BABEŞ BOLYAI UNIVERSITY

FACULTY OF GEOGRAPHY

PhD Summary

THE SETTLEMENTS IN THE MINING AREAS OF THE APUSENI MOUNTAINS . AN APPLIED GEOGRAPHY RESEARCH

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CONTENT

Key words: *settlements, mining areas, sustainable development, risks, vulnerability, planning model, Apuseni Mountains*

1. Introduction

1.2. Research goal and objectives

The undeniable beauty of Apuseni Mountains area, the diversity of tourism and ethnographic heritage and the desire of finding viable solutions and sustainable alternative development in mining areas affected by the restructuring of the mining process after 1989, were the main reasons that motivated me in choosing the present theme research.

The paper entitled "The settlements of the Apuseni Mountains mining areas. A Case Study in Applied Geography" has a double purpose: first, to contribute and get involved in the timeless Romanian geographical research by providing data, information, analysis and methodology, and secondly, to identify opportunities for recovery and applicability of the elaborated research by developing a useful tool in the process of planning and sustainable development of the Apuseni Mountains at different scales (local, county and regional) in view of facilitating the decision-making process.

Based on the author's knowledge of the scientific literature covering the field area, knowledge of the studied areas, experience in the development of territorial planning documents and regional development, knowledge of computer processing technology for geographic data, the present research started and evolved from the analysis of the evolution and current status of settlements from mining areas in the Apuseni Mountains, to identifying needs and solutions for future directions of development and to correlating them with the national politics and the politics of territorial cohesion, economic and social development of the European Commission.

At the same time, the present research paper challenges the reader by addressing complex issues related to settlements of mining areas, by trying to develop a concept of integrated development strategy of mining areas and a methodology for calculation of vulnerability, and by proposing a model of development of settlements in mining areas from a sustainable perspective using Geographic Information Systems technology (GIS).

Overall, this study aims to answering the following questions:

- What are the metal resources exploitation areas of the Apuseni Mountains and which were the basic criteria for their delineation?
- What are the shortcomings of the mining settlements of the Apuseni Mountains areas as identified by the analysis of their evolution and current situation?
- What causes delays in the sustainable development of settlements in the mining areas in the Apuseni Mountains?â
- What are the main concerns as related to the integration of mining settlements included in the area of study into the regional municipalities system (Apuseni Mountains and the counties included in the area) and the national system?
- What are the relationships between the development of the Apuseni Mountains counties on the one hand, and the local socio-economic development in the studied mining areas, on the other?
- What are the main indicators and the relations between them in an integrated analysis of settlements in the mining areas in order to identify needs and appropriate solutions for sustainable development?
- How can one calculate and estimate the degree of vulnerabilityof of the territorial administrative units with focus on mining activities in view of

helping decision-makers compile a plan of action and a financial allocation plan adjusted to priorities and real needs of the communities?

- What are the risks faced by the mining settlements of the Apuseni Mountains?
- What are the main strategic short, medium and long term directions regarding the harmonious and sustainable development of settlements in the mining areas in the Apuseni Mountains?
- What would be the sustainable development scenario if applying a spatial model for the planning of mining settlements, in particular the Zlatna - Almasu Mare - Stănija mining areal?

2. The impact of mining activities and sustainable development in the national and international literature

This chapter includes an overview of the national and international literature on the impact of mining activities (mainly those taking place in the Apuseni Mountains area), the complexity and dynamics of settlements, and sustainable development of mining areas.

3. The complexity of the Apuseni Mountains and its incorporated counties within the context of major aspects of development

The main purpose of this chapter is to identify characteristics, potential, restrictions, and future directions of development of the Apuseni Mountains and incorporated counties, serving as support in developing a model of integration and functioning of mining areas within a regional context

Special attention was given to: the geographic personality of the Apuseni Mountains (especially its metallogenic province complexity), localities network accessibility, population growth, economy (extractive industry in particular), disadvantaged areas over a 10 years period of time through O.G 24/1998 and H.G. 20/1999, and a series of synthetic indicators that can help create a general overview of the current degree of development.

The analysis of the four provinces of the metallogenic Apuseni Mountains Province (North Apuseni Subprovince, Subprovince associated with mesozoic magmatic events, Subprovince associated with paleogene magmatic events-banatitic, and Subprovince associated with neogene volcanism) represented the starting point for delineating the studied mining areas.

The analysis of the network development trend of localities in the counties of the Apuseni Mountains was based on results of research on polycentric development process financed through ESPON Program[1].

The degree of development of the Apuseni Mountains and delineated counties was analyzed by calculating the Human Development Index (HDI) [2] and by using data for: Local

[1] ESPON (European Observation Network for Territorial Development and Cohesion) is a program of the European Comission that finances territorial research, http://www.espon.eu/

[2] Based on the methodology „Calculating the Human Development Index”, http://hdr.undp.org/en/media/HDR_2010_EN_TechNotes_reprint.pdf

Social Develpment Index (LSDI)[3], Communes Development Index (CDI)[4] , and Village Development Index (VDI)[5].

After analyzing the evolution of the industry specialization index in the Apuseni Mountains counties over a 12 years period of time, there has been a downward trend of industrial activities in the county of Cluj, and increase in the counties of Arad, Bihor and Sălaj. A sinusoidal evolution was registered in Alba and Hunedoara counties.

Following the restructuring of the mining sector, most of the metal mining activities were stopped. The analysis of the table below identifies a reduction of extractive industry activities in six counties. Currently, the largest share of mining activities is held by Hunedoara county.

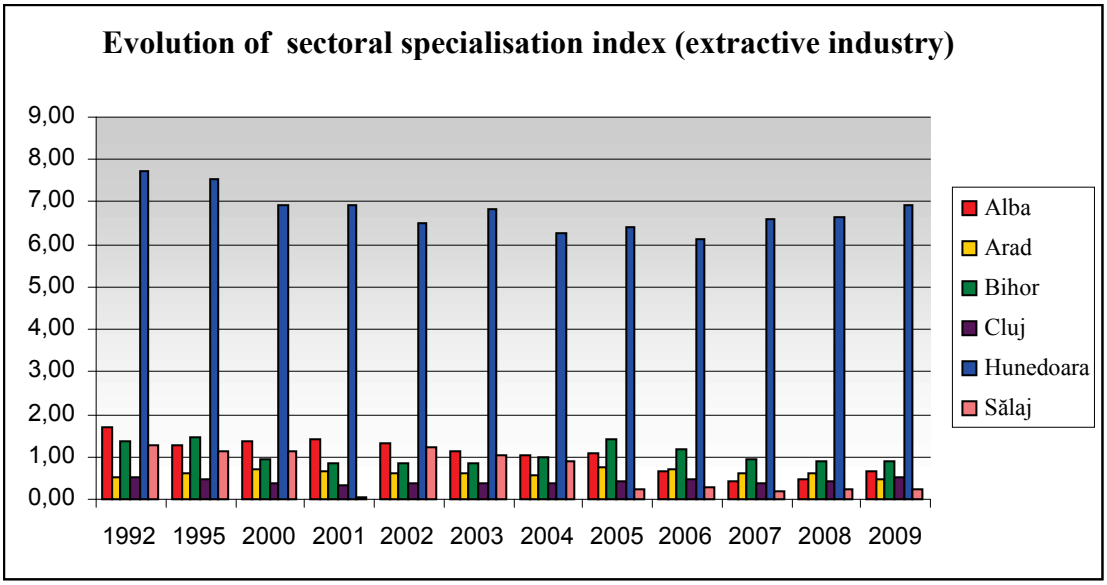

Fig. 1 Evolution of sectoral specialisation index (extractive industry) at the Apuseni Mountains component counties level in between 1992 and 2009(Source: INS, Statistical Yearbook 1992-2009)

Apuseni Mountains counties' level of development analyzed in terms of the Human Development Index (HDI)

Indicator of synthetic measuring of human development, Human Development Index (HDI) was calculated using the geometric mean ratios of the three basic dimensions of human development: a long and healthy life, access to information and education, and a decent standard of living. For the six incorporated counties of the Apuseni Mountains the Human Development Index was calculated using three indices calculated on the basis of four indicators (life expectancy at birth, literacy rate, school rate and GDP per capita).

[3] Research paper „Social disparities in regional policy and development in Romania" 2010, as part of the project entitled"Community capital development in Romania", CNCSIS-ID 2068, coordinator prof.univ.dr. Dumitru Sandu, Bucureşti University, Faculty of Sociology and Social Assistance

[4] Sandu, D., Voineagu, V., Panduru, Filofteia, „Development of communes in Romania" , 2009

[5] Dumitru Sandu, Village Development Index DEVSAT

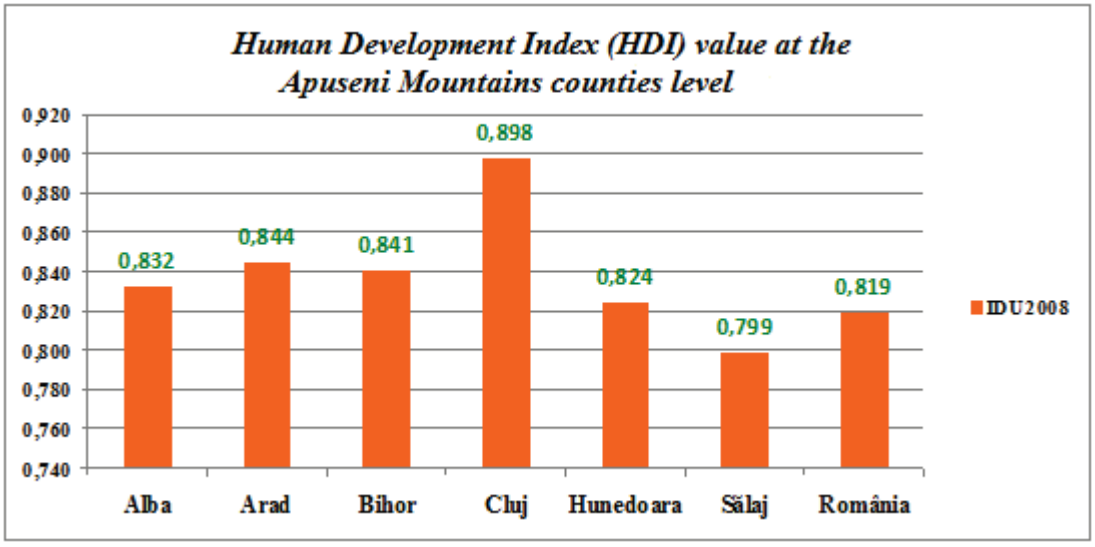

Fig. 2 Human Development Index (HDI) value at the Apuseni Mountains counties level, 2008

Looking at the graph above we see that the highest level of human development is in Cluj county, folowed by Arad county. On the opposite side are Sălaj and Hunedoara counties. Except for Sălaj county, all counties largely incorporated in the Apuseni Mountains have a value situated above the average index of human development in Romania.

4. The settlements of the Apuseni Mountains mining areas

Mining area is defined as a geographically delineated area as a result of a relatively metallogenic homogeneity in which were conducted or are currently being conducted mining activities leading to the formation of a specific physiognomy of the place. Mining areas comprise one or more mining perimeters, which in turn are defined by mine mouths, waste dumps, tailings ponds, ore preparation units, etc...

The territorial delineation of the mining areas in the Apuseni Mountains transcends the strict content of the definition, with given priority to the administrative criteria that supports the established statistical information. This is the reason why we will meet some atypical cases in the mining settlements, which have a less strong or negligible connection in relation to the general economic profile. At the same time, the metallogenic particularities and the past or present existence of mining activities to exploit metal resources (ferrous or nonferrous) are the fundamental criteria based on which the delineation of the mining areas of study has been realized.

The delineation of the Apuseni Mountains mining areas was realized after a detailed analysis of the settlements based on accumulated data and information in order to enable the identification of homogeneity on: metallogenesis (districts, fields or metallogenic nodes), accessibility and mining (and mining area types of exploited ores). Based on this analysis there have been identified administrative units that are specific to mining, while settlements were grouped into 11 mining areas. Seven areas of exploitation of polymetallic deposits of gold and silver were located in the Golden Quadrangle (Alba and Hunedoara), two areas for exploitation of iron ore (Cluj county), a mine with resources of uranium (Alba and Bihor counties), and a mine with bauxite resources (Bihor county).

Table 1 Apuseni Mountains mining areas delineation based on administrative-territorial criteria (Source: author, 2011)

No. Mining area	Mining area	Administrative-territorial units	Mining Exploitation (ME)	Main ore deposits
1	Mining area Baia de Arieş	Baia de Arieş	ME Baia de Arieş	gold, lead, zinc
2	Mining area Abrud - Roşia Montana - Roşia Poieni	Abrud, Roşia Montana, Bucium, Lupşa, Bistra	ME Roşia Montana	gold
			EM Roşia Poieni	cupru
3	Mining area Zlatna - Almaşu Mare - Stănija	Zlatna, Almaşu Mare, Buceş, Balşa	ME Zlatna	gold, lead, zinc
4	Mining area Brad - Căraci - Rovina	Brad, Baia de Criş, Bucureşci, Ribiţa, Luncoiu de Jos	ME Brad	gold, copper
5	Mining area Certeju de Sus – Hondol – Săcărâmb	Certeju de Sus	ME Certeju	gold
6	Mining area Băiţa – Hărţăgani – Trestia	Băiţa	ME Băiţa	gold, lead, zinc
7	Mining area Vorţa	Vorţa	ME Vorţa	gold
8	Mining area Iara - Băişoara	Iara, Băişoara	ME Iara Băişoara	iron, leader, zinc, gold
9	Mining area Căpuşu Mare	Căpuşu Mare	ME Căpuşu Mare	iron
10	Mining area Nucet - Băiţa Bihor - Avram Iancu	Nucet, Ştei, Câmpani, Pietroasa, Avram Iancu, Gârda de Sus, Arieşeni	ME Băiţa Bihor	uranium
11	Mining area Dobreşti - Vârciorog - Roşia	Dobreşti, Roşia, Vârciorog, Aştileu	ME Dobreşti	bauxite

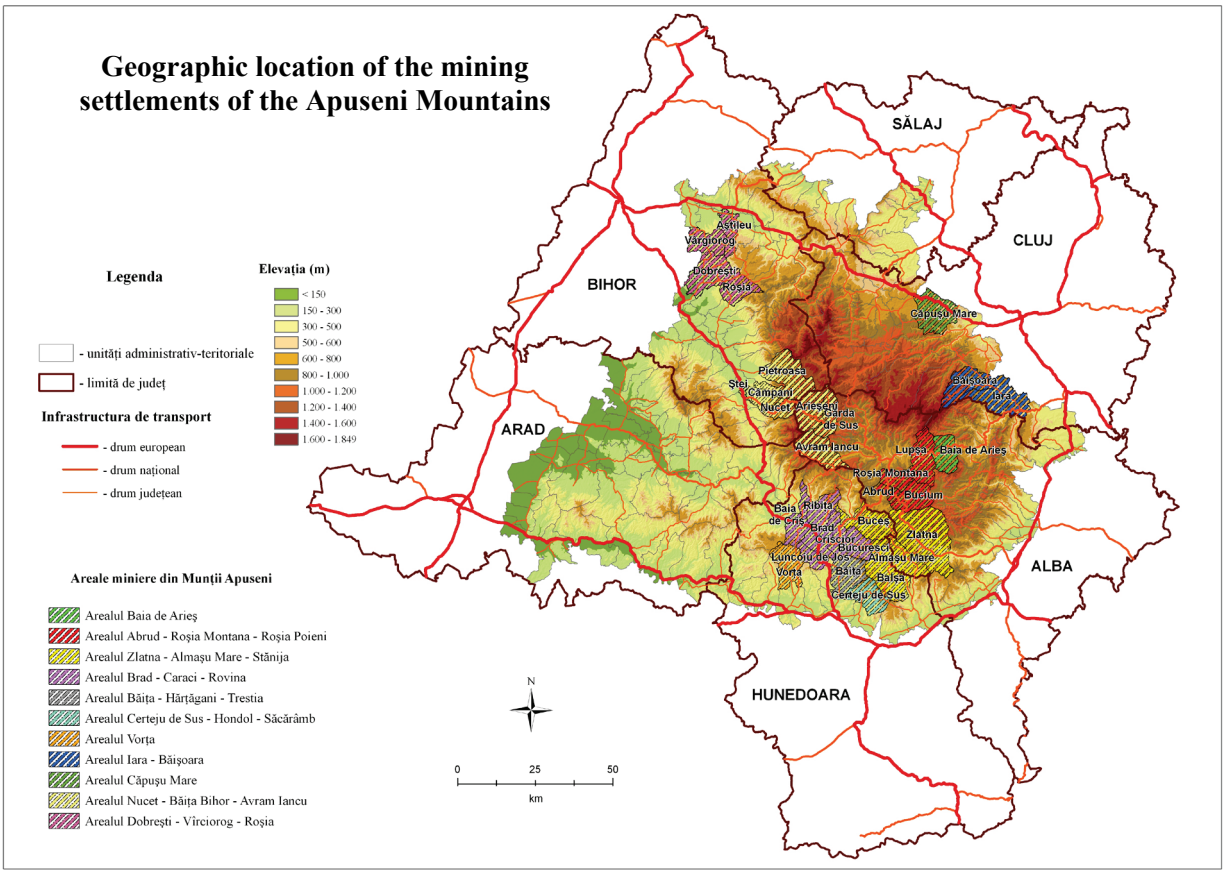

Fig. 3 Map of Apuseni Mountains mining areas geographic location

The basic characteristic of a mining complex is the vulnerability of settlements manifested within the territorial, socio-demographic, economic, and environmental components. A diagnosis of these settlements in the defined mining areas allows for support datasets gathering in view of identifying the potential and opportunities for development, as well as the involved risks and threats, with the possibility of shaping a concept of sustainable development strategy starting from a real case scenario.

The research methodology of the mining settlements was based on: analysis, processing and interpretation of relevant statistical data, elaboration of maps, the covering of the written geographic literature related to the area of study, public documentation, and field observations.

Thus, attempts have been made to compile a summary of the most relevant aspects, phenomena, or information obtained after a deep analysis of the mining areas of the Apuseni Mountains.

Given that the eleven studied mining areas do not show geographical homogeneity or the same characteristics in terms of mining, economic, and social activities, the author could not realize an integrated analysis. Instead, the best considered option was to look at each area separately while paying attention to the same aspects so that the information and the obtained results could be compared at the end of data collection.

Depending on the existence and access to statistical data, and the relevance of certain aspects in the territorial, social, economic and environmental analysis and field observations, each mining area was analyzed in terms of four major perspectives in order to obtain new data and support information in identifying future directions of sustainable development.

a. *Geographic characteristics, accessibility, and territorial structure*

- Location of the geographic mining area

- The administrative-territorial structure and incorporated localities
- Geographic characteristics
- Accessibility: main roads, distance from the county capital and nearest town
- Structure of agricultural land: surface area and the share of agricultural land by use at the end of 2009
- Total number of dwellings at the end of 2009
- Total number of dwellings built between 2005 – 2009
- The percentage of housing built between 2005 - 2009 of total housing
- For urban areas: the length of the road network for both modernized and non-modernized streets.

b. *Aspects of mining activities and their impact on the environment*
   - Main mining activities to exploit metal resources
   - Main issues related to the impact of mining on the environment

c. *Demographic, social, and economic aspects*
   - *Population and its density*
     - Total population on 1 July 2010 at the mining and the administrative – territorial area level
     - Share of total female population in between 2005 - 2010 - 1st of July 2010 population density at the mining and the administrative – territorial area level
     - Population evolution at the mining and the administrative – territorial area level in between 2005 - 2010
     - Rate of increase / decrease in population over the previous year in the mining area during 2005 – 2009
   - *Natural movement of population*:
     - Number of live births during 2005 – 2009
     - Number of deaths during 2005 – 2009
     - The birth rate in the period 2005 – 2009
     - The mortality rate during 2005 – 2009
     - The rate of natural increase during 2005 – 2009
   - *Population mobility:*
     - Number of new settlers in the village during 2005 – 2009
     - Number of local resident departures during 2005 – 2009
     - Balance of residence changes during 2005 – 2009
     - The rate of migration during 2005 – 2009
   - *Local Economy*:
     - Current main economic activities
     - Number of companies and their areas of activity
     - Number and percentage of firms with turnovers over 100,000 lei
     - Number and percentage of firms with turnovers of more than 1,000,000 lei

d. *Elements of attractiveness and development opportunities*
   - The main natural and anthropic attractions
   - Specific resources of the area
   - Opportunities for development and to attract potential investors

Exemples of mining areas selected based on the type of exploited metal resources

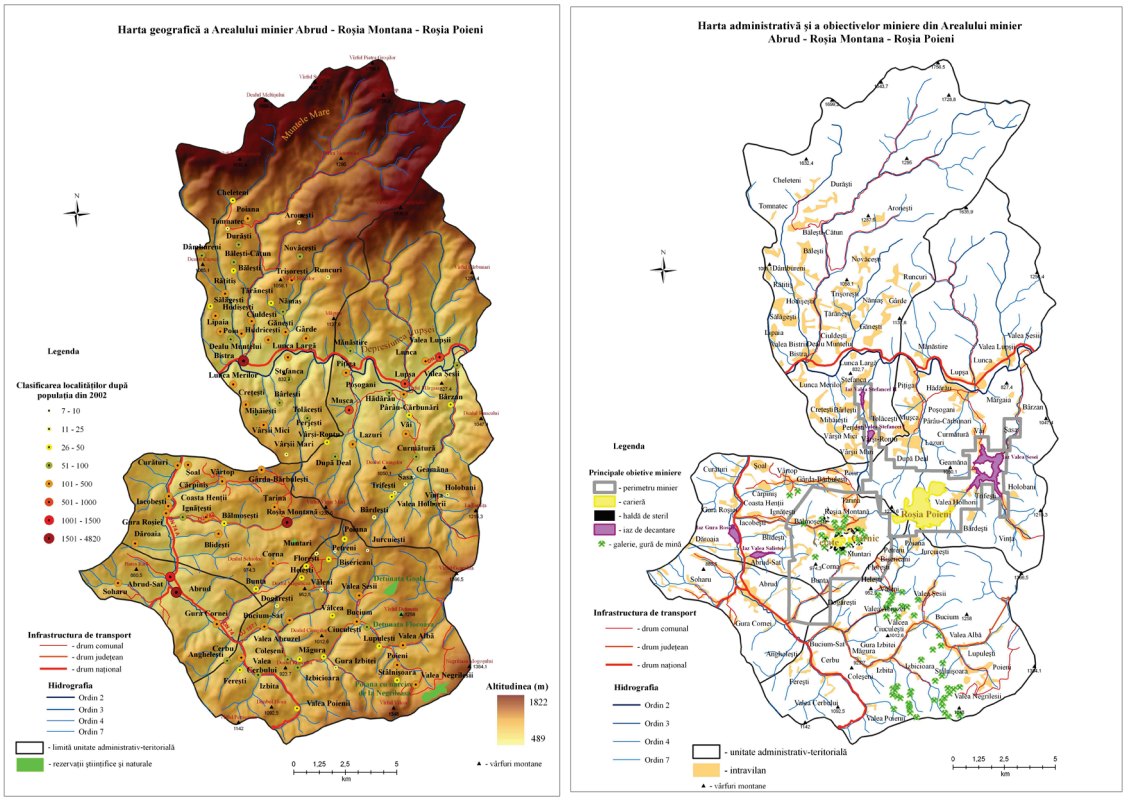

Fig 4. Mining area Abrud – Roşia Montana – Roşia Poieni from Golden Quadrangle (gold, silver, and copper)

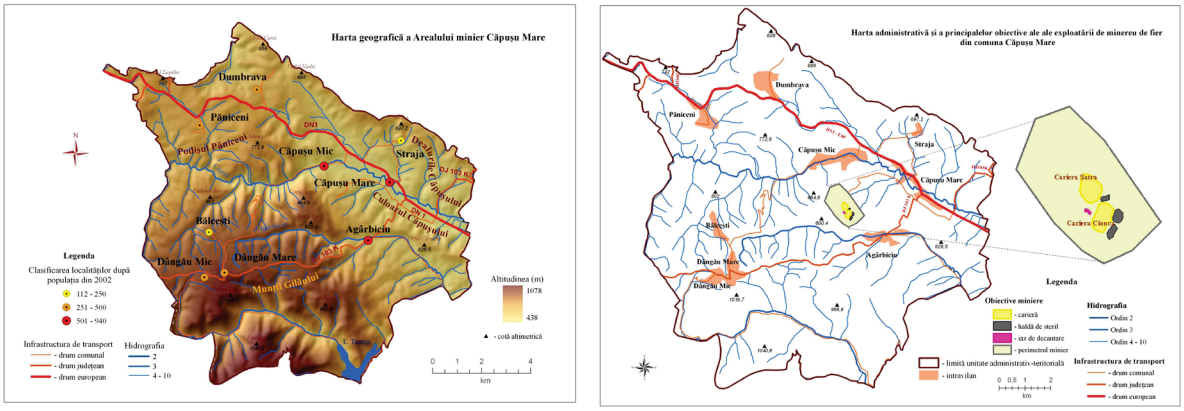

Figura 5 Mining area Căpuşu Mare (iron)

Main three aspects presented for each component of the SWOT analysis of the mining areas settlements of the Apuseni Mountains

Strengths	***Opportunities***
1. Existence of a significantly high natural potential (diversity of resources, mainly of underground resources) 2. Existence of a rich tourist natural patrimony (large number of	1. Possibility to develop specific economic sectors (mainly based on existent resources and physico-geographical characteristics): agriculture, zootechnics, animal plants, tourism and agri-tourism,

reservations and natural monuments), and of an anthropic patrimony of an incontestable value ***3.*** Conservation of the ethnographic and cultural patrimony: traditions, folk art, peasan architecture, handcrafts, cooking traditions, etc.	energy conservation and efficiency (use of renewable sources of energy-RSE: micro-hydroenergy, biomase), mining 2. Attraction of potential investors due to incentives offered by local public administration as well as based on the existent natural potential 3. Development and implementation of projects financed through non-refundable funding.
Weaknesses 1. Poor utilities infrastructure and transportation infrastructure (caused by the degree of isolation and restrictive natural environment) 2. Lack of strategic vision and culture regarding partnership opportunities in developing and implementing feasible projects 3. Reduced population access to quality education and vocational training, culture, healthcare, and information.	***Threats*** 1. Accentuated population aging and decrease in the numbers of active population 2. Increasing economic and social gap between regions including the mining areas and other regions due to: low degree of economic valorification of the natural and human potential (agriculture, industry, tourism, unemployment, population loss) 3. Increased risk of pollution and ecological hazards due to lack of a system in place aimed to atenuate, evaluate, and monitor the impact of the closing of mining activities, superficiality regarding ecologization and environmental regeneration activities.

Table 2 Main three aspects presented for each component of the SWOT analysis of the mining areas settlements of the Apuseni Mountains

5. Risk typology of mining settlements based on the major identified risks

Based on the written scientific literature that has identified a series of risks and elements associated with those risks, the present study was started from:

- the relationship between risk components (hazard, vulnerability, exposure) and geographic environment components (nature, society, and territory) (Ayala-Carcedo and Cantos[6], 2002, Chrichton[7], D, 1999)
- research on risks identified in the Apuseni Mountains (demographic risks for example) (Surd Vasile[8] et al., 2007)

[6] Alcantara-Ayala I. (2002), *Geomorfology, natural hazards, vulnerability and prevention of natural disasters in developing countries*, Geomorfology, Vol 47, 2-4 October 2002

[7] D. Crichton (1999), *The Risk Triangle in Natural Disaster Management*

[8] Surd, V., Zotic, V., Puiu, V., Moldovan, C., (2007), *Riscul demografic în Munții Apuseni*, Presa Universitară Clujeană)

- indicators used in risks and vulnerability analysis (Birkmann Joern[9], 2007)

- **The classification risks from the mining settlement based on dominant risk**

Starting from the premises that the physiognomy and the specific of the mining settlements is given by the exploitation of the mineral resources activities which in turn attract a series of risks for the components of a settlement, the author has attempted a classification of risks based on three major periods of time:

- the period of active mining activities (regardless of the intensity of the mining related activities, economic turnover, utilized mining technologies, etc.)
- the period of mining sector restructuring and the process of closing the mines and their specific activities
- the post-mining period, immediately following the closing of the mines period .

Given the three previously presented periods, the present thesis has identified the dominant risk that, based on its characteristics, can generate a series of additional risks, vulnerabilities and hazards, as illustrated in the chart below:

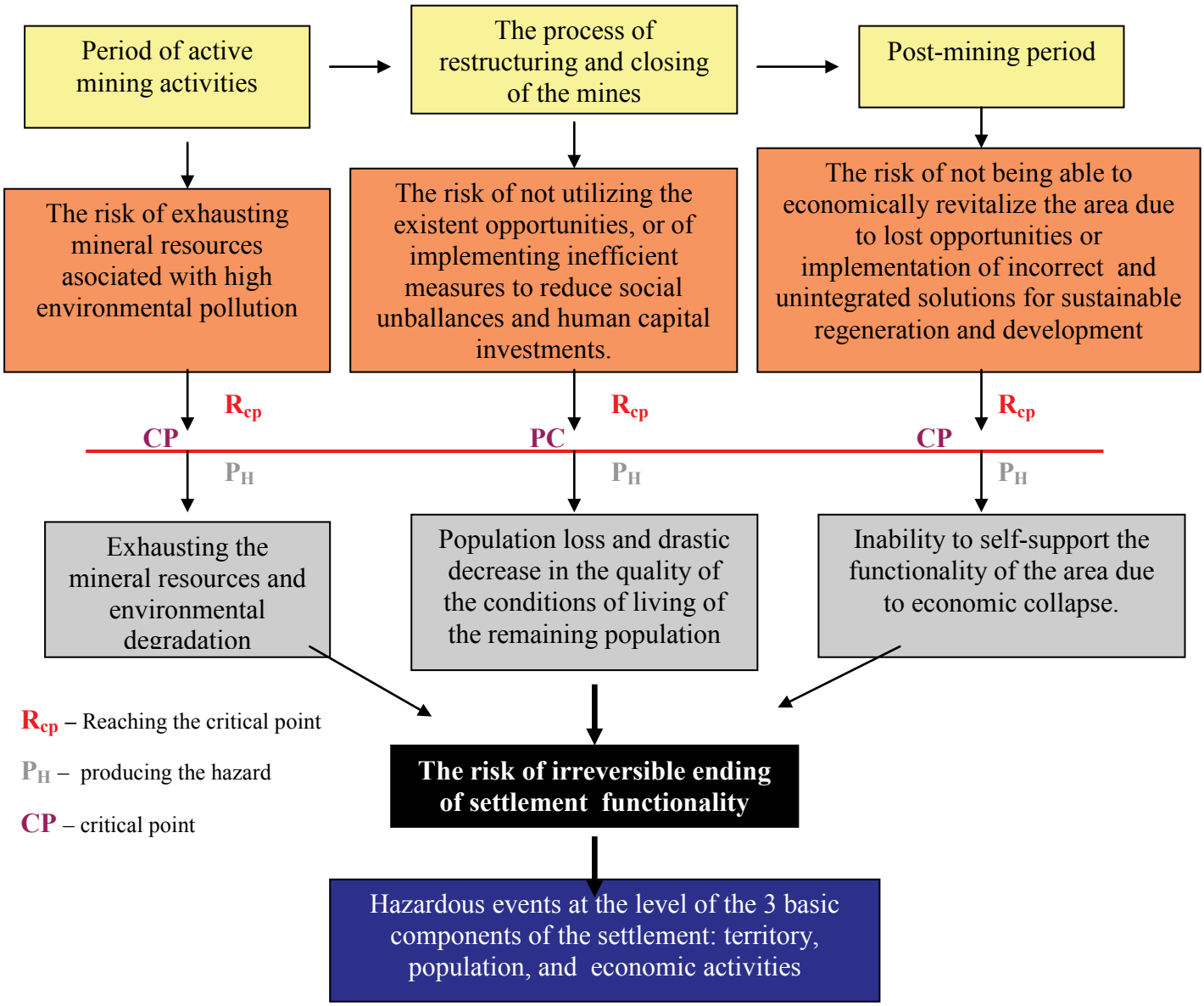

Fig. 6 Dominant risk based on the three major periods of time in the evolution of a mining settlement and the consequences of hazards (Source: author, 2011)

[9] Birkmann, J., (2007), *Risk and vulnerability indicators at different scales: Applicability, usefulness and policy implications*, Environmental Hazards, Vol. 7, No.1, pg. 20-31

- **Proposed method to calculate the vulnerability of mining settlements**

The vulnerability of settlements (in particular those of mining settlements) was seen in the light of:

- the complexity and dynamics of a settlement, as well as of the main demographic, economic, and social phenomena etc.
- the interchangeability between settlement and population, human community behavior, economic activities, and natural environment
- the local conditions and policies for sustainable development related to those at the regional, national, and European level.

The elaboration of the *calculation methodology* of the mining setlements vulnerability started from:

- the analysis and prioritization of issues that directly or indirectly affect the balance of the sustainable development of settlements, especially those part of of the mining areas
- identification of sets of relevant statistical indicators in relation to the issues mentioned above and the established relations between them
- development of the formula for calculating the vulnerability of mining settlements
- establishing and argumenting classes of values based on which one can quantify the degree of vulnerability of settlements
- validation of the estimate formula for calculating the degree of vulnerability in the rural settlements of the Apuseni Mountains in Alba County based on the mathematical formula

In proposing a method for estimating the vulnerability of settlements the author started from the mathematical formula for calculating the risk : R = H * E * V, where R represents the risk, H is the hazard, E represents the exposed elements, and V the vulnerability. This equation shows that vulnerability is given by the relationship between the risk and the product of hazard and exposed elements.

Given the major differences between urban and rural settlements the present paper proposes a metodology for calculating the vulnerability of rural settlements, future further research being needed for the urban settlements. The choice of the rural settlements was motivated by the characteristics of the Apuseni Mountains in terms of economic activities, this incorporating a predominantly rural area and rural population (high share of rural inhabitants).

In determining the most suitable indicators and the relationships between them one needs a more clear picture of the scope, role, and expected results regarding the aplicability of the method used for estimating the vulnerability. Therefore, the table below sets the context and framework for identifying the appropriate indicators for the proposed method of calculation:

Table 3 Key questions related to the elaboration of a methodology used in estimating the degree of vulnerability

Question	Answer
What is the main purpose of the applicability of the mathematical formula for calculating the degree of	To estimate the degree of vulnerability of the rural settlements from an established region as related to the sustainable

vulnerability of the rural settlements (mainly that of the mining settlements)?	development and the directions of evolution in conformity with the national and european politics of development.
What are the fundamental elements analyzed from the vulnerability standpoint?	The vulnerability for all the fundamental components of a rural settlement will be estimated: territory, population, economic activities, and natural environment.
What is the main objective of applying the mathematical formula that estimates the vulnerability of a rural settlement?	To facilitate decision making at the local public administration level by setting priorities and allocating financial resources. According to the degree of vulnerability (very small, small, medium, high or major) and based on the four components previously announced, one can develp and implement integrated projects with the goal of diminishing the vulnerability and of encouraging sustainable development of the rural settlements.
What is the fundamental principle in the elaboration of the calculation methodology used in estimating the vulnerability of rural settlements?	Offering a concrete picture of the degree of vulnerability of a rural settlement through an integrated approach to the components of a settlement, and defining the relationships between indicators based on the cause and effect principle.

Following a detailed analysis it was concluded that all components of rural settlements are exposed to vulnerability, not only the population and the natural environment, but also the territory and the economic activities. Taking into account the three fundamental elements in vulnerability analysis (risks, hazards, and exposed elements), the author proposes a centralization of the main elements associated thereto as presented in the chart below.

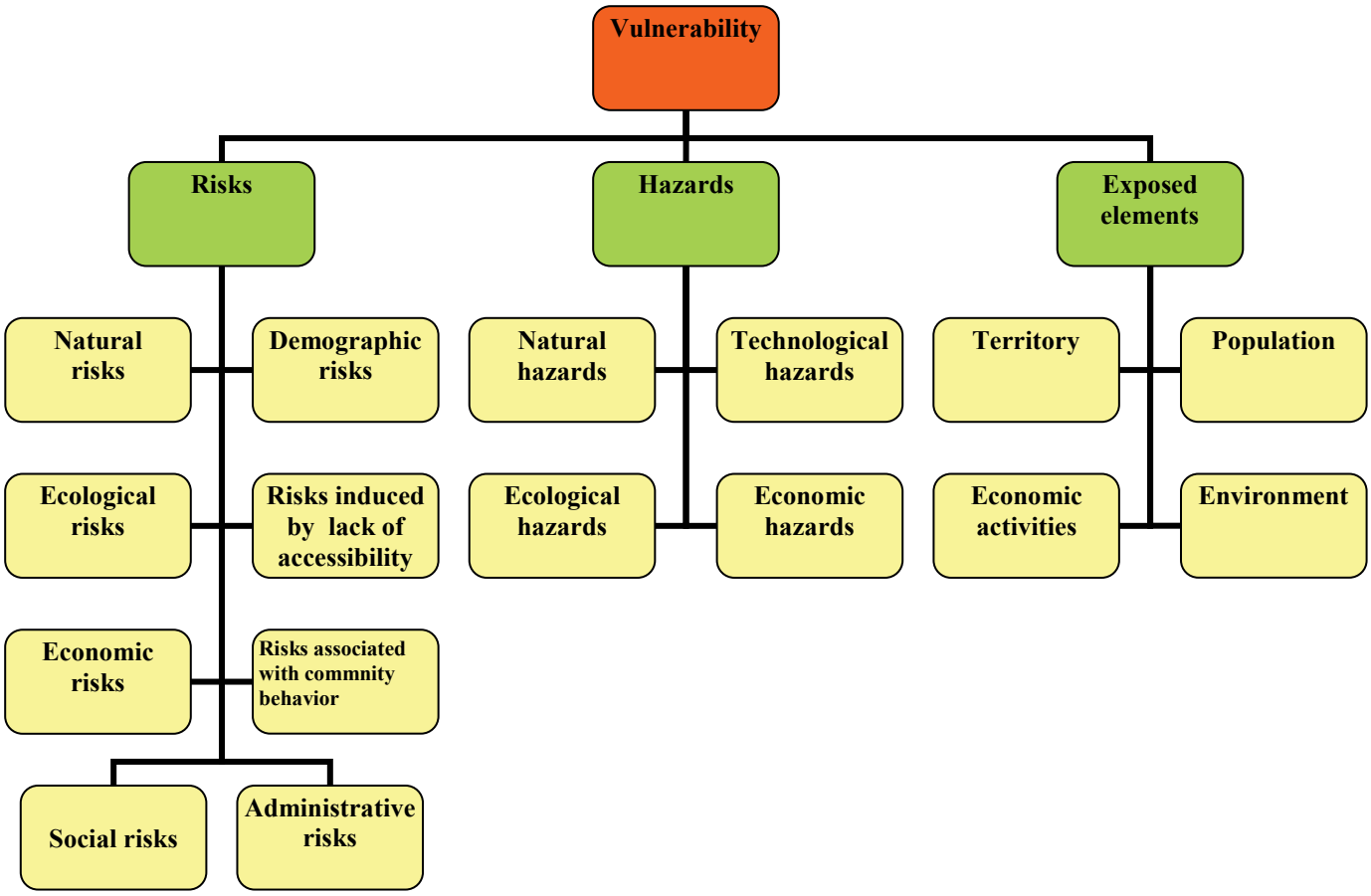

Fig. 7 Identification of elements associated with the three components in estimating the degree of vulnerability (risks, hazards, and exposed elements) at the rural settlements level (Source: author, 2011)

Considering the complexity and dynamics of rural settlements, the vulnerability was calculated based on the conditions and processes resulting from ten factors or aspects considered to be the most important:

- Geographic factors
- Aspects related to the utilities infrastructure
- Aspects related to accessibility
- Demographic factors
- Social factors
- Factors of decission and administrative factors
- Psychologic factors and motivational factors
- Economic factors
- Environmental factors
- Restrictive aspects in the process of sustainable development

The proposed formula for calculating the degree of vulnerability of rural settlements has been adapted to the territorial- administrative unit for a more facile application by the local public administration (who wil decide directions and priorities for development taking into account the vulnerability settlements).

Matematically, the proposed formula is calculated as follows:

$$V\_rur\_settl = \sum_{i=1}^{10} F(i) \left(\sum_{j=1}^{n} I(j)/n\right)/10$$

where,
Fi – factors determining vulnerability (10 types were identified as most important)
Ij – specific indicators for Fi
n – number of specific indicators for Ij (n varies based on Fi; for example for F1, n = 5, for F2, n = 4, for F3, n=10, etc.)

A total number of 55 indicators were selected based on the 10 factors and various other aspects presented above. The chosen method was the bonitation method, each indicator being given from 1 to 5 points for each value based on the methodology used in applying the formula. Hence, a rural administrative- territorial unit can be assigned value points within the following ranges based on the final result:

- Very low vulnerability (1 – 1,5)
- Low vulnerability (1,5 – 2,5)
- Medium vulnerability (2,5 – 3,5)
- High vulnerability (3,5 – 4,5)
- Major vulnerability (4,5 – 5)

For additional relevance and an easier comparison of the degree of vulnerability of the rural mining settlements confronted with a series of negative aspects, the author selected a geographic study area of Alba county in the Apuseni Mountains, which includes:

- The Apuseni mining area declared „disadvantaged area" in between 1999 - 2009[10]; it incorporates 3 towns (Abrud, Baia de Aireş and Zlatna) and 9 communes: Almaşu Mare, Bistra, Bucium, Ciuruleasa, Lupşa, Mogoş, Roşia Montana, Sălciua and Sohodol.
- All the communes situated in the western and eastern side of the mining area declared „disadvantaged" before 2009 and are located in the Apuseni Mountains. Thus, the western limit is represented by the borderline of the Alba County, whereas the Alba Iulia – Turda Corridor, Alba Iulia – Aiud sector make the eastern limit.

[10] DECISION no. 813 of 7 October 1999 declaring Apuseni mining area, Alba County, deprived area of development. The decision was approved by the Romanian Government pursuant to Art. 2, 3, 3 {1} and art. 5. (2)of the Emergency Ordinance no. 24/1998 on the regime of deprived areas, approved and amended by Law no. 20/1999, 20/1999, http://freelex.juridic.ro/DocumentView.aspx?DocumentId=00031358

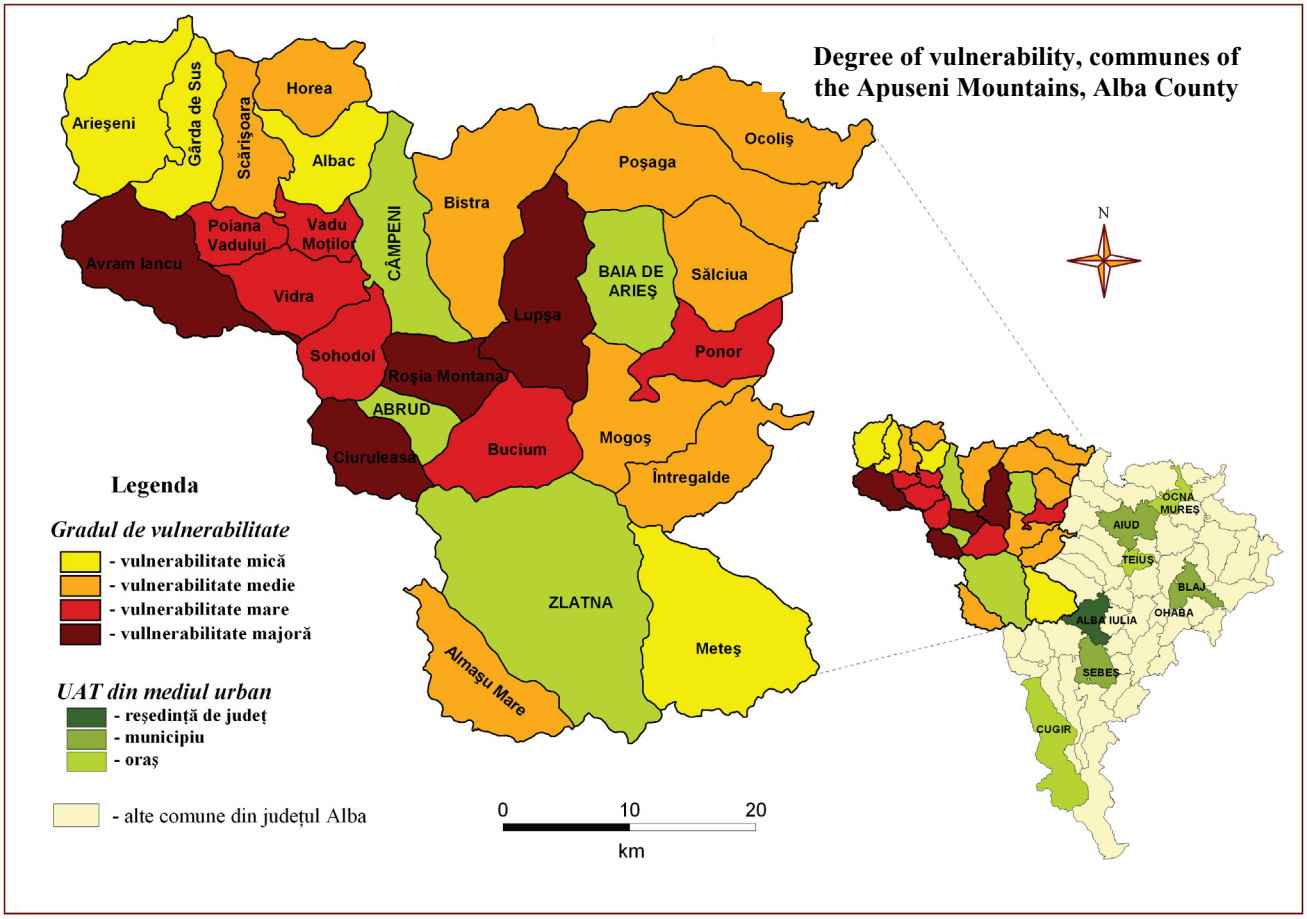

Fig. 8 Geographic location of Alba County communes, Apuseni Mountains, based on degree of vulnerability.

Based on the map presented above, the highest degree of vulnerability at the administrative-territorial level was registered in Roşia Montana, Lupşa, Ciuruleasa, and Avram Iancu, with the lowest being in Meteş, Arieşeni, Gârda de Sus and Albac.

6. Proposal of a strategy concept for sustainable development of the Apuseni Mountains mining settlements for the period 2011 – 2030

Assuming that a strategy of sustainable development is the result of a collective effort, this paper proposes a concept of sustainable development strategy of the settlements that are part of the Apuseni Mountains mining areas, which provides both a vision of integrated development paralleled by greater challenges at the national and european level, and pragmatical aspects that can represent a real support in the decision-making (ideas and concrete proposals for project thematics, identification of financial resources that are elligible for proposed actions, etc.).

The concept of sustainable development of the mining settlements of the Apuseni Mountains represents a summary of conclusions drawn from both scientific and field research, materialized through the identification of concrete solutions for sustainable development. At the same time, the concept of strategy is consistent with the most important politics and strategic, pragmatic, or planning documents in the area of development.

The development of the strategic concept of sustainable development of the mining settlements of the Apuseni Mountains was based on:

- Geographic knowledge, socio-economic and environmental evolution analysis of the mining areas of the Apuseni Mountains
- Discussions with local and regional decision-makers, and analysis of information gathered from meetings with representatives of city halls, mining companies, economic agents, institutions of higher education, experts in mining, environment, economy, demography, geology, etc. who are somehow connected to the geographic area of the Apuseni Mountains.
- SWOT analysis of the Apuseni Mountains mining areas
- Experience in the field of regional planning with the purpose of sustainable development and reduction of local and regional disparities
- Consultation of fundamental public documents at the national and regional level regarding the planning and development of the territory, economic development, human resources development, sustainable environmental development
- Consultation of EU directives related to territorial, social, and economic cohesion
- Documentation on strategic directions of sustainable development at the european level, mainly within the next 10 years
- Study of related scientific literature
- Knowledge of successful models of sustainable planning and development from mining areas from countries members of the EU

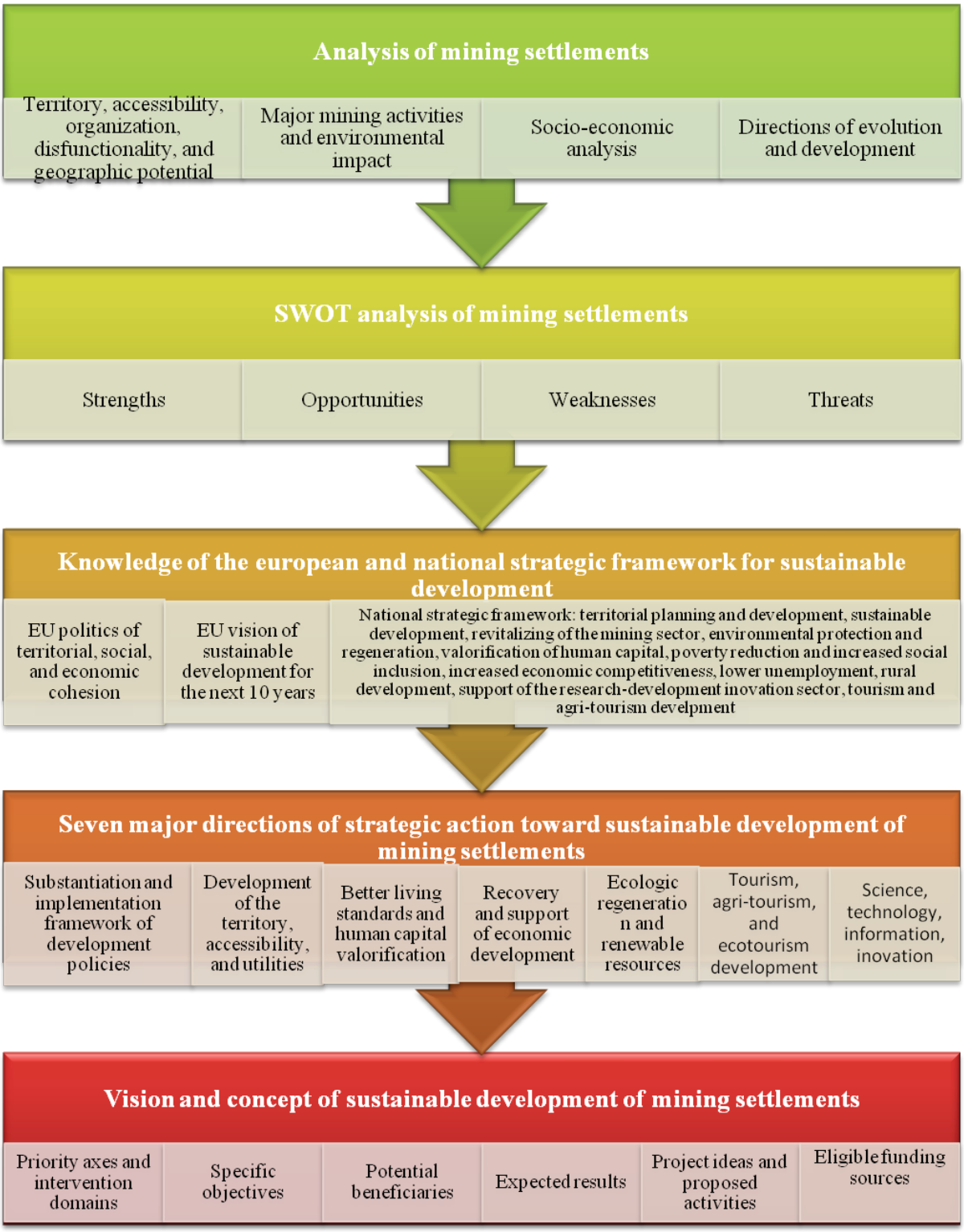

Fig. 9 The process of developing the concept of sustainable development strategy for the mining settlements of the Apuseni Mountains

In order to establish a strategic vision for integrated sustainable development of the mining areas of the Apuseni Mountains, the author has classified the major public reference documents at the national level in order of importance, while identifying seven priority development policies in the area of study:

- *politics of planning and development of the territory*
- *politics of sustainable development*

- *politics of rural development*
- *politics of economic development and restructuring of the mining sector*
- *politics of employment, reduction of poverty, and social inclusion*
- *politics of environmental regeneration, protection, and conservation*
- *politics of tourist, agri-tourist, and ecotourist development*

In the Apuseni Mountains and not only, the mining activities have been significantly reduced in the past 20 years, which has created inbalances, especially fom the social, eonomic, and ecologic standpoint.

Vision of integrated development of the mining areas settlements of the Apuseni Mountains: transformation of the mining areas into attractive areas, favorable to territorial, social, and economic development as a consequence of the elimination of their dependency on the mining industry.

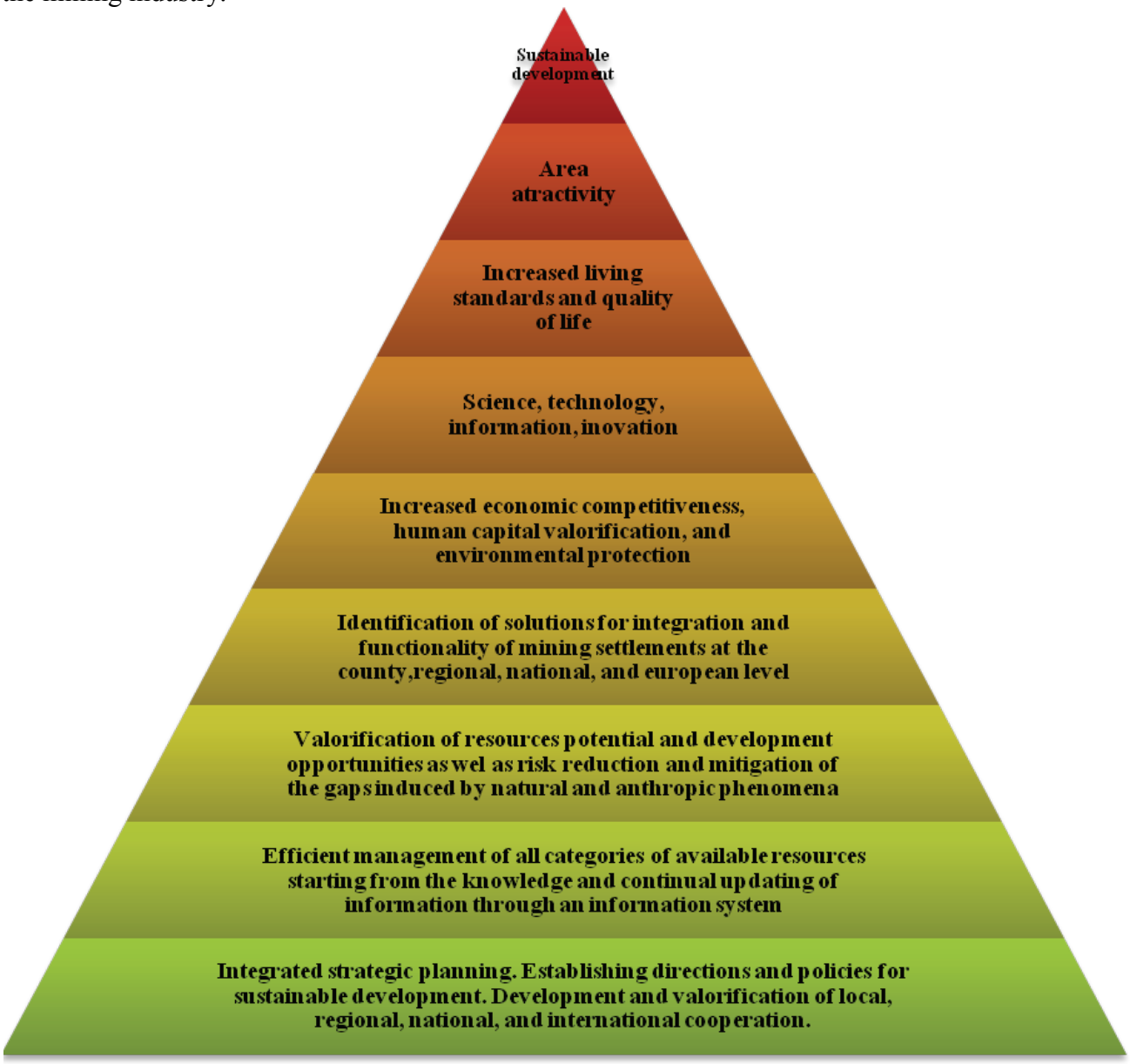

Fig. 10 Vision of sustainable development and increased attractivity of the mining settlements in the Apuseni Mountains

Table 4 Priority axes proposed through the concept of sustainable development strategy of the mining settlements of the Apuseni Mountains and five identified strategic directions of action

Priority axis	**Proposed five major strategic directions of action for which project ideas and elligible and non-refundable funding sources have been presented and identified**
Priority axis 1 ***Strategic planning and consolidation of the planning and implementation framework for integrated sustainable development policies***	**1.** Harmonization of local actions with the objectives proposed by the national, regional, and county strategies and plans **2.** Development of databases and of necessary instruments in the process of territorial planning, social and economic competitivity, sustainable development and environmental protection **3.** Consensus in decision-making and planning. Integrated valorification of the functional territorial structures within the context of reduction of disparities and augmentation of spatial cohesion **4.** Consolidation of territorial planning and development and sustainable development policies through masterplans and revitalization strategies of the mining areas **5.** Improvement of activities and services offered by the local, county, and regional administrative structures responsible for the planning, and sustainable development of the settlements affected by the restructuring of the mining sector
Priority axis 2 ***Increased accesibility and territory revitalization through rehabilitation, modernization, and development of the road and utilities infrastructure***	**1.** Increased accessibility through rehabilitation, modernization, and road infrastructure development **2.** Rehabilitation and modernization of the utilities infrastructure of the mining settlements **3.** Development of the utilities infrastructure of the mining settlements **4.** Equipment planning of the territory in order to attract new investments and investors **5.** Diversification of the utilities infrastructure in order to improve conditions of living among the population
Priority axis 3 ***Human capital development,***	**1.** Slowdown in depopulation and demographic aging **2.** Professional training, professional reconversion, and

quality of life improvement and increased access to social, educational, cultural, and rehabilitated and modern healthcare infrastructure	increase in active population employment rate **3.** Attracting and retaining the young population in the area by providing access to education, culture, information, and opportunities for development and available employment. **4.** Development of civic responsibility, community involvement in solving identified issues, change of mentalities and attitudes toward the perception of change **5.** Increased standard of living through access to rehabilitated and modernized social, educational, cultural, and health infrastructure
Priority axis 4 ***Recovery, support, and economic development by encouraging the business environment and local, entrepreneurship, and by capitalizing on the existent human capital to attract investments***	**1.** Encouraging and supporting the business environment and entrepreneurial initiatives by offering certain facilities **2.** Development of a partnership culture and establishment of producer groups, associations and economic clusters **3.** Increasing the competitiveness of mining areas through diversification of rural economic activities **4.** Attracting foreign investment and potential investors by promoting and capitalizing on opportunities and on the potential of the natural and human resources **5.** Economic valorification of industrial sites
Priority axis 5 ***Ecologization, environmental protection, and rehabilitation of industrial sites. Valorification of renewable sources of energy and increase in energetic efficiency***	**1.** Develop an integrated management system of monitoring mining areas **2.** Rehabilitate, ecologize, and conserve affected mining areas and those with increased potential for tourist, agri-tourist, and eco-tourist valorification **3.** Support and promote ecologic education as well as encourage the transfer of know-how regarding ecological regeneration of industrial sites **4.** Valorification of renewable resources of energy and increase in energetic efficiency **5.** Promote the use of innovative solutions in adapting to the restrictions imposed at the national and european level as related to environmental protection

Priority axis 6 ***Increasing the attractiveness of mining settlements of the Apuseni Mountains through promotion, valorification, and development of tourism, agri-tourism, and eco-tourism***	**1.** Inventory of natural and anthropic resources that have potential for tourist development and identification of opportunities for development of tourism, agri-tourism, and eco-tourism **2.** Conservation and promotion of local values, the ethnographic and cultural heritage, handcrafts and traditional patrimony **3.** Development of new forms of tourism in mining areas: mining tourism, scientific tourism, ethnographic and cultural tourism **4.** Development, rehabilitation, and modernizing of the tourist infrastructure and services **5.** Improvement of the vizibility and tourist attractivity of the mining areas at the national and international level
Priority axis 7 ***Sustainable development of mining settlements by creating, attracting, and capitalizing on the opportunities offered through science, technology, information, and inovation***	**1.** Planning and improving the sustainable development process of mining areas through capitalizing on rezults and opportunities offered by science, technology, information, and inovation **2.** Stimulating and supporting the development of companies focused on inovations and high technologies **3.** Stimulating the transfer of know-how based on cooperation between research and development institutions, enterprises, and the decision making environment **4.** Increasing competitiveness and social, economic, and territorial cohesion by capitalizing on the research, development, and inovation sector **5.** Creating a research and technologic transfer center in the Apuseni Mountains to enhance sustainable development and revitalization of areas affected by mining activities

7. Proposal of a sustainable planning and development model of the Zlatna – Almaşul Mare – Stănija mining area

The main goal of spatial planning is to harmonize the economic, social, ecological, and cultural politics established at the national and local level in order to insure balanced development of different areas of the country and increased cohesion and efficiency of the economic and social relationships among them. In general, the major objectives[11] of spatial planning are:

- balanced economic and social development of the regions and zones with respect to their characteristics
- improving the quality of the human life and of the human communities
- responsible management of natural resources, environmental and cultural space protection
- rational use of land
- preserving and developing cultural diversity

Based on settlement analysis, SWOT analysis, and field research in the Zlatna - Almaşu Mare - Stănija mining area, the proposed planning model identifies the potential for development and the necessary infrastructure that, if capitalized, can insure the sustainable functioning of the area of study. Meanwhile, the planning model could be an example of how to apply the concept of strategic sustainable development of the mining settlements of the Apuseni Mountains at a smaller scale, model that can become a source of inspiration for the decision-makers involved in sustainable development planning.

Starting from the idea that the future is built largely on the actions taken today, sustainable development planning must be based on creating a framework for integrated functionality, focusing on priorities, potential, and opportunities for development aimed at increasing the level and quality of life. In turn, they are reflected the quality of human capital, economic competitiveness, progress, decisions and actions for regional development and environmental protection.

The proposed model of development for the Zlatna - Almaşu Mare - Stănija mining area aimes at identifying solutions to transform the area from a sustainable development perspective, namely:

- Raising living standards among the population and opportunities to reduce the phenomenon of depopulation and demographic aging
- Creating an urban-rural balance through revitalization and adaptation to new conditions
- Creating an economic and ecologic equilibrium through economic exploitation of resources and ecologization, rehabilitation and preservation of industrial sites
- Increase of Economic Competitiveness
- Increase of area attractivity for:
    - the population
    - investors and economic environment
    - tourist
    - developers and scientists

Apart from the data and information related to the Zlatna – Almaşu Mare – Stănija mining area presented in the previous chapters, there are some additional aspects to focus on, namely:

[11] Law 350/2001 regarding Spatial Planning and Urbanism

- Identification of the degree of accessibility of the studied mining area and its connectivity to major zones and cities
- Identification of area specific resources
- Current economic activities
- Inventory of investments and finalized or ongoing projects of the local public administration that have a positive impact in raising the living standards among the population, economic development, and increased area attractivity for potential investors
- Inventory of facilities granted to potential investors, as well as of the business opportunities in the area
- Identification of tourist potential in a more detailed approach to providing solutions to develop rural tourism, agri-tourism, cultural tourism, and recreational tourism (winter sports, mountaineering, etc.)
- Identification of insufficiently tapped or exploited potential that would lead to increased economic competitiveness if appropriate solutions are developed and implemented
- Identification of unfavorable aspects that restrict and slow down the process of development in the studied mining area
- Establishing specific elements of mining area planning from the sustainable development perspective
- Identification of the target group and potential beneficiaries in a long-term strategic project regarding the studied mining area planning with the purpose of increasing its attractivity and promoting sustainable development

In order to develop integrated solutions for sustainable develpment of the Zlatna – Almaşu Mare – Stănija mining area it is necessary to establish, rehabilitate, preserve, develop, and transform some of the anthropic sites. In developing the model of development, emphasis was placed on unlocking the potential and opportunities for tourism and agri-tourism development, local economy (local business environment) and human capital development, and on increasing competitiveness by encouraging the transfer of know-how.

In planning the development of the studied mining area a consensus is needed at the decision-makers' level, as well as careful and feasible planning to develop integrated projects and to identify and attract grant funding sources.

Following the implementation of the planning and development scenario for Zlatna – Almaşu Mare – Stănija mining area the from the sustainable development perspective, the main expected result by 2030 is to increase area competitiveness and attractiveness for the:

- *Population* (contributes to: reducing the process of depopulation, population aging, decreased natality rate, and increased migration)
- *Tourists* (contributes to: increased national and international visibility of the area, increased attractiveness and commissioning of tourist patrimony, increased revenues
- *Investors and economic environment*, considered as the foundation of development and key elements in increasing economic competitiveness
- *Scientific researchers and developers* (contribute to: identifying appropriate solutions in areas such as: ecologic agriculture, zootechnics, agri-tourism, entrepreneurship, creating brands, use of renewable resources of energy, preservation and promotion of the ethnographic heritage, etc.)

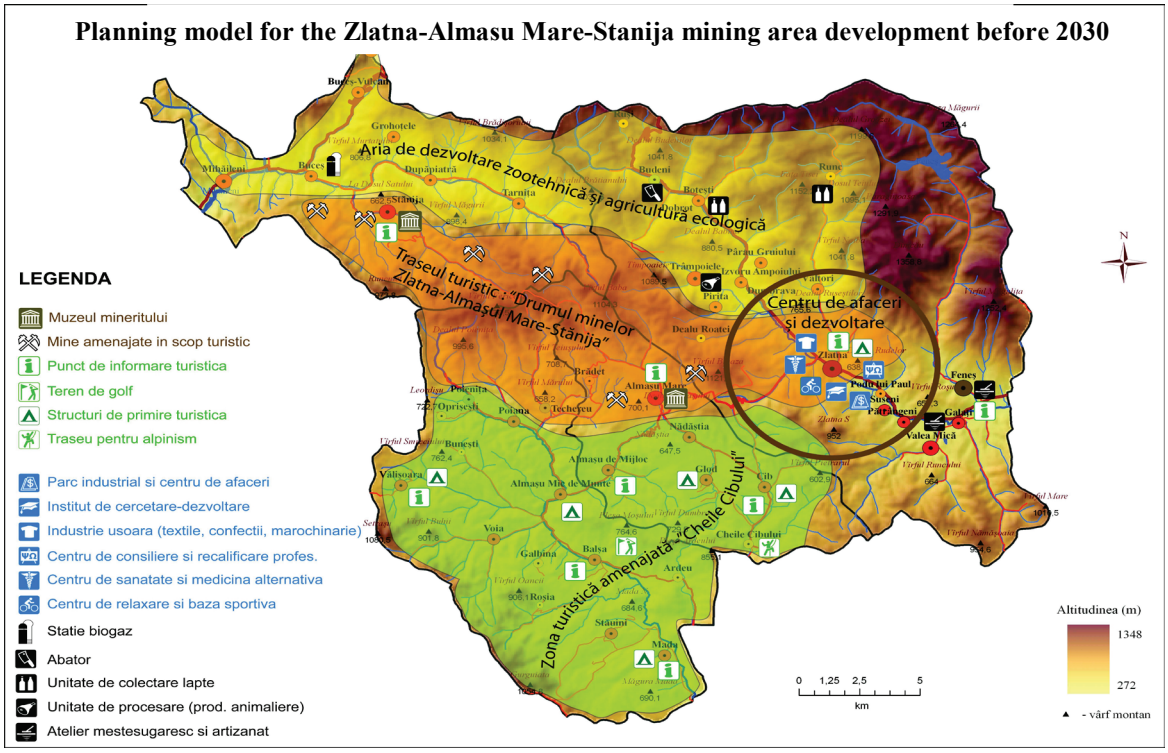

Fig. 11 Planning model for the Zlatna-Almasu Mare-Stanija mining area development before 2030

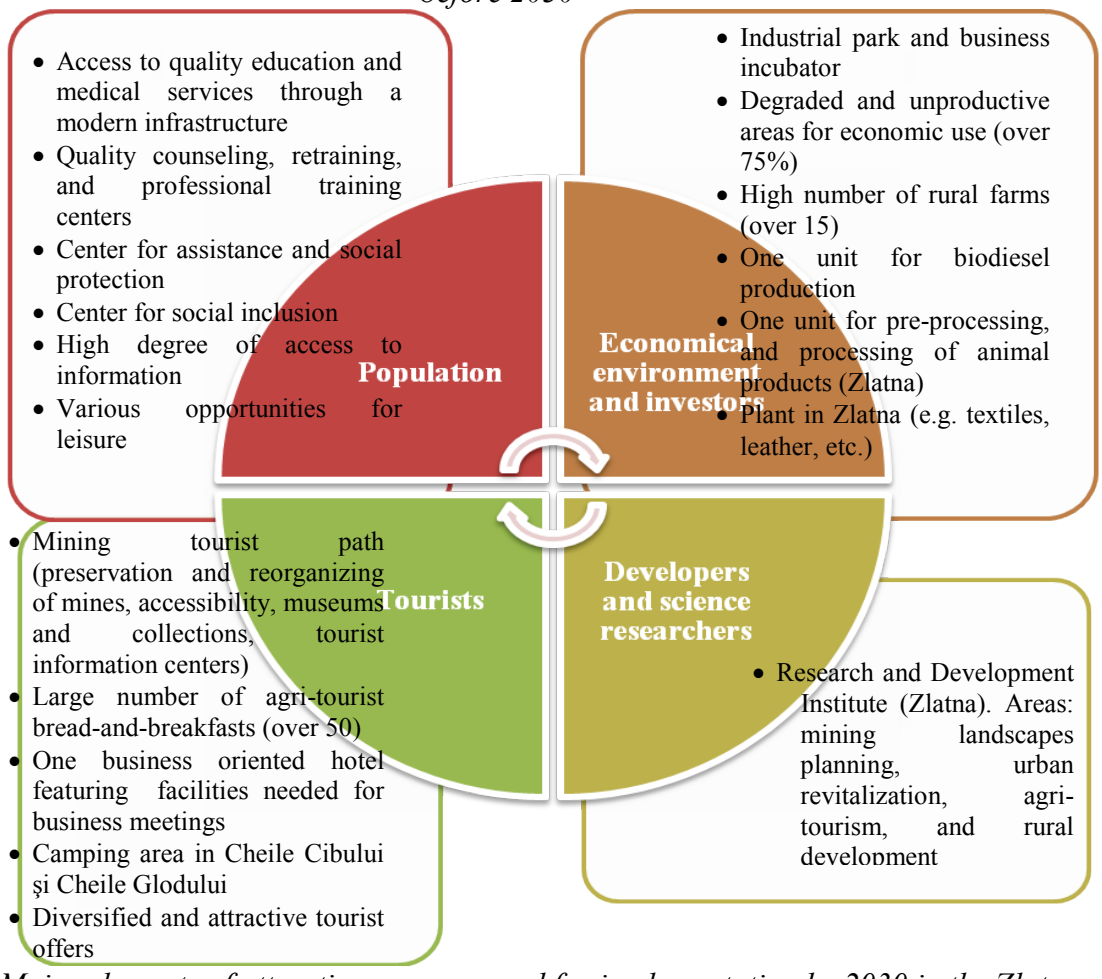

Fig. 12 Major elements of attractiveness proposed for implementation by 2030 in the Zlatna - Almaşu Mare - Stănija mining area

8. Succesful models regarding planning and development of former mining areas

The present paper has made references to two European mining areas, namely:

- *Outokumpu mining area (Finland, North Karelia region)* - a mining area that shares important elements in terms of planning and post-mining revitalization with the Zlatna – Almaşu Mare – Stănija area of study
- *Lower Lusatia (Germany, Brandenburg Land)* – the largest revitalized mining area in Europe

9. Conclusions and future directions of development

Some of the major conclusions regarding the studied mining areas of the Apuseni Mountains include:

- Increased depopulation and population aging
- Low leve of use or limited access to information on development opportunities
- Superficiality and negligence in the process of ecologization of the mining areas
- Abandoned mining sites, presenting an advanced level of decay as well as risks of soil and underground water pollution (mine mouth, former administrative units, etc.
- Most of the metal resources exploitation activities were conducted underground, which had a much lower impact on the environment as compared to the upper level activities (quarry).
- Very low valorification degree of the specific resources (natural potential, tourist potential, ethnographic heritage, traditional crafts and occupations)

One of the major challenges faced in writing the PhD thesis was the development of the vulnerability formula for the rural settlements. The author tried to identify the most appropriate indicators and the relationships between them. Future efforts will be directed toward developing a vulnerability formula for urban settlements with focus on the mining areas.

By proposing a typology of risks faced by mining settlements based on the dominant risk, the author intended to pinpoint the need for increased awareness of the existent probability for hazards in the studied mining area both during the period of mining activities and the period of mining sector restructuring.

Following the analysis and documentation for identifying the best solutions for sustainable development, regeneration and planning of settlements in the mining areas, it was concluded that there area at least three key aspects that determine the future success of transforming a degraded and vulnerable area (from several points of view) into an attractive and socially and economic developed area:

- Developing integrated long-term strategic projects which contribute with concrete results to solve and reduce major issues rather than implementing short-term plans of action. Skills in attracting funding sources to implement grant proposed actions
- Efficient management of resources and rational and sustainable planning for used of area resources
- Involving all relevant actors (decision-makers, business environment, research environment, not-for-profit organizations) and especially the population in the sustainable development process

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