

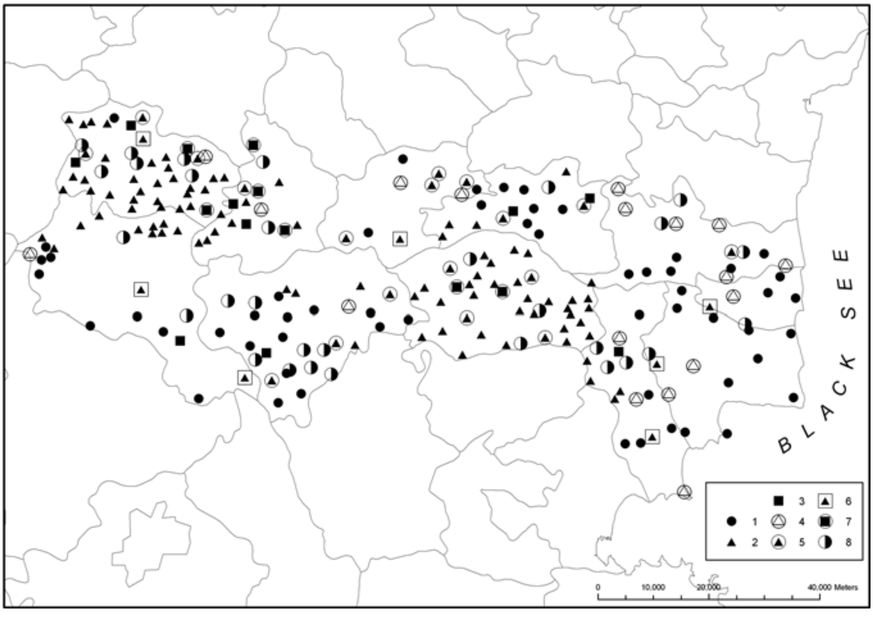

Fig. 19.7 Classification of settlements in Eastern Stara planina region according to their ethnic structure (as of 2001): 1 – Bulgarian; 2 – Turkish; 3 – Roma; 4 – Bulgarian-Turkish; 5 – Turkish-Bulgarian; 6 – Turkish-Roma; 7 – Bulgarian-Roma; 8 – Mixed

in one and the same group. The “true” monoethnic settlements are less than the bi-ethnic settlements in that group. On the other hand, in the group of settlements with mixed (tri-ethnic) population, sometimes the dominating group exceeds by far the other two groups, and yet it is less than 90% of the total population and therefore could not be put in the “monoethnic” group (Figs. 19.6 and 19.7).

The group of settlements with a highest share of Roma population consists of settlements in which Roma ethnic group is the largest, and the percentage share itself was not taken in consideration. For example, in some settlements of that group, share of Roma population is around 40% of the total, while in others that share is over 80%. The main criterion in defining that group of course was the fact that it is the Roma population which is dominant.

The bi-ethnic groups such as Bulgarian-Turkish, Turkish-Bulgarian, the Bulgarian-Roma, and the Turkish-Roma are sometimes tri-ethnic, but the presence of a third ethnic group is insignificant—over 90% of the population belongs to the dominant two ethnic groups.

In some cases, settlements have been conditionally put in the group of settlements with a mixed ethnic structure, only because of the higher share of population with undeclared ethnicity (2001), while in the classification based on 1965 census data, a certain number of settlements formed a “no data” group.

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Part IV
Nature Protection and Conservation

Chapter 20
Applying Integrated Nature Conservation Management: Visitor Management and Monitoring of Winter Recreation Activities Focusing Grouse Species in Berchtesgaden National Park

Sabine Hennig and Michaela Künzl

Abstract Modern nature conservation management must act as an interface between recreation and nature, i.e. nature conservation and its objectives. Therefore visitor management plays a key role. The acceptance and successful implementation of integrated visitor management measures depends on well-founded data on recreation and nature, and an extensive knowledge and understanding of both. This is provided by visitor monitoring, which today combines methods of data collection as well as computer-based processes like data modelling, statistical analysis and spatial analysis (using, e.g., databases and Geographical Information Systems, GIS). For protected area management the integration of different methods helps to identify possible impact of land use on nature and supports decision making. For European mountain protected areas, the application of diverse methods is of special importance: Regions like the Alps, the Carpathian Mountains, and the Balkan Mountains on the one hand side are essential destinations for recreation, on the other hand side they are regions, nature conservation activities focus on. But how does integration of management and monitoring as well as the combination of methods occur in practice? This chapter gives an example on handling winter recreation and wildlife protection in the Alpine Berchtesgaden National Park (Germany).

Keywords Protected areas · Nature conservation · Visitor management and monitoring · Ecological impact and conflicts · Wildlife disturbance · GIS

20.1 Introduction and Background

For today's "leisure society" nature and landscape play a major role. Enjoying nature is a main purpose of vacation, leisure and recreation (Opachowski, 1999; Wagles et al., 2002). Particularly, nature-based recreation showed growth potential in the last years: An increasing number of persons perform an increasing number

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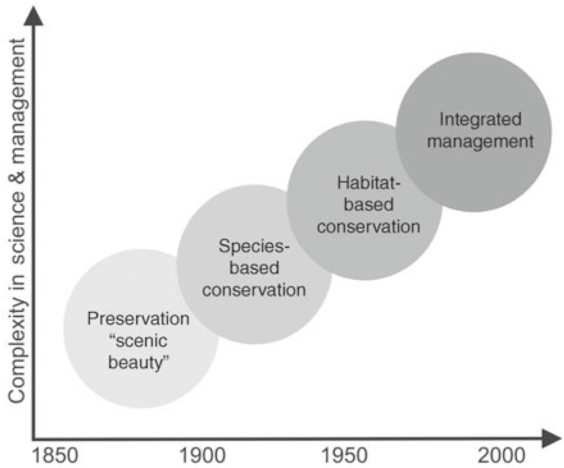
of different (nature-based) recreational activity forms. More and more areas of previously unspoiled nature are made accessible to recreation and its recreational use in time is, seasonally and diurnally, prolonged. This development is associated with ecological impact to a significant degree. Examples are, among others, habitat degradation, loss and fragmentation as well as disturbance to wildlife (Ingold, 2005; Manning, 1999; Scheuermann, 2005). As a consequence, in areas of concern the existing situation and changes in recreation, with their effects on nature, must be considered carefully. To do justice to the requirements of nature conservation and recreation, management measures are required, which on the one hand treat recreation in accordance to nature's supply and conservation needs, and on the other hand recognize recreational demands in nature conservation. This calls for the implementation of contemporary integrated nature conservation management approaches – being holistic, interdisciplinary and moreover multidisciplinary: Integrated management encompasses methods and instruments coming from different fields into one consistent structure or framework. It aims at to examine different requirements considering diverse points of view. Doing so, it provides a clear picture of all aspects of an organization or system, how they affect each other and their associated risks, impacts and conflicts. In comparison to singular management measures, by using synergies and by concentrating resources more efficient management is possible. Integrated management is a challenge to conventional practices, attitudes and professional certainties. It confronts entrenched sectoral interests and requires that resources are managed holistically for the benefits of all. Figure 20.1 shows changes in nature conservation management during time and compares characteristics of conventional and integrated management.

In protected areas, visitor management is used to fulfil the task to develop integrated nature conservation management strategies, which aim to handle recreation and natural demands towards sustainable development. This relatively new field of activity was not developed until the second half of the 20th century in a response to the increasing and changing recreation. Today, it has become an ever more important element. Adequate measures (see Fig. 20.2) are used to balance the ecological and social benefits and disadvantages that visitors bring (Newsome et al., 2004). However, it must be considered that each recreational activity is different. This concerns use pattern, target groups, requirements on infrastructure, weather, etc. Further, the impact on the environment differs for each activity. As a result, management has to apply various measures depending on the specific recreational activity. Searching for a suitable way to realize, to develop and to guide recreation, management approaches for the individual activities are required integrating diverse points of view.

The realization of appropriate visitor management measures requires well-founded and actual data, and an extensive understanding on recreation and nature. Thus, an essential part of visitor management is visitor monitoring (Worboys et al., 2005). It entails the systematic and ongoing collection and analysis of data on nature- and landscape-related recreation, as well as on the motives, needs and conflicts involved. Thereby, visitor monitoring aims to assess and/or evaluate the recreational use made of an area in a targeted fashion, taking all aspects into



1962		2003	
central administration	individual areas, strict categories	part of systems (e.g. corridors, newtworks)	various parties involved, alliances
conservation as single purpose	managed "island like"	embedded in the region	social & economic purposes
state financed	scenic beauty	econmic, cultural, scientific interests	financed by diverse ressources
managed by experts, academics	preservation	also: renaturation, rehabilitation	interdisciplinary teams, cooperation
without local population involvolved	"reactive" management, short planning	adaptive management, long-term	management for/ with the local population

Fig. 20.1 Nature conservation concepts and their change over time (adapted from: Brüggemann, 2004; Job et al., 2003)

account that relate to recreation as a whole, be they social, ecological, economic or management-related. The information gathered and analysed can be quantitative data such as the number and spatial distribution of the visitors as well as qualitative data like visitor characteristics and visitor behaviour. Visitor monitoring does not mean data collection for its own sake. Its outlook, requirements and scope are defined by clearly formulated objectives, concrete questions and the expectations of the management (Arnberger, 2007; Muhar et al., 2002; Newsome et al., 2004). Today, numerous data collection methods are utilized for visitor monitoring including methods of computer-based data-handling (storage, analysis, processing, visualization, modelling and simulation, etc.). The need for continuously and routinely available and accessible data demands the use of different computer programmes (see, e.g. Arnberger, 2007; Hellmuth, 2007; Manning et al., 2005). But how does the integration of visitor management and visitor monitoring as well as

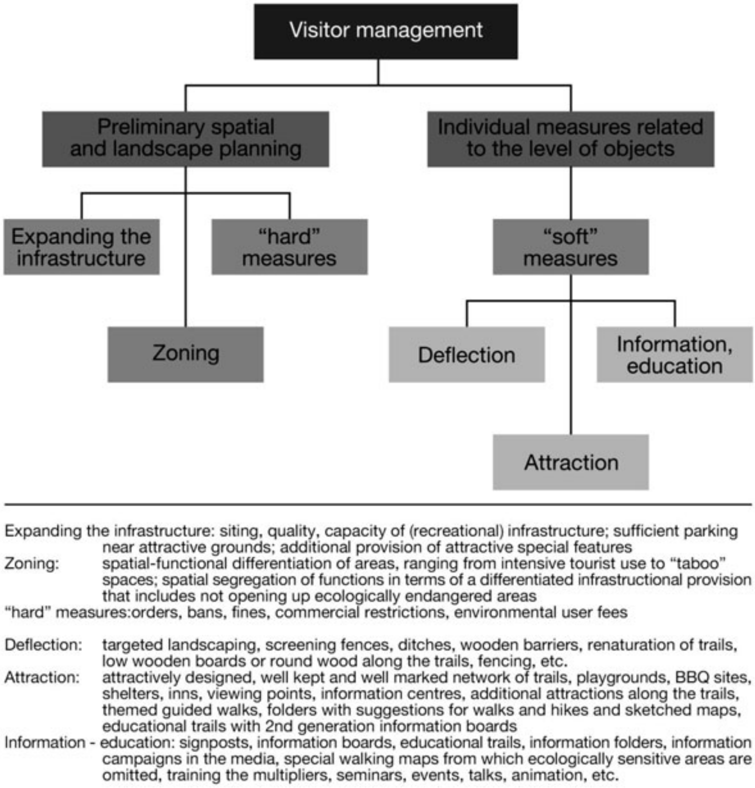


Fig. 20.2 Selection of visitor management measures (adapted from: Ausschuss für Bildung, Forschung und Technikfolgenabschätzung im deutschen Bundestag, 2002, Hennig and Großmann, 2008; Job, 1991; Scharpf, 1998; Schemel and Erbguth, 2000)

the combination use and interplay of data collection methods and computer-based data-handling methods occur in practice? This is presented by an example of visitor management and visitor monitoring in Berchtesgaden National Park.

20.2 Study Area and Objects

Changes in nature-based recreation have a significant effect on mountainous regions like the Alps. This mountain range is one of the most important tourism, leisure and recreational regions in Europe. Tourism, leisure and recreation are one of its main economic factors. In addition, the Alps are (still) a relatively intact large ecosystem of international meaning (Bätzing, 2003). An increase in recreation will be contrary to the conservation needs of its nature. However, within the Alps especially the nature-based recreation during winter season has grown steadily over the last years. Particularly, in the Bavarian Alps today ski-touring and snow-shoeing take centre stage. This region is easily accessible from the nearby densely populated areas like Munich and thereby is preferred for winter recreation by its inhabitants. This gives rise to ecological conflicts. One example among others, which requires management solutions, refers to the impact of ski-touring and snow-shoeing on the grouse species. For several reasons management initiatives focus on the four grouse species native in the Bavarian Alps. Investigations on their population dynamics indicate negative trends. Besides other factors, this is caused by habitat degradation, fragmentation and loss. Further, many grouse species are regarded as species with a high degree of sensitivity to disturbance. Experts draw attention to the growing danger of disturbance by recreation principally during winter (energetic bottleneck for most wildlife) as well as spring and summer (reproduction time with courtship and breeding: key phase for species survival) (Bezzel et al., 2005; Marti, 2002; Zeitler, 2005). Today, in the Alps all four grouse species are designated as endangered species (LWF, 2005; Marti, 2002). They are listed in the Bavarian Red List (RL-BY) and the Conservation of Wild Birds Directive of the European Committee (VS-RL). For a number of other species grouse function as umbrella species. Hence, they can occupy key positions in nature conservation decision making.

Large protected areas like national parks are suitable for developing prototype conservation management programmes which pay attention to recreation and nature conservation. These areas are mainly managed for conservation, scientific research, environmental education and recreation, i.e. tourism (see, e.g. BNatSchG, IUCN Management Categories). According to the management objectives *conservation* and *recreation*, especially national parks demand for scientific research to provide management solutions that interface between both. In the Bavarian Alps Berchtesgaden National Park is a satisfactory study area to develop an integrative management programme example that takes into account wildlife (i.e. grouse species) and winter recreation (i.e. ski-touring and snow-shoeing).

20.3 Protected Area Berchtesgaden National Park

The study area of Berchtesgaden National Park is situated in the south east of Germany. The only German Alpine national park (accepted by the IUCN as management category II) covers an area of about 21,000 ha. It ranges in altitude from 600 m AMSL (Lake Königssee) to 2,700 m AMSL (peaks of the Watzmann massif) and comprises the different elevation zones (montane, sub-Alpine and Alpine). As a natural landscape unit, it is part of the Northern Limestone Alps and provides a home to numerous (endangered) floristic and faunistic species. As one of the oldest holiday destinations in the Alps, the whole region “Berchtesgadener Land” has a long history of recreation and tourism. Both still play an important role in the area today. The natural world and spectacular Alpine scenery are what attracts visitors. Landscape attractions include viewing points, Alpine meadows, wildlife observation points and lakes. Further, the protected area provides about 240 km of official trails, numerous visitor facilities and services such as six national park information centres, nine Alpine huts, several options to stop for a bite to eat and places to rest (see Fig. 20.3). Currently, more than 1.3 million people visit the protected area

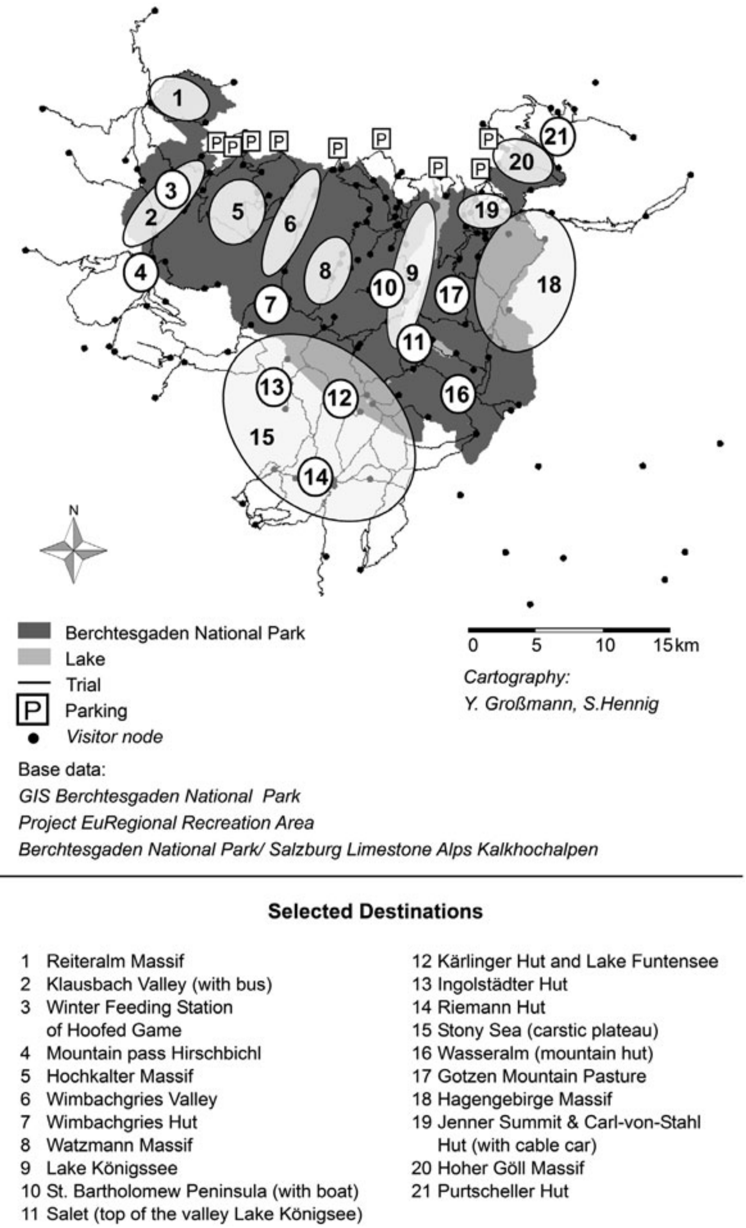


Fig. 20.3 Selected nature and landscape attractions in Berchtesgaden National Park and bordering regions

every year mostly in the summer. They perform walking, hiking and mountain biking. However, visitor numbers are steadily growing. One main reason is the increase in winter recreation by activities like winter-walking, snow-shoeing and ski-touring (BayStMLU, 2001; Job et al., 2003).

20.4 Winter Recreation: Ski-Touring and Snow-Shoeing

Winter activities, particularly ski-touring and snow-shoeing have become more popular since the 1970s. Originally, only performed by few people, both were classified as "ecologically" tolerable. Today, ski-touring is a major sporting activity, and snow-shoe sales figures and expert observations related to this activity show that interest has grown remarkably in this recreational activity in the last few years (Scheuermann, 2005; Zeitler, 2005). In recent times, both winter activities have resulted in increasing ecological conflicts. Reasons are not only the increased number of recreational users but also the prolonged diurnal and seasonal use, and the expanded spatial coverage mainly based on the high number of people taking part in these activities. Moreover, as compared to most summer activities, ski-touring and snow-shoeing are not linked to existing infrastructure, especially trails. Thus, the winter recreationalists cannot be guided and managed by providing a trail system adapted to management goals. Normally, their activities depend on personal abilities (e.g. skiing skills, fitness), the snow situation and avalanche risk. To create management measures focusing ecological impact and conflicts (e.g. with grouse species), it is essential to know use pattern of both recreational activities. Table 20.1 provides information on ski-touring and snow-shoeing.

20.5 Wildlife: Grouse Species

In the Bavarian Alps four grouse species can be found: hazel grouse (*Bonasa bonasia*), rock ptarmigan (*Lagopus mutu*s), black grouse (*Tetrao tetrix*) and capercaillie (*Tetrao urogallus*). Their habitats range over the different elevation zones (see Fig. 20.4). Depending on seasonal changes in habitat, during each phase of life, generally different specific habitat structures are required. Obligatory habitat types comply with courtship sites, breeding areas, upbringing habitats, feeding habitats during spring and summer and feeding habitats during autumn and winter (Ingold, 2005; LWF, 2005).

20.6 Temporal and Spatial Characteristics of Ski-Touring and Snow-Shoeing

Necessary precondition for an effective visitor management is to determine and characterize conflicts between grouse species and winter recreationalists. Only by

Table 20.1 General characteristics on ski-touring and snow-shoeing (Ingold, 2005; Scheuermann, 2005)

	Ski-touring	Snow-shoeing
Description	Ascents: physically exertive, descents: demand for large hill areas for ski-run	easy to learn, space intensive, off the beaten track
Reason	access to winter landscape, physical exercise, nature experience	solitude, nature experience, unspoiled nature (without any infrastructure)
Spatial Distribution	in all elevation zone: valley to summits	montane zone (below forest line), terrain without steeps
Abilities	ability to ski off-piste, good navigation skills, good awareness of the risks of mountain environment in winter (e.g. avalanches)	
Season	November to Mai, peak season February to mid of April	January to March
Day Time	after daybreak to afternoon	morning to late afternoon
Development	strong increase: 7,00,000 persons in the year 2000 3,00,000 persons in the year 2005	strong increase during the last years alternative due to insufficient snow and for non-skier

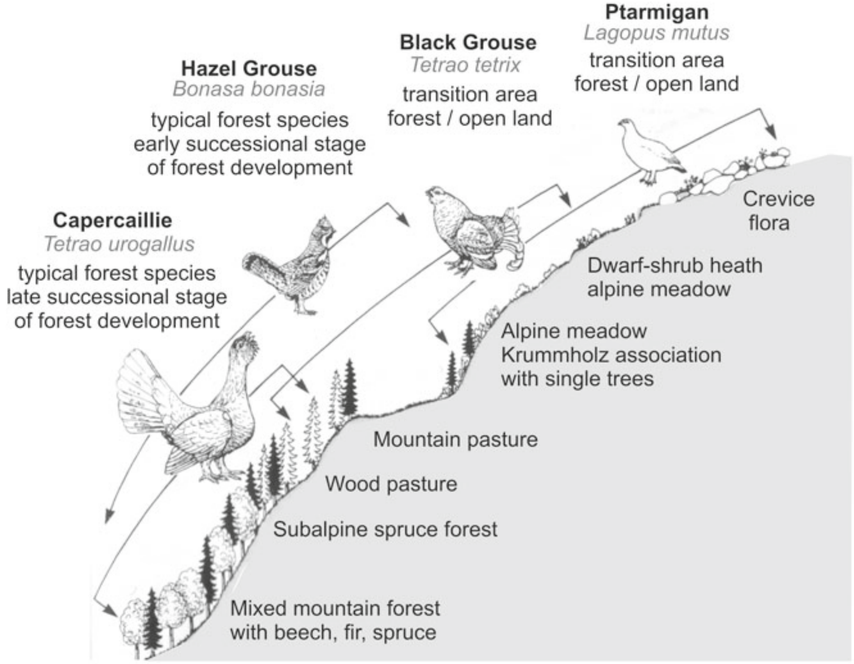
knowing temporal and spatial aspects of recreational use and wildlife habitat, it gets obvious if both intersect. However, concerning grouse species – in general (see, e.g. Ingold, 2005; LWF, 2005) and for Berchtesgaden National Park (see, e.g. Künzl, 2007; Preuss, 2005) – a large amount of data as well as knowledge are available (e.g. habitat requirements during each season, mode of life, disturbance behaviour: response time, escape distance and length). With reference to winter recreation (e.g. concrete number of ski-tourers and snow-shoers, their spatio-temporal distribution) there is still a lack of information. Due to this, management decisions related to both activities are frequently based on estimates and generalizations instead of concrete data. In addition, there is extensive knowledge on collecting and processing ecological data, but comparatively only little experience in the field of nature- and landscape-based recreation (Giles, 2003). In Berchtesgaden National Park data collection by visitor monitoring methods, data management in adequate data models and data processing via statistics were central steps to provide information and knowledge on spatio-temporal use patterns of the winter activities. For spatial analyses and cartographic visualization a Geographic Information Systems GIS was used.

20.7 Visitor Numbers and Temporal Performance Pattern

In the winter of 2005/06 data on ski-touring and snow-shoeing were collected by common visitor monitoring methods, as described in Arnberger (2007); Muhar et al. (2002):

- counts of parking ticket sales to get information on visitor numbers (at six parking areas which were the respective starting points of recreational activities),
- observations by four time lapse video systems to get information on visitor numbers distinguished by the performed activity (at two starting points of recreational activities and two sites located in the park area),
- observations by personal random sampling to get information on visitor numbers distinguished by the performed activity (at one starting point of recreational activities and two sites located in the park area),
- expert knowledge gained through various interviews with park rangers, Alpine hut hosts, mountain guides and literature research to supplement the data.

Computer-based data analysis and data processing show that in Berchtesgaden National Park one explicit peak season, as commonly described in the literature,



	Capercaillie	Hazel Grouse	Black Grouse	Ptarmigan
Courtship	Beginning of April to middle of May	Middle of March to middle of May	April to May	Middle of March to middle of May
Bredding	Beginning of May to middle of July	Middle of March to middle of May	End of May to beginning of July	Beginning of June to beginning of August

Fig. 20.4 Ecological niches and temporal aspects of courtship and breeding of the grouse species in the Bavarian Alps

Table 20.2 Temporal aspects of ski-touring and snow-shoeing daytime-season matrix

	5:00–8:00	8:00–14:00	From 14:00 till night
November–Mid February		ski-touring, snow-shoeing	ski-touring, snow-shoeing
Mid February–March	ski-touring	ski-hiking, snow-shoeing	ski-touring, snow-shoeing
April–May	ski-touring	ski-touring	

cannot be found. From the moment that snow of sufficient depth and adequate conditions (e.g. no/low avalanche risk) is available, the season starts for winter recreationalists. During the winter of 2005/06 there was not 1 day without any ski-tourer being active in the area regardless of weather conditions or avalanche risk. On peak days the number of ski-tourers was approximately 200–400 in some areas. In these parts of the national park the number of daily winter recreationalists was almost the same as the number of daily hikers and bikers during summer season. Moreover, it can be said that ski-touring is not an activity performed from early morning until afternoon as commonly argued (compare Table 20.1). For example, in the last few years the popularity of "moonlight tours" has steadily grown. On the basis of the collected data and the performance requirements of ski-touring and snow-shoeing (daylight, temperature, snow conditions, avalanche risk etc.), temporal use characteristics (concerning day and season) were derived (see Table 20.2).

20.8 Spatial Presence

Although ski-touring and snow-shoeing do not depend on a trail system, they follow so-called well-known routes. Spatial data that describe ski-touring and snow-shoeing routes in Berchtesgaden National Park are available by various sources: expert knowledge, maps, literature, the Geographic Information System (GIS) of the national park administration and GPS-mapping on site (see, e.g. Preuss, 2005). In Berchtesgaden National Park about 20 (main) ski-tours (including variations) can be identified (see Fig. 20.3).

In maps ski-touring ascents and descents are mainly represented by lines. Even though performing ski-touring leaves a linear trace in landscape, linear geometries do not meet the demands for analysing ecological problems. More adequate solutions on *spatial-data modelling* are asked. This requires an understanding of the course of ski-tours: Ascents depend on the landscape (forest, mountain pasture area, etc.), relief and infrastructure (forest roads, hiking trails). Nevertheless, as the slope angles increase, the ski-tourer ascending will begin doing so-called "kick-turns" to change direction. This typically results in a line that climbs at a moderate angle of 20–30°. After each snowfall the ascent trace varies depending on the first person ascending. Accordingly the "spatial coverage" of ski-tour ascent must be considered (at least in some segments) as areal. Thus, in these situations polygon features are the more adequate geometry type. Descending is principally areal and thereby (also in maps) represented by areas. With slight changes this concept is applied for snow-shoeing as well.

With this approach, it is possible to balance winter activities in the park area via Geographic Information Systems GIS: About 9% of the park area, core zone as well as buffer zone, are affected by ski-touring and snow-shoeing. As one example the extent of ski-touring and snow-shoeing at the test-side “Watzmann Massif” is shown in Fig. 20.5.

20.9 Conflicts and Integrated Management Measures

By combining information on the seasonal and/or daily habitat use of the four grouse species with information on winter recreation (e.g. routes, temporal aspects, frequency of use), conflicts can be identified. They can be individually named, characterized and categorized as spatio-temporal use-intersections of grouse and recreationalist. Mainly, two conflict-situations can be distinguished. They refer to winter and spring. In both seasons, the recreational use (see, e.g. Table 20.2) as well as the habitat of grouse species varies (see, e.g. Fig. 20.4).

During the winter months, ski-touring can be referred to as activity, which is performed throughout the entire day. Disturbances to grouses during this time cause the animals resting in snow caves to startle and flee. In doing so, they waste precious energy reserves they would normally need otherwise. In areas with regular presence of persons (e.g. traditional ski-touring routes) habituation can be observed. Snow-shoeing results in a completely different situation: Snow-shoeing is characterized by particular use-patterns mainly depending on the search of solitude, unspoiled nature and individual nature experience. Principally, no “determined” routes exist. Due to this, in the montane zone snow-shoer reinforce habitat fragmentation, and considerable impact on (so far in winter season) unspoiled nature. While grouses can rarely habituate to that, disturbance potential can be evaluated as quite relevant.

In spring, depending on snow conditions, ski-touring starts in the early morning with return around midday. At this time, during early morning hours, disturbance to grouses has serious consequences. It affects courtship, which is described as very disturbance-susceptible. Here no habituation takes place. Hence, because of early-morning ascents, spring ski-touring deserves special attention. However, the impact on the birds differs: The four grouse species occupy different habitats (e.g. diverse elevation zones) and also vary in their time of courtship (see Fig. 20.4). The courtship of hazel grouse and capercaillie (from the middle of March to middle of May) takes places in habitats below the tree line. Due to spring snowmelt ski-touring occurs in these areas to a lesser extent. A different situation exists for rock ptarmigan and black grouse. During their courtship period (middle of March to end of May) they use habitats along and above the tree line. Just at this time ski-touring takes place at these elevations. In the winter months, because of, e.g., snow situation and avalanche risk these (spring) tours are of minor importance. Thus, in spring-time conflict potential between ski-tourers and grouses can be considered as high. Mainly, for rock ptarmigan this involves a critical situation: In the Bavarian Alps

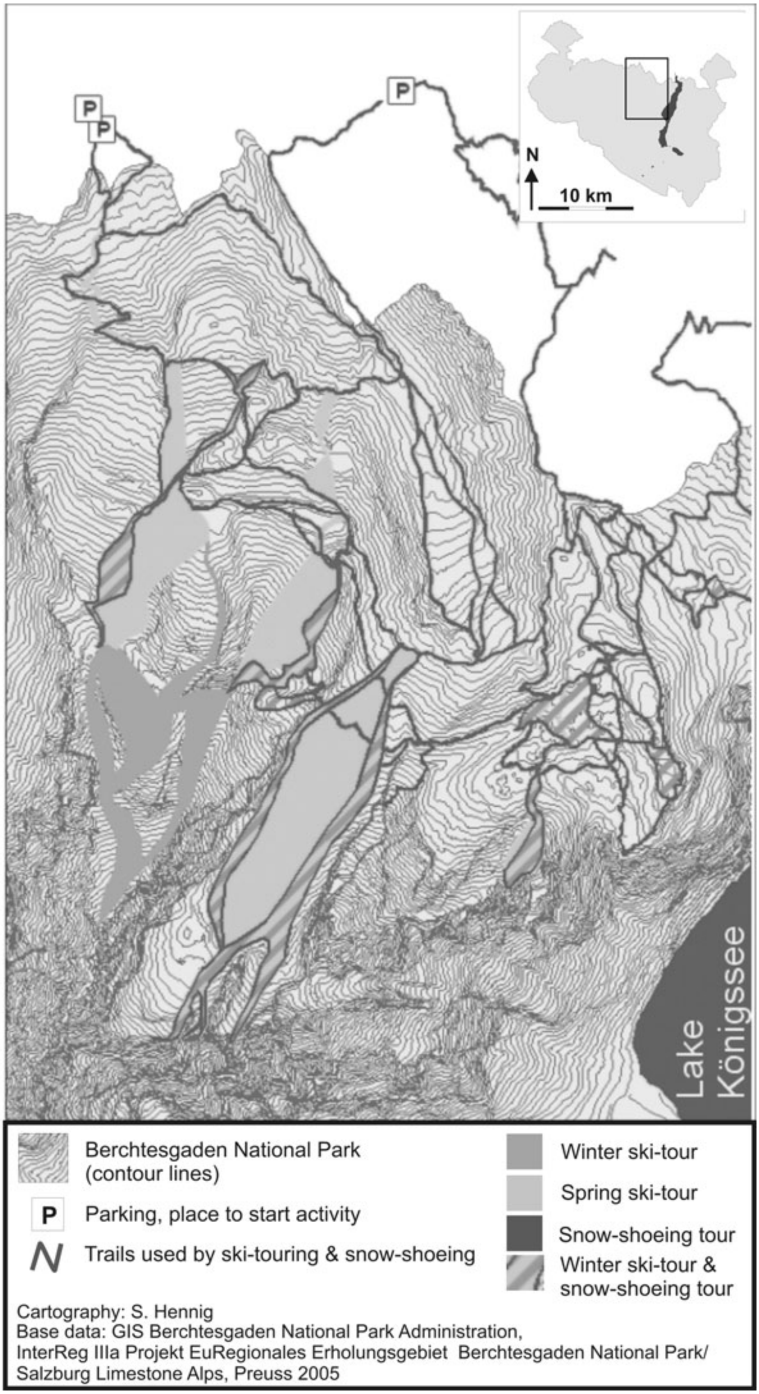


Fig. 20.5 Winter Recreation at Watzmann Massif (size 24 km^2)

they are currently endangered and probably most affected by climate change. Nature conservation carries a high responsibility for this species (LWF, 2005). Finally, regarding snow-shoeing in the montane zone during springtime, normally at this time of year the amount of snow is not sufficient to perform this activity in this elevation zone. Conflicts are less probable.

For each conflict category and each single conflict situation individual measures can be defined. Special attention is paid to suitable, practicable and target-oriented actions. They must correspond with the individual conflict, its cause, location and time. Particularly, modern visitor management measures like communication, environmental education, setting of infrastructural equipment and stakeholder co-operation are applied (see Fig. 20.2): The presence of park rangers on site, information signs at adequate locations and vegetation-clearings are useful measures to guide recreationalists and concentrate the activities in ecologically less critical areas. In ecologically critical areas and at ecologically critical times they should lead to voluntary renouncement of the recreationalist. To support this stakeholder co-operation is an important aspect. Suggestions to renouncement and behaviour are more likely to be accepted in this way. This is shown, e.g., by the project "Ski-Touring Nature-Compatible" of the German Alpine Association (Scheuermann, 1999).

20.10 Outlook

Ecological impact is caused by the combination and the interaction of many different factors. Today, recreation represents one of these factors. However, spatio-temporal data that describe *recreation* and *nature* are a prerequisite to identify and characterize ecological conflicts associated with recreation. For Berchtesgaden National Park this study outlines an example for the integrated management of winter recreation with focus on spatio-temporal interaction with the life-cycle of grouses. It is only one of many conflicts existing between recreation and conservation. In Berchtesgaden National Park impacts, caused by summer recreation, need management as well. This demands evolving guidelines to give managers a helping hand on how to collect, store and process spatial, attribute and temporal data on recreation. They will provide a basis to identify and describe ecological conflicts in detail, and to further establish appropriate measures. The individual but integrated handling of conflicts, keeping in mind spatio-temporal aspects of *recreation* and *nature*, plays an important part in the success and sustainability of nature conservation management – not only in Berchtesgaden National Park but also in other (mountain) protected areas.

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Chapter 21
Human Pressure on the Environment in the "Munţii Maramureşului" Natural Park

Dan Bălteanu, Mihaela Felciuc, Monica Dumitraşcu, and Ines Grigorescu

Abstract In order to protect the natural environment in the Romanian Carpathians, 22 major protected areas totalling approximately 1 million hectares, as well as some 600 reserves and natural monuments totalling 50,000 ha, were declared. The chapter is aiming to point out the main human-related pressures characteristic for the mountain natural landscapes, by selecting as case study "Munţii Maramureşului" Natural Park (MMNP). This protected area can be considered as a landmark in the Romanian Carpathians protected areas assessment, taking into account both its environmental stressors and its landscape qualities for acceding to UNESCO Biosphere Reserve status. Although MMNP was declared in 2004, later than other similar protected areas in Romanian Carpathians (Apuseni Natural Park and Bucegi Natural Park in 1990 etc.), its landscape and biodiversity features are no less significant and valuable. The authors are aiming to identify and assess the main present-day human impact categories encountered in MMNP: deforestation and over-grazing, mining activities, poaching, waste deposits, etc. in order to prevent their expansion and diminish their negative impact upon the environment.

Keywords Romanian Carpathians · Human pressure · Environment · "Munţii Maramureşului" Natural Park

21.1 Introduction

The Carpathian Mountains are the largest, the longest and the most twisted and fragmented chain in Europe with the greatest extent in Romania (43%). The Romanian Carpathians expands from the country's northern border (the Tisa valley) to the Danube Defile (Sviniţa) in the south-west covering 66,872 km^2 (29.3%) of its surface area (UNEP, 2007).

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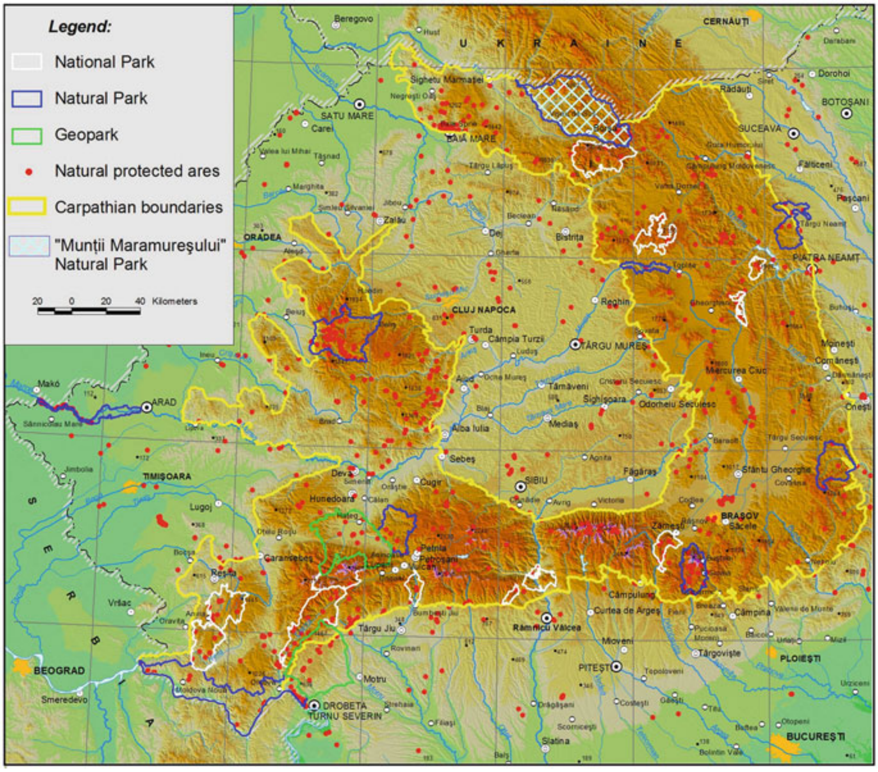

Fig. 21.1 Natural protected areas in the Romanian Carpathians

Over the last 20 years, Romania has experienced radical changes, mainly related to global environmental change and to regional and local socio-economic transformations. After the fall of the communist period, mountain areas are facing new landscape-related problems in terms of climate change, biodiversity loss, trans-boundary pollution, trade in endangered species and waste management (Bălteanu et al., 2008). In order to protect the natural environment in the Romanian Carpathians, 22 major protected areas totalising approximately 1 million hectares, among which 12 national parks, 8 natural parks and 2 geoparks, as well as some 600 reserves and natural monuments totalling 50,000 ha, were declared (Fig. 21.1) (Bălteanu et al., 2009).

Maramureş Mountains are the highest mountain massifs built up on crystalline schists and flysh folds rising up to approximate 2,000 m (Farcău Peak 1,957 m), located on the northern boarder of Romania with Ukraine (Bălteanu et al., 2006). In 2005, Maramureş Mountains were declared protected area, under the *Category V IUCN – Protected Landscape-Natural Park*. Among the main characteristics for this designation were: the original mountain landscape covered by forests alternating with alpine meadows, the presence of flora and fauna that is emblematic for the Carpathians, developed within ecosystems which are still in balance (forests, pastures, river bodies, lakes and marches, underground waters), the existence of natural habitats on large extension and the preserve of the traditional way of life. The Park also offers the possibility of visiting the area for scientific, educational, recreational and tourism purposes. The massif's total surface (including the depression areas and boarder hills) is of about 1,500 square km, covering the northern part of the Eastern Carpathians. The Park is administrated by the National Forest Administration and has 133,354 ha, representing the biggest park in the Romanian Carpathians. Moreover, 70% of the park area – except the inner-city of the localities within – has been up for Site of Community Importance, within the European Eco Network – Nature 2000. In the Park area, all the three species of big carnivores: the wolf, the bear and the lynx, listed in Directive 92/43/CEE of the European Council, Appendix II, can be identified (Romanian Forest Administration, 2007).

21.2 Human Impact in the "Munţii Maramureşului" Natural Park

Romanian Carpathian Chain has a long history of human influence upon the environment mainly as a result of its adaptation to ecological stressors and limitations. In the context of global environmental change, the integrity of mountain systems as well as their ability to provide goods and services to the human society is seriously affected. The human impact upon the mountain space has increased in intensity and concentration over the last 20 years in terms of intensive spatial development, land use/land cover changes, etc. Therefore, the environmental stressors "Munţii Maramureşului" Natural Park is dealing with are largely related to *settlements expansion, deforestation, over-grazing, mining activities and tourist activities* with high pressure upon the environment's quality.

21.2.1 Settlements Expansion

Human communities in the Park area are located in the eastern and northern part, along the national roads and along the main river streams: Vişeul de Sus, Borşa, Bistra, Leordina, Moisei, Petrova, Poienile de sub Munte, Ruscova, Repedea and Vişeul de Jos, totalling 89,294 inhabitants.

After 1989, due to an increased urban sprawl, the build-up area of the "Munţii Maramureşului" Natural Park has been expanding, in Poienile de sub Munte and especially in the Borşa Complex and Vişeul de Jos – Vişeul de Sus, where housing development conditions proved more favourable. The area prone for construction in the park is 7,000 ha and the extension of this area is brought forward by the specific social phenomenon, which consists in the work force migration and in the investment of the revenues.

The population in the area has dropped in percentage over the last years as a result of *human migration* inside the Romanian boundaries (especially towards the West of the country), on the one hand and outside the country, especially to France (34%), Italy (26%), Spain (19%), etc. (Boar, 2005), on the other hand (Fig. 21.2). Therefore,

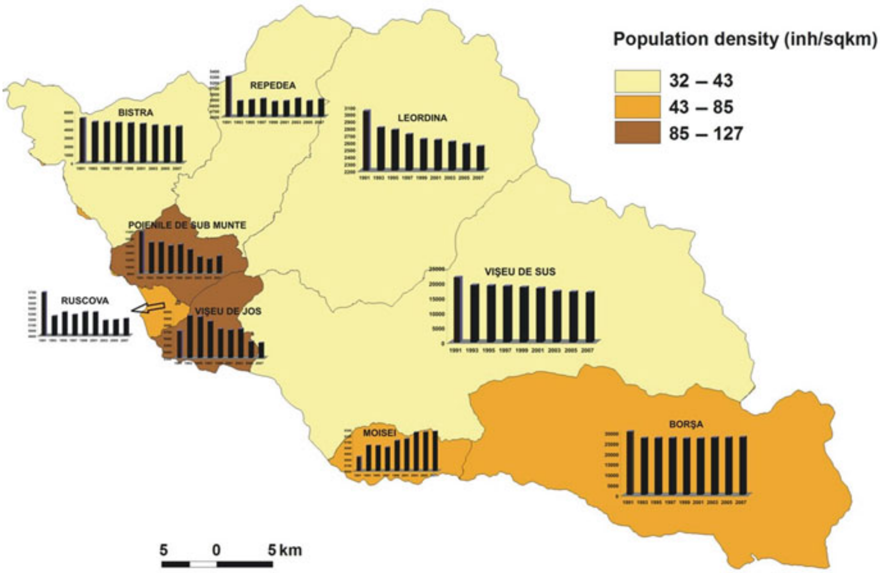

Fig. 21.2 The population dynamics in the "Munţii Maramureşului" Natural Park (1991–2007)

one of the main causes which led to a decrease in the number of inhabitants and to population ageing is the migration of 83% of people able to work, because the closure of mines made some 15,000 of their employees redundant (Romanian Forest Administration, 2009). Another consequence of the migration process is the tendency of loosing the traditional architectural style of the area. A significant proportion of the incomes in "Munţii Maramureşului" Natural Park are generated by the people working outside the country, who return to their original villages with lots of money, new ideas and new architectural approaches. While some of those ideas are welcome and can improve their welfare, others go against the tradition of the area. Thus, the constructions style and the newly introduced materials reduce the significance of the Maramureş landscape, which affects one of the major objectives the Park is meant to value, that is, to preserve the traditional lifestyle, having a negative aesthetic impact, at the same time.

Even though the number of the inhabitants in the area has dropped, within the last period, the human pressure upon the natural resources of the park is continuously growing, causing *land use/land cover changes.* The forest cover is the most affected by these changes as it is connected with settlements expansion (urban sprawl) and deforestation (Fig. 21.3).

Other consequences of human activities expansion are related to pollution due to environmental facilities insufficiently developed (water supply system, gas supply system, sewerage, waste management). Therefore, the study area is facing serious problems connected with the absence of water purification plants, waste deposits and moreover with saw dust being spread chaotically, thereby sometimes reaching riverbeds and having a major negative impact upon the environment.

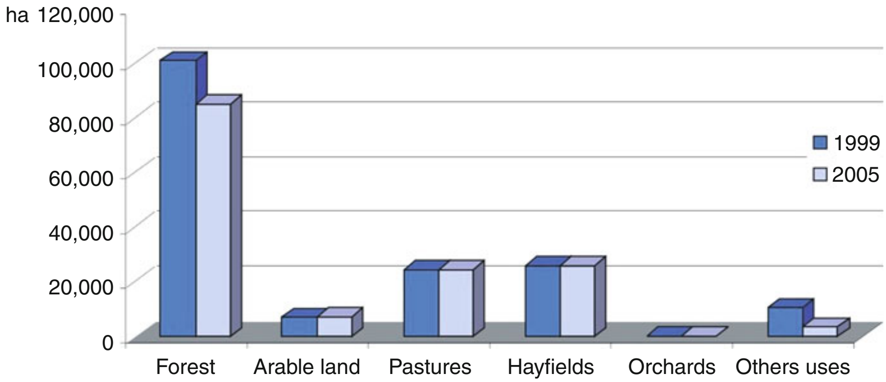

Fig. 21.3 Land use/land cover dynamics 1999–2005

21.2.2 Over-Grazing

The “Munţii Maramureşului” Natural Park has always been an agricultural area especially in terms of cattle breeding on the rich sub-Alpine pastures and meadows extending in the vicinity of settlements. Thus, over the last 100 years, livestock (especially sheep) tripled (34,342 heads in 2003), putting great pressure on the mountain pastures. In the past few years the number of sheep has severely diminished, so that the local population chose to undertake other activities (Fig. 21.4).

Intensive grazing or over-grazing has caused the degradation and, implicitly, the reduction of biological diversity and pastures’ productivity in some areas like Pop Ivan, Şerban, Poloninca, Paltin, Pietrosu Bardăului, Pecealu, Bucovinca, against the dwarf mountain pine (*Pinus mugo*) thus *affecting the upper forest limit*. By

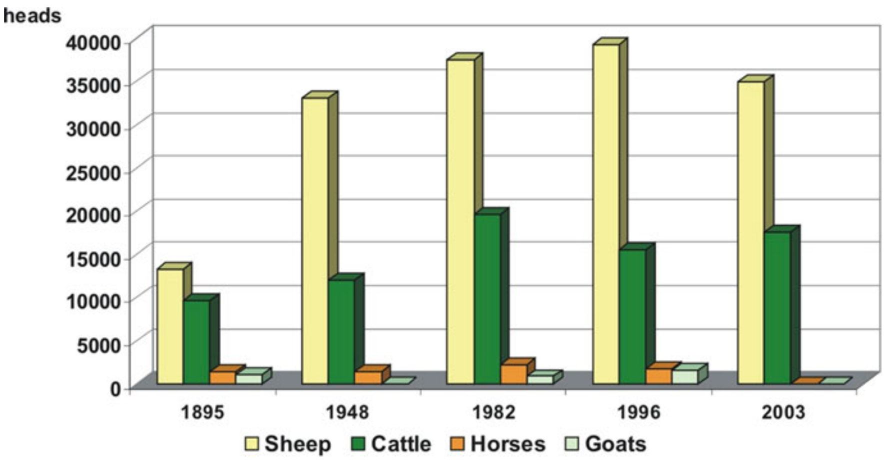

Fig. 21.4 Livestock dynamics in “Munţii Maramureşului” Natural Park

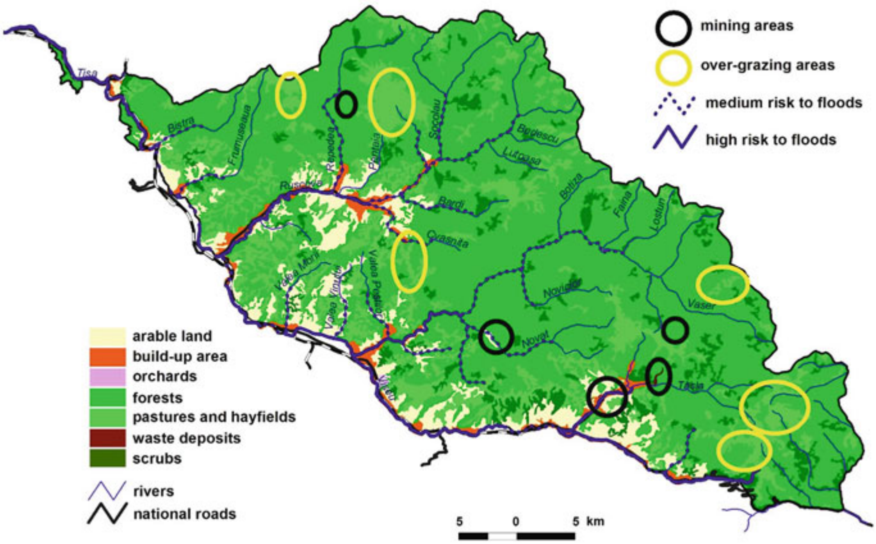

Fig. 21.5 Areas affected by mining activities, over-grazing and floods in the "Munţii Maramureşului" Natural Park

understanding the dwarf mountain pine's protection role and by declaring it nature monument, in 1994, the local authorities have forbidden its cut. Presently, the dwarf juniper (*Juniperus nana*) can be found only on very small areas: Pop Ivan, Şerban, Pecealu, Pietrosul Bradaului, Farcău (Moisei, 2000; Sparchez et al., 1977).

As a result of over-grazing (Fig. 21.5), other effects are to be identified, such as *habitats fragmentation* by reducing the areas covered by native species such as *Juniperus nana, Pinus mugo* or *Rhododendron myrtifolium*; *biodiversity reduction*, for instance, Tisa (*Taxus baccata*), which used to cover large surfaces in the study area, today only has 2–3 species left because shepherds believed that its leaves (needles) were toxic for the animals (Resmeriţa, 1966) and *land degradation*, the main processes affecting the area under discussion are gully erosion (Fig. 21.6), sheet erosion (mainly solifluctions) and shallow landslides.

Although the law forbids the grazing within the forest area, the *margin forests* are always affected by the intensive grazing and by the expansion of the Alpine pastures towards the forest, as a result of the same process. Another significant consequence of the over-grazing is related to the *increasing of the occurrence of flash floods* (1998, 2000, and 2008) in the basins with high torrential risk, such as Valea Repedea (Vinderel) and Valea Socolău.

21.2.3 Deforestation

The Park's main natural resource, the forest, is both an environmental regulator and a wood and non-wood goods supplier. Forest management tends to achieve

Fig. 21.6 Gully erosion in Vinderel Area (photo: Gheorghe Kucsicsa)

the conservation and development of the state-owned forests, the preservation of the forest's production capacity, protection and/or production functions, the rational use of forest resources, conservation and, at the same time, monitoring forest health.

The area has a tradition in timber harvesting. Due to the fact that the industry is poorly developed, forest economy attracts a major part of the available work force.

Besides the industrial processing capacities, there are other traditional activities carried out by small manufacturers (sculpture, building of wooden houses and churches etc.). Most individuals depend on the existence of wood to heat the houses and as building material. The local population also uses other non-wood resources for their own needs (forest fruits, mushrooms, medicinal plants).

The end of 1989 marks the beginning of transition from a centralised economic system to the market economy. Thus, under the application of the laws and administrative measures to restructure and privatise agriculture and land found, the transition from state and collective property to private ownership exposed the mountain environment to a fundamental change of property determining fragmentation of forest property and ultimately deforestation. Under the current socio-economic conditions, a potential threat to the forest would be the excessive interest for the economic gains it offers to the detriment of the protection actions. There might appear some contradictions between the conservation objectives of some biodiversity elements or landscape and the forest management plans, particularly in the case of forests returned to their former owners and to the local administration after 1990 (under the land retrocession law). Since these owners lack financial means, they start exploiting their forest plots, irrespective of protection status, because they receive no compensations to make them preserve biodiversity (Table 21.1).

As a result of the increased human pressure in terms of timber harvesting and grazing, the study area experienced a fragmentation of the terrestrial ecosystems which generated a mosaic of habitats that communicate among them through natural corridors, since there are no important barriers to stop the population exchanges.

The human activity in the "Munţii Maramureşului" Natural Park always had a high pressure on forests, especially on those of beech and mixed ones. The noticeable human intervention on this area has begun with the first permanent settlements near the park and in the depression area, as well as in Ruscova Valley, giving birth

Table 21.1 Property structure in the "Munţii Maramureşului" Natural Park

Owner	Manager	Land use category	% of the MMNP surface
State property	National Forest Administration	Forest Found	41.60
State property	Local Public Administrations	Agricultural land use, Forest Found	12.88
Legal persons (Church, Education units)	National Forest Administration, Others	Forest Found Pastures, Hayfields	0.43
Forest associations	Private forest district, National Forest Administration	Forest Found	8.88
Private individuals	Others	Households, Hayfields, Forest Found	36.21

Source: Romanian Forest Administration (2009) to the activity of timber harvesting. The most significant forest cuts were recorded through feudalism period (Idu, 1999).

During 1990–2000 a surface of 36 km^2 forest (2.35%) was cut in Maramureş Mountains and only 17 km^2 (1.11%) were naturally regenerated (Mureşan Al, 2008). Another phenomenon related to forest cut is the uncontrolled wood exploitation (Fig. 21.7) and inappropriate storage of leftovers (over 90 small mills produce

Fig. 21.7 Uncontrolled wood exploitation in the Munţii Maramureşului Natural Park (photo: Mihaela Felciuc)

over 43,000 m^3 of sawdust along rivers and streams). The situations of clear cutting with no subsequent afforestation are rather frequent and they endanger forest plant and animal species.

Another important aspect to discuss as referred to deforestation is the removal of dead wood out of the forest, without taking under consideration the fact that it represents the only habitat for fungi and *Xylophilus* insect, moss and lichens, as well as an excellent shelter for chiropters and micro-mammals.

According to the researches conducted by the "Munţii Maramureşului" Natural Park Administration, among the species threatened by forest cutting in the park area, we mention the chamoix (*Ciconia nigra*), the capercaillie (*Tetrao urogallus*), the black grouse (*Tetrao tetrix*), the black woodpecker (*Dryocopus martius*), the grey woodpecker, etc.

In 2007, the "Munţii Maramureşului" Natural Park Administration requested a study on the quantification of goods and services provided by the ecosystems of the area. The study conducted by Gund Institute for Ecological Economics, University of Vermont, USA and Earth Economics, was aimed at assisting decision makers in evaluating environmental costs versus forest goods and services. The findings of that study have revealed that water flow regulation and carbon sequestration have the highest environmental costs (Table 21.2).

Annual value for carbon sequestration in forest was based on primary data of standing timber volume and assuming an annual volumetric increment of 6 m^3 per hectare (corresponding to an annual increment in biomass of 342,765.18 tons). The combined value of carbon sequestration from forests, hayfields and Alpine pastures resulted substantially different depending on whether pricing was based on an exchange rate of 31.6 RON per ton or a social cost of 205 RON (Romanian Forest Administration, 2009).

21.2.4 Mining Activities

Another economic branch that affects the environment in the Maramureş Mountains is mining, mostly close to the Toroiaga volcanic massif. Historically known for its

Table 21.2 Environmental costs evaluation in relation to forest services

Services	Value per ha/yr (mil. RON)
Carbon sequestration	26.4
Water flow regulation	43.2
Soil erosion control	3.1
Wilde life habitats	0.8
Fishing	0.7
Recreation	4.8
Cultural heritage	0.7
Traditional landscapes	0.6
Total	80.6

Source: Romanian Forest Administration (2009) mining activities of both base (Cu, Pb, Zn) and precious metals (Ag, Au), this activity begun Before Christ and continued with the first important mine works related to complex raw metal exploitation in the 17th and 18th centuries, while in 1855, three major mines in the perimeter of Toroiaga Mountain were opened: Gura Băii, Burloaia and Toroiaga (Fig. 21.8). After a throw-back of mining during 1990–2005, in 2006 the activity in the region was shut down and the area was declared disadvantaged.

Fig. 21.8 Abandoned mining exploitation in the Gura Băii open-pit (photo: Mihaela Felciuc)

The "finger-prints" of this activity shall exist for a long time though. Besides the social impact related to unemployment, other consequences are related to water pollution by the mine waters, the aesthetic visual impact of the wastes, the accumulation of heavy metals on the banks of âsla and Vişeu rivers, mine roads, tumbling buildings, biodiversity loss – especially aquatic species (amphibians, *Hucho hucho*), habitat's fragmentation, etc.

Another element of impact is represented by the presence of Colbu I, II and Novăţ tailing ponds, which repeatedly polluted the area with heavy metals. Between 1994 and 2003 waste from mining activity at Baia Borşa was stored in the Novaţ-Roşu tailings pond in the upper Vişeu catchment. However, in March 2000, the tailings dam failed releasing approximately 100,000 m^3 of contaminated water and 20,000 ton of mineral-rich solid waste, which was routed downstream through the Rivers Novaţ, Vaser and Vişeu into the River Tisa (Bird et al., 2008).

Moreover, the unprotected tailing ponds from Vinderel area are a source of pollution for Repedea, Ruscova, Vişeu Rivers.

21.2.5 Tourist Activities

The Park is extremely attractive to the public due to its local attractions: the narrow gauge train line ("Mocăniţa") which runs along the Vaser Valley; the wooden churches; the Maramures gates; local tradition; the history and culture of its surroundings and the local landscape.

The area of "Munţii Maramureşului" Natural Park is visited for its cultural, historical and traditional objects, such as the wooden churches (Ieud, Rozavlea, Bogdan Vodă, etc.), the monasteries (Moisei, Bârsana, Izvorul Tămăduirii) and the traditional festivities during the year, such as Daisies Fest from Repedea, the Hora in Prislop, Christmas, etc. However, the main tourist attraction of the park remains Vaser Valley, due to the steam locomotive and the narrow gauge train, which brings thousands of tourists every year.

The evaluation that the park administration team has carried out on the tourists visiting Vaser Valley shows that only a small share of them is interested in natural values – approximately 25%. The reason for that is mainly related to the lack of necessary tourism infrastructure on most of the park area, as well as the lack of promotion for the associated objects, mostly inexistent in the western part – Borşa, and Borşa Complex areas. Tourists could bring serious benefits to this area in terms of park infrastructure development by paying visit taxes in Vaser Valley; chalets, hotels and guest-houses in the park area; for the local communities in the park area, by developing rural tourism and promoting the handcrafted products.

In the "Munţii Maramureşului" Natural Park disagreements have in time cropped up in matters of environmental protection between some managers and visitors, especially whenever tourists, willing to visit the Vaser Valley, outnumbered the area's bearing capacity, or when biodiversity conservation activities are at stake. The main causes and effects of this kind of conflicts are connected to water and environment pollution, waste deposits, hearths, car washing, all of these having a negative impact upon the environment, affecting at the same time the main tourist attractions. Another attraction of the Park is related to the hunting found in terms of chasing campaigns and even poaching, which reduces the game populations and has an impact on habitat fragmentation.

"Munţii Maramureşului" Natural Park offers special opportunities for tourists to get in touch with the biodiversity, in general, and with specific elements of fauna and flora, in particular, and respectively with other types of assets, such as the Narrow Gauge Railway, etc., thereby promoting environmental protection and tourist education. In this sense, we have to use the existing opportunities, to observe the tourism strategy and to develop the adequate infrastructure, by involving the interested stakeholders.

Recreation and tourism values were assessed in the Vaser Valley through a survey aiming to assess the contribution of 10,000 visitors who came to this area, estimated to around 4,835,000.00 RON. At the same time, willingness to pay for the different guided tours and conservation programmes was used to estimate non-use values of wildlife, cultural heritage and hayfields (Fig. 21.9) (Romanian Forest Administration, 2009).

Another threat to the tourist potential of the subject area is represented by the loss of connection with the "wood civilization". The new constructions have modern and futuristic influences from the Western Europe, which generates a coloured and mixed landscape, characterised by contrasts, totally unattractive to tourists. Therefore, tourist agencies are not interested in promoting Romanian tourism outside the country, their major interest being the promotion of international travel destinations. Unfortunately, this is a fact and the proof consists in the overall tendency of the Romanians to spend their holidays abroad, rather than visiting "traditional" Romanian destinations. However, since the establishment of "Munţii Maramureşului" Natural Park, the number of tourists in Vaser Valley (the most important tourist attraction in the area) has been continuously growing, from

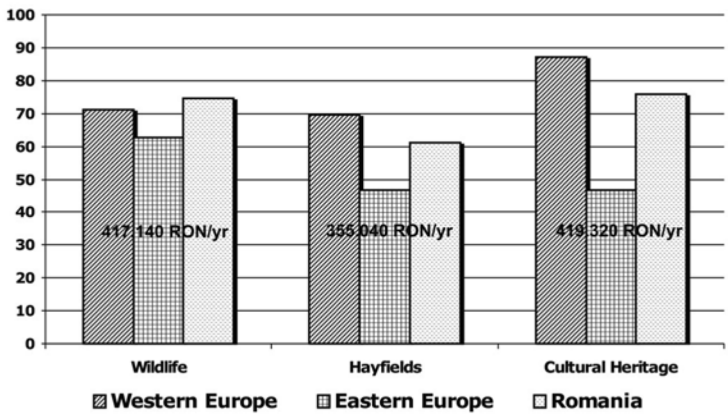

Fig. 21.9 Willingness to pay for conservation (Romanian Forest Administration, 2009)

approximately 6,000 tourists in 2005, to 10,000 in 2007 and 20,000 in 2009 out of which about 18,500 tourists were registered only in Vaser Valley. Thus, besides the loss of traditional and aesthetic values, the impact of tourist activities on the environment also determines *biodiversity loss, uncontrolled waste deposits, pollution*, etc. As compared to the other types of impact, tourism is not as yet a high-pressure element for "Munţii Maramureşului" Natural Park, but rather a potential threat.

21.3 Conclusion

Environmental stressing factors in the "Munţii Maramureşului" Natural Park are the result of historical and economic developments, producing land use/land cover changes, land degradation, fragmentation of natural habitats, etc. in the study area. The loss of traditional architectural style in the study area, which is an element extremely difficult to preserve from the Park's Administration perspective, also represents a consequence of human impact. Therefore, all analysed impact categories are critical for local livelihoods leading to negative environmental consequences.

In order to minimise human pressure upon the environment, the management plan of "Munţii Maramureşului" Natural Park has established the internal zoning, which takes into account both the biodiversity and landscape conservation and the economic development of the area, through activities that hardly affect the environment. Thus, the park has been divided in three main areas:

1. *A fully protected area* in which all human activities are forbidden, except for the research, education and eco-tourism. Inside this protected area, natural phenomena and processes shall be left to unfold without man's intervention;
2. *Sustainable management area* (79,585 ha), which links the fully protected area with the areas of sustainable development human activities;
3. *Sustainable development area of human activities* (35,000 ha), where human activity is permitted. It includes the build-up area of the Park as well as the surfaces covered by transport infrastructure, mountain pastures situated outside the fully protected area and the surfaces from the outer part of the localities suffering man-made changes.

The *sustainable management area* and the *sustainable development area of human activities* are mainly responsible for maintaining and encouraging traditional activities in terms of species, habitats, ecosystems and landscape preservation and limiting the human activities triggering negative environmental impacts.

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Part V
Networks and Strategies for Mountain Regions

Chapter 22
Models and Strategies for Sustainable Management of Mountain Territories in Central and Southeastern Europe

Georgi Zhelezov

Abstract The chapter shows strategies for sustainable management, development and use of the potential of mountainous areas in Central and Southeastern Europe. The research concentrates the experience of single countries or groups of countries connected with organization and optimization of human activities in various economic areas. Interaction between different programmes or initiatives is a key moment for Balkan countries in the way for determination and foundation of Balkan convention for sustainable development of mountain regions. We have a good practice of Alpine Convention and relevant experience of Carpathian Convention as an example.

Keywords Mountains · Convention · Strategy · Transborder cooperation

22.1 Introduction

The development of new strategies for sustainable management and use of the potential in mountainous areas of Central and Southeastern Europe is key element in the conceptions of the different international and regional programmes. The investigation observes the experience of single countries or groups of countries connected with organization and optimization of human activities in various economic areas. The experience from a good practice of Alpine Convention and Carpathian Convention can use in future initiatives. The process of interaction between different programmes or initiatives is an important moment for Balkan countries in the way for determination and foundation of Balkan convention for sustainable development

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of mountain regions. The problems detected in the present models for regulation of the activities are important for future development of the mountainous regions.

22.2 Specific Mountain Legislation

Specific legislation concerning mountains exists only in countries with well-developed state policy for mountain regions such as Italy, France and Switzerland. At first it was the Swiss law on investments in mountain regions (LIM) adopted in 1974 and amended in 1997. The Italian Constitution from 1948 defined mountains as areas with specific needs. Mountainous municipalities in Italy were defined in 1971 and in 1994 the Law on Mountains was adopted. The first determination of mountains in France was in 1961. France have developed conception for mountain massives on political and operation level with goal for preposition, discussion and application of the basic directions on the transregional level coordinated with mountainous perimeter. The massives have realized as a conception since 1973, but they are determined in "Mountainous Law" as a development of mountain zones with neighboring regions connected with then in 1995.

In Spain definition of mountain regions was prepared in 2002 during the International Year of mountains. Regarding candidate countries and new Member States of the EU, Mountain Laws are at various stages of preparation and adoption. In Poland the Mountain Act from 1986 was repealed in 1989. Various acts had been prepared since then but none was adopted. Mountain legislation can be at subnational level such as Law on High Mountains in Catalonia (Spain) adopted in 1983 and Law on Aposeni Mountains (Romania) dated from 2000.

Federal Chancellors of Austria presented "Special Initiative for Mountain region" in 1979, but after that it was enlarged by including other regions in the country in 1985 and renamed "Initiative for authentic regional development". In certain countries legislation covers agriculture in mountain areas as in Austria where since 1972 there has been a special programme for farmers in mountain areas which later included also other parts of the country and in Spain where the Law on agriculture in mountain areas was adopted in 1982. In other countries legislation may cover specific agricultural activities, such as milk production.

The third European conference for the mountain regions (1994) adopted European Charter for Mountain Regions. The text was approved by the European Commission, Congress of Local and Regional Authorities of Europe (CLRAE) and Committee of the Regions in the European Union. According to a decision of the Council of the European Union this document was transformed in a project for convention and its parts were combined in order to create a frame convention, which was supported by CLRAE during the session in May 2000.

22.2.1 Mountain Law in Southeast European Countries

In 2007, the Government of Romania adopted a law to establish the Romanian National Agency for Mountain Areas. Special offices devoted to mountain issues will be set up in the local departments of agriculture and rural development in the 28 counties with mountain areas. In this new structure, professional training centres will support the establishment of professional mountain farmers' organizations. The creation of this national body for mountains followed an intensive lobbying process by parliamentarians and civil society.

In Turkey, the Government is working with partners such as the International Fund for Agricultural Development to boost employment and foster new businesses in the remote mountainous regions of Diyarbakir, Batman and Siirt provinces. The project supports new non-farming opportunities and expands existing profitable businesses by improving access to markets.

22.3 Regional Conventions

22.3.1 Alps Convention

The Alps are considered as a region of extreme importance belonging to all Europeans. For that reason these mountains must be protected and their condition should be improved. Their natural recourses, biodiversity and landscapes must be managed and protected and the environment must be preserved. However, it should be guaranteed that human societies of the Alps may continue to live and work in these territories. The most important element of whole system is sustainable economical and social development of people in Alpine region. It is important that local and regional authorities participate directly in implementation of the Alpine policy taking into consideration the principle of subsidiarity in the frame of a genuine politics of transnational and interregional cooperation.

Practical implementation of the Convention and its parameters requires determination of several specific priorities instead of preparation of new measures as the only way of true cooperation beyond the borders of the single countries. The efforts should be united and the funds should not be spent only economically. Establishment of permanent secretariat should assist the beginning of the Convention until the strengthening of the system for observation and information for Alps and Alpine net of protected areas.

Alpine Convention intends to maintain the interest towards these regions and the hopes of the people living in the Alpine region. In Europe and in the world the value of these regions increases because they are source of water with primary importance for the world.

22.3.2 Initiative Carpathian Ecoregion (Carpathian Convention)

This initiative is coalition of NGO and research institutes which have worked for environment protection and sustainable development of Carpathians mountain region. They use characteristics of biodiversity and opportunities for integration with social and culture factors. The region includes seven Carpathian countries. The activities were carried out in working groups for biodiversity, tourism, communications, ecological education, development of rural regions etc.

22.4 Transborder Initiatives between Bulgaria and Neighbour Countries

22.4.1 Transborder Ecological Network between Bulgaria and Greece

First transborder ecological network has been established between Bulgaria and Greece in 2007. They used the conception of Pan-European ecological network, which is a part of Pan-European strategy for biological and landscape diversity.

22.4.2 Euroregion in Western Balkan Mountain between Bulgaria and Serbia

The region geographically is described as Western Balkan. It includes seven municipalities in Bulgaria and four in Serbia. The basic natural component of the region is biodiversity. The central point of interest is natural territory and its management. The form of institualization is Transborder Forum as independent platform for dialogue. There is signed letter of the majors of participating municipalities. The letter is supported by Ministries of Foreign Affairs in the two countries and brought for ratification in the Governments.

22.4.3 Green Network Strandzha/Yildiz between Bulgaria and Turkey

The network will develop as mechanism for transborder integrated management of the whole ecosystem (transborder region). The basic aims are:

- Improvement of the competitive power of the region.
- Development of potential, important for the network regions using the opportunities for application for concrete projects.
- Improvement of information base for the local people who are connected with the problems of sustainable economical development.
- Establishment of the structure for coordination and interaction between transborder partners.
- Future development of this partnership.

Structure of green network Strandzha/Yildiz

- Central coordination group.
- Basic “knots” or participants in their Public council.

- Connection between participants and mechanism of interaction.
- Territory covered by the network.

22.4.4 International Cooperation of Bulgarian Mountain Regions

National Park “Central Balkan”, Nature Park “Vitosha”, Biosphere Reserve “Sreburna”, protected area “Kalimok-Brushlen”, etc. are partners and participate in transnational programme for cooperation in Southeastern Europe (SouthEast Europe Transnational Cooperation Programme). The activities are connected with monitoring, management of protected areas, development of ecotourism, education courses, which are priority for the Institutions.

Bulgarian–Swiss program for protection of biodiversity and GEF project support the elaboration of management plans for protected areas such as the three national parks – “Rila”, “Pirin” and “Central Balkan” and the Black sea wetlands as a part of international projects. The subject of these projects is renovation of important nature habitats. Ministry of environment and water has helped in activities connected with announcement of new protected areas.

There were a number of education activities and programmes connected with change of human consciousness about the importance of nature protection activities. Centres for nature protection have been established and equipped. There were activities for development of administrative capacity in regional structures of Ministry of environment which is responsible for protection of biological diversity, management and control of protected areas as a part of the projects.

Bulgaria is the first country with two national parks in the network PAN Parks – National park “Central Blakan” and National park “Rila”. This is a great success for the country and proof for unique Bulgarian nature, economical development connected with high quality of tourist services in accordance with sustainable development.

Ministry of environment and water supports initiative “green belt” of one of greatest nature protection organization in the world – International union for protection of nature (IUCN). The initiative is orientated towards protection of important nature habitats at country borders between East and West Europe and integration of these places in ecological network.

Bulgaria together with other Balkan countries participated in development of the idea for Balkan Green Belt. Protection and sustainable development of the mountain regions at Bulgarian border (West Balkan, Kraiste, Osogovo, Vlahina, Maleshevska, Ograzhden, Belasista, Slavianka, Rodopi and Strandzha) are key elements in the conception and will be very important for realization of the biggest nature protection initiative in United Europe. The basic points of the project “Green Belt” are:

- Popularization of the territories of Green Belt and wide help for social support in the process of protection
- Collection of basic information for biological diversity in the regions of Green Belt;

- Creation and coordination of national working groups for Green Belt;
- Preparation of the projects for sustainable development of the regions in Green Belt.

Realization of the initiative for mountainous regions is connected with development of two general structures – Centres and programmes and Source of financing.

22.4.4.1 Centres and Programmes for Education

There are centres for investigation and education connected with inventory, analysis of mountain tendencies and directions, new ideas for development, education in research and recourse management in countries with wide mountain regions. These centres are very important for development and realization of the politic on mountain regions. Using the important information they encourage the innovations and conditions of the management of mountain resources. Investigation centres are solid in Austria, France, Italy, Norway and Switzerland and also in some new member countries as Romania and Slovakia. There are similar instruments in more of Alpine countries. Education centres are oriented towards agriculture, mountain guiding and skiing. Strong politic connected with mountain regions is a part of investigation centres. We need effective regional or national institutions and centres for education, investigations and training for development of the understanding of questions connected with mountain regions in different countries – members or nonmember of European Community.

22.4.4.2 Funding

Mountain development funding is still inadequate. This is despite the increasing awareness of the importance of mountains and the persistently high incidence of poverty, food insecurity and vulnerability of mountain populations, particularly in the developing world. Traditional funding sources and approaches are important, but these can fail to recognize and address the specificities of mountains and mountain people. There is also undoubted potential to tap newer, more innovative financial mechanisms for mountain development, such as debt-for-nature swaps, payment for environmental services and microfinance opportunities. Payment for environmental services, which compensates local land-users for environmental services, has increasingly been used to manage biodiversity in mountains in recent years. For example, the Regional Integrated Silvopastoral Approaches to Ecosystem Management Project, initiated by local NGOs and financed by GEF, uses payment for environmental services to encourage Silvopastoral practices in degraded pastureland in the mountains of Colombia, Costa Rica and Nicaragua. Participating land-users receive direct annual payments for the environmental services they generate. Initial results show that payment for environmental services has induced positive land use changes such as improved water quality and increased bird and ant species diversity.

The Mountain Partnership is providing information about the availability of funds for mountain activities from all possible sources on an ongoing basis. Its searchable funding database on the Mountain Partnership website contains details on the various thematic and regional areas of mountain development supported by financial institutions, foundations, multilateral development banks and donor agencies around the world. The database is complemented by online resources and tools that offer tips, practical suggestions and guidelines for funding and proposal writing.

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Chapter 23
Science Networks for Global Change in Mountain Regions: The Mountain Research Initiative

Astrid Björnsen Gurung

Abstract The Mountain Research Initiative (MRI) promotes and coordinates research on global change in mountain regions around the world. In its 8 years of existence it has actively participated in the design of the international research agenda. The Global Change and Mountain Regions (GLOCHAMORE) Research Strategy, a product stemming from an FP6 Support Action, is at the core of the MRI. It identifies gaps and formulates priorities for future activities in mountain research. Through its regional networks MRI catalyzes the interdisciplinary research described in the GLOCHAMORE Strategy. Within the European network, the recent establishment of the Science for the Carpathians (S4C) initiative is an encouraging signal for the strong will and interest of research communities to steer mountain research towards international and interdisciplinary collaboration. Mountain scientists working in the Balkan Region could take the Carpathian initiative as an example to build up a science network in and for Southeastern Europe.

Keywords Global change · Mountains · Science networks · Europe · Research coordination

23.1 Origin of the Mountain Research Initiative

The International Geosphere-Biosphere Programme (IGBP) workshop on mountains held in Kathmandu, Nepal, in 1996, set the first milestone in the history of the Mountain Research Initiative (MRI). The workshop report highlighted that mountain systems are at risk and need special attention, in particular with respect to the possible impacts of global change. It pointed out the need of intensified, collaborative and coordinated research to be fostered through an international research programme (Becker and Bugmann, 1997).

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IGBP joined forces with the International Human Dimensions Programme (IHDP) on Global Environmental Change and the Global Terrestrial Observing System (GTOS) during the following years to collaboratively define the objectives, approach and activities of this new research programme – the Mountain Research Initiative. The final product of this joint effort outlines the four dimensions of research activities, which were determinant for the formal establishment of the MRI (Becker and Bugmann, 2001):

1. Long-term monitoring of environmental change in mountain regions (e.g. meteorological and cryospheric indicators, plant communities, soils and freshwater ecosystems);
2. Integrated model-based studies of environmental change in different mountain regions;
3. Process studies along altitudinal gradients;
4. Advice to sustainable land use and natural resource management.

In brief, the MRI strives for a better understanding of the mountain system's processes and functions under Global Change, which is then translated into specific recommendations for furthering sustainable development in mountain regions around the globe. The notion was never that MRI as institution would direct such a programme but rather that MRI – both as institution and as a community of researchers – would facilitate the emergence of such research through the promotion and coordination of research funded and conducted by myriad agencies and individuals around the world.

23.1.1 Actions at Global Level: Design of an International Research Agenda

Only in 2001, an MRI Coordination Office was established in Berne, Switzerland, at the Swiss Academy of Sciences using funding from several Swiss agencies and the ETH. The first Executive Director, Dr. Mel Reasoner, set off to foster and coordinate research of the four types listed above. He set the scene by producing the first comprehensive compendium of past and current research on "Global Change in Mountain Regions" (Huber et al., 2005). This 700-page book provides an overview of what is known and what directions research should take in the future.

A further milestone in the MRI history was the successful launch of the Global Change in Mountain Regions (GLOCHAMORE) project. This FP6 Specific Support Action (2003–2005) translated the global goals of IGBP Report 49 into much more specific disciplinary objectives coupled to a recommendation for inter- and transdisciplinary research approaches. Targeting at UNESCO Mountain Biosphere Reserves around the world, the project included more than 250 scientists and managers of Biosphere Reserves and was coordinated by MRI and by the University of Vienna. The GLOCHAMORE Research Strategy (Björnsen, 2005), the project's final product, is an integrated and implementable research strategy to better understand the causes and consequences of global change in mountain regions around the world. The strategy is a consensus document developed through consultation with the international community of scientists and Biosphere Reserve managers.

23.1.2 Implementing the GLOCHAMORE Research Strategy

In 2006, after the completion of the GLOCHAMORE project, the MRI moved from strategy development to implementation through the initiation and support of regional networks of global change researchers. As MRI is a promotion and coordination effort, it cannot simply "do" the research necessary in a region, but must induce research groups and individual scientists to fill the scientific gaps defined by the GLOCHAMORE strategy. Thus, four programme activities are at MRI's core:

1. MRI strives to enlist key scientists promoting inter- and transdisciplinary research through their national or multinational research funding agencies. By engaging these champions, MRI can vastly improve its effectiveness.
2. MRI supports the formation of new research partnerships and catalyzes groups and individuals to develop project proposals to funding agencies. This is a direct and efficient way to create the kind of research defined in the GLOCHAMORE Strategy.
3. MRI facilitates the development of peer-reviewed papers on specific key scientific issues. These contributions to the literature focus the community's attention on some of the most important issues in mountain regions.
4. MRI distributes relevant information to researchers on global change in mountains. By increasing the flow of information to these researchers, MRI seeks to create additional interaction and a stronger sense of community.

23.2 MRI Europe: A Regional Network for Global Change Research in Mountains

A large part of MRI's activities occurs through the three regional networks: MRI Africa, MRI American Cordillera and MRI Europe. Within these regional networks MRI attempts to catalyze global change research in the thematic fields defined in 2001 and specified in the GLOCHAMORE Research Strategy. It does so principally through the development of new funding proposals, but also through the engagement of regional leaders and the development of regional-specific communication products. The functioning of MRI's regional networks and their scientific output can be illustrated with the example of the European network (http://mri.scnatweb.ch/networks/mri-europe/).

In 2006, the MRI undertook a first attempt to initiate the "Global Change Research Network in European Mountains". At the outset, MRI attempted to use place rather than discipline as an organizing paradigm. Shortly after the publication of the GLOCHAMORE strategy, the MRI invited scientists and managers associated with the European Mountain Biosphere Reserves that had participated in the GLOCHAMORE project to attend a meeting in Zurich (May 3–4, 2006) to translate the GLOCHAMORE strategy into a programme appropriate for Europe. The assumption underlying this approach was that the global change related issues were more completely owned by those managers than by disciplinary scientists. These managers would therefore have an interest in promoting an inter- and trans-disciplinary research programme in their Biosphere Reserves and in linking those programmes together into a network. For manifold reasons, the hoped-for launch of a global change research network in European mountains did not, however, ensue from this meeting. The assumption that Biosphere Reserve managers were central to the implementation may have been simply wrong. Some Biosphere Reserves had long, rich histories of research, and it is plausible that those managers saw no particular benefit to them or their constituencies in "standardizing" research at their sites to some international standard. In other sites, research was but one of many management concerns, usually of lower priority. In yet others, the site was essentially managed by researchers and therefore had no administrative apparatus through which stakeholders could make their concerns manifest. Thus, while Mountain Biosphere Reserves remained quite logical sites for Global Change research, their management did not prove to be a useful starting point.

Thereafter, MRI took quite a different approach, one focused on scientists, regardless of their affiliation with place, and on funding. MRI announced another meeting for February 1–2, 2007, on global change in European mountains, but this time with a sub-title emphasizing funding through the European Commission's 7th Framework Programme for Research and Development (FP7). Furthermore, it made no assumptions regarding an optimal structure for implementation, but rather asked researchers how they wished to proceed. This meeting drew ten times as many participants as the earlier meeting. At the occasion of this February meeting, the MRI Europe science network was officially launched (Fig. 23.1).

As defined by its network members, it aims to connect and support global change researchers working in different mountain regions in Europe. Networking meetings convened by MRI and its regional partners allow participants to exchange ideas and

Fig. 23.1 The regional science network MRI-Europe was launched in 2007 to address global change issues in European mountains. (Logo by Claudia Drexler, MRI)

to locate opportunities for collaboration. By fall 2008 MRI Europe has grown to almost a thousand active scientists.

23.2.1 Science for the Carpathians: Working towards a Research Agenda for the Carpathians

The Science for the Carpathians (S4C) initiative developed within the European network at an unprecedented speed. In spring 2008 a group of researchers with a mandate from the Interim Secretariat for the Carpathian Convention (UNEP-Vienna) requested the MRI's assistance in organizing science in the Carpathian region. The MRI worked with the Jagiellonian University, the European Academy Bolzano, Joanneum Research, the University of Applied Sciences Eberswalde and the Humboldt University zu Berlin to organize the first S4C meeting in May 2008 in Kraków, Poland. The goal was to set the stage for a new science network for global change research in the Carpathian mountains (Fig. 23.2). The workshop aimed at defining the current status of global change research in the Carpathians, at drafting a research agenda for topics relevant to the region, and at establishing an active science network.

In the wake of the S4C launching workshop, the initiative became visible through various means and occasions. The S4C electronic Newsflash informing more than 300 network members about current and future activities in the field of Carpathian research is complemented by an S4C website (http://mri.scnatweb.ch/networks/mri-carpathians/) documenting its progress. Part of the progress is the growth of the "S4C List", a simple spreadsheet with names and expertise of the numerous network members that actually embody the initiative. As a product from the Kraków workshop, a synthesis paper on "Global Change Research in the Carpathian Mountain Region" with 15 co-authors has been published (Björnsen et al., 2009). The paper reviews the current status, identifies knowledge gaps and suggests avenues for future research. As such, it is the first step towards a Carpathian Research Strategy. From the same occasion, a workshop report was compiled by the Institute of Geography

Fig. 23.2 The Science for the Carpathians (S4C) initiative was launched in 2008 in response to need to develop a pan-Carpathian research strategy

and Spatial Management, Jagiellonian University, and published by the MRI Berne Office (Ostapowicz and Sitko, 2009). These products testify the interest, willingness, and active support of the S4C community to give the Carpathian mountain research a new impetus and profile.

To sustain the S4C network on a long-term basis, the initiative needs to be formally established in the region. For that purpose, shortly after its launch in May 2008, the S4C initiative received the support of the Conference of Parties of the Carpathian Convention at their meeting in Bucharest in June 2008. To sustain the science initiative on a long term, a 2nd S4C Meeting has been scheduled for June 9–10, 2009, at the Slovak Academy of Sciences in Bratislava targeting at (1) the formation of an S4C Steering Committee, (2) the preparation of the first Forum Carpathicum scheduled for September 15–17, 2010, in Kraków, Poland, and (3) the discussion between representatives of National Science Academies and Carpathian scientists on the long-term establishment of S4C.

23.2.2 South Eastern European Mountain Research Network

The evolution of the Carpathian science network is an encouraging example for other regions that have undergone strong political, historical and environmental changes during the last decades. Although the mountains of Southeastern Europe are plentiful and host diverse cultures and habitats, Global Change researchers of this region have not become very visible within the European science community. With the emerging European funding opportunities and new options to establish research partnerships within Europe, it is high time to give mountain science in the Balkan area a profile (Fig. 23.3). Examples from other mountain ranges such as the Carpathians can be taken as a model. Specific priorities, structures and operational modes, however, need to be freshly defined by the research community of the Balkan region.

Countries covered by the South Eastern European Mountain Research Network (SEEmore) are Albania, Bosnia and Herzegowina, Bulgaria, Croatia, Greece,

Fig. 23.3 In 2009 mountain researchers from Southeastern Europe launched the SEEmore network to address problems of environmental and socioeconomic change in the region

Macedonia, Montenegro, Romania, Serbia, Slovenia and Turkey. The research network is also open to mountain scientists from outside Southeastern Europe who have expertise or a research interest in the SEEmore region.

Similar to the history of the MRI, great things start with a good idea and grow with the commitment of individual researchers working towards concrete activities.

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Index

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