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EVALUATING MOUNTAIN LANDSCAPES THROUGH THE PARADIGM OF SOCIETAL BIOHARMONISM: THE BIO-ELCA MODEL

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Abstract. *This study analyzes the adaptation and resilience of local communities in mountain areas facing overlapping contemporary crises. It proposes an objectivized evaluation framework—the BIO-ELCA Model—designed to support sustainable territorial planning by balancing socio-economic, agro-rural, natural, and cultural dimensions. The model builds on the paradigm of societal bioharmonism, offering a quantification methodology adaptable to the European level, with indicators derived from newly developed calculation formulas. Applied to the Romanian Carpathians, the model reveals differentiated yet comparable features among mountain massifs, providing an analytical basis for targeted strategies. The results highlight the potential of the Societal Bioharmonism Index (SBI) as a reference tool for guiding public policies in mountain counties. Furthermore, the study outlines a pragmatic Local Action Guide aimed at fostering bioharmonist development of mountain and pre-mountain landscapes over the coming decades. By integrating resilience, sustainability, and cultural-ecological balance, the BIO-ELCA approach offers both a scientific and policy-oriented contribution to the future of European mountain regions*.

Keywords: societal bioharmonism, quantification methodology, sustainable development, mountain regions, applied strategy

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1. Introduction

The territorial landscape is a complex concept that reflects the interaction between natural and anthropic (human) factors within a given geographic space. It is composed of several elements, each playing an important role in defining the identity and functionality of that territory. Methodologically, the focus is on the transition from natural bioharmony to societal bioharmonism, which represents a paradigm shift in understanding the relationship between humans, nature, and society. This transition reflects the way in which the biological harmony inherent in nature is reinterpreted

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and integrated into the complex structures of human society, with the aim of creating a sustainable balance between social, technological, and ecological development.

Among the biophysical (natural) elements, the following can generally be listed: relief (mountains, hills, plateaus, plains, erosion forms, landslides, etc.), hydrography (rivers, lakes, springs, wetlands, groundwater), climate (temperature, precipitation, winds – influencing vegetation and human activities), soils (types of soil and their fertility – a foundation for agriculture), natural vegetation (forests, grasslands, shrublands, endemic species), and wildlife (mammals, birds, insects, fish – indicators of biodiversity).

Literature review

The natural elements interact with the anthropic (human) elements, which are the result of social, economic, and cultural action and organization of human communities. A brief inventory from the specialized literature [16,18, 21, 26, 29] highlights the following technical and managerial aspects: human settlements (villages, towns, metropolises, isolated farms), infrastructure (roads, railways, bridges, dams, power grids, communication networks, etc.), agriculture (types of crops, agricultural plots, irrigation systems, greenhouses, farms, pastures) [9, 27], industrial and economic activities (factories, quarries, commercial centers) [31, 32], constructions and architecture (houses, churches, schools, administrative buildings – which may reflect local, historical, or modern styles), cultural and symbolic elements (monuments, cemeteries, statues, roadside crosses, gardens, theme parks).

The knowledge and understanding of these components are essential for: sustainable territorial planning; natural resource management; the protection of natural and cultural heritage; the development of sustainable tourism; ecological and civic education. In short, all these aspects can be analyzed through land-use patterns, which are fundamental in territorial planning analysis: functional zoning (residential, industrial, agricultural, forestry, tourism) [1, 4, 6, 7, 23, 28, 34]; communication and mobility networks (transport nodes and axes, internal and external connectivity, education, vocational training) [3,32]; ecosystem services (air purification, water retention, pollination, biodiversity) [24,25]; cultural and recreational functions (agro-touristic landscapes, thematic routes, UNESCO sites, etc.) [2, 20, 22, 30, 33, 35, 36].

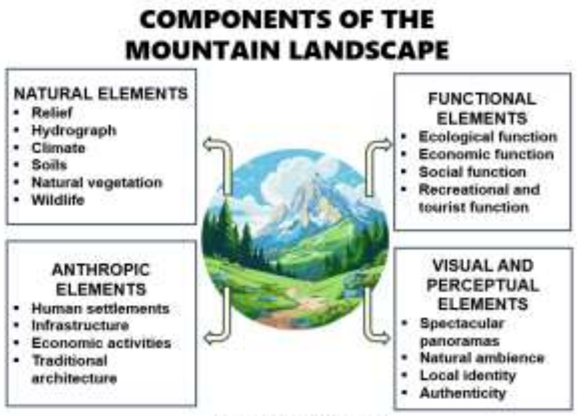
The quantification of the territorial landscape is an interdisciplinary endeavor that combines elements of geography, ecology, urban planning, economics, sociology, and information technology, with the aim of transforming subjective perceptions of the landscape into a coherent, measurable, and comparable evaluation system [5, 8, 39]. It should be emphasized that this is a crucial topic for the adaptation and resilience of local communities in the face of challenges and crises of the present. As a complementary theme, we can mention the approach to landscape from the perspective of ecosystemic and/or anthroposystemic modeling [10,11,12,15], as well as a series of official methodologies widely applied across Europe that allow for an objective and structured evaluation of the landscape, designed to underpin decisions regarding planning, conservation, sustainable development, and territorial education.

The most widespread among these is the **ELCA Methodology (*European Landscape Character Assessment*)**, which represents an extension and harmonization of the **LCA Method (*Landscape Character Assessment*)** at the continental level (in accordance with the **European Landscape Convention / ELC, Florence, 2000**). In essence, ELCA proposes a transnational, comparable, and integrated approach to European landscapes, aimed at supporting common policies for territorial planning, protection, conservation, and sustainable development.

Through the concept of **BIOHARMONISM** [13], we can learn from nature how to organize our societies, which may be the key to building a sustainable and resilient civilization. This is not about an ecological ideal, but rather a practical necessity in the context of multiple contemporary crises —climatic, social, economic— with highly diverse geographic and altitudinal implications.

As a tool for strategic territorial planning at local, regional, and national levels, the differences related to the altitude gradient are also of great interest. In this regard, considering the fragility of mountain areas, this study focuses on the quantification of this zone, taking into account the process of societal bioharmony and the improvement of living standards [37].

It should be emphasized that the **MOUNTAIN LANDSCAPE** is a complex system where natural and anthropic elements are articulated in a manner specific to altitude, climate, and the lifestyle of mountain communities. Considering the interconnected specific elements that make up a bioharmonized mountain ecosystem, it becomes useful to carry out an analysis of the mountain landscape, as essentially illustrated in the following scheme:



Sustainable development through the **BIOHARMONISM PARADIGM MODEL** represents an integrative and evolutionary process through which human society ***HARMONIZES*** its economic, social, cultural, and ecological needs within a system of co-evolution with Nature (more precisely with the "living" planetary system), based on principles of interdependence, emergent integrations, and collective consciousness. This model responsibly harnesses local resources, human capital, and biocultural heritage, generating processes of bioharmony and paving the way toward ***societal bioharmonism***, which is essentially a dynamic balance leading to an active state of coherence between humans, community, and ecosystem [9,14,17,19].

As an **innovative contribution**, our research aims to develop a model based on bioharmonism, called ***"Bioharmonist Evaluation of Landscapes through Combined Assessment"*** (acronym: **BIO-ELCA**). It should be noted that the **BIO-ELCA Model** is essentially a transdisciplinary method that integrates the classical European criteria (LCA/ELCA) with the principles of societal bioharmonism [13], grounded in the **Societal Bioharmonism Index (SBI)**. Methodologically, it is a key instrument that underpins the harmonious relationship between communities and territory, enabling the protection of landscapes as sources of life, identity, and balance.

The main objective of the study is to propose a calculation methodology for the objectivization of territorial landscape assessment in a sustainable, altitude-differentiated manner, highlighting fragile zones such as mountain areas, through the development of **"weighted composite index"** formulas that emergently integrate all relevant indicators into a single scalar value.

As secondary objectives, the study seeks to contribute in two directions: - **simulation through the application of the proposed formulas**, to holistically express the integration of bioharmonist development factors at systemic and societal levels; - ***establishing principles and guidelines for an integrated development model,*** serving as an **Action Guide** necessary for future public policies tailored to the altitudinal groups present within the Romanian territory, with particular focus on mountain and premountain areas.

2. Materials and Methods

The calculation of the weighted arithmetic mean, based on Multi-Criteria Analysis (MCA) [5,13], is used to quantify the territorial landscape balance of the proposed regions through objective indicators, relying on the scoring and weighting method. A series of thematic maps were also analyzed [38,40,41,42].

Methodologically, the performance matrices comprise three stages:
(1) **Scoring**: the anticipated consequences for each option are assigned a numerical score on a preference-level scale, for each option and for each criterion;
(2) **Weighting**: numerical weights are allocated to define, for each criterion, the relative estimations of the oscillations between the lower and upper limits of the chosen scale;
(3) **Quantification of indicators** through the weighted arithmetic mean (Mp), as follows [8,17]:

$$Mp = \frac{a_1 \cdot p_1 + a_2 \cdot p_2 + \ldots + a_n \cdot p_n}{p_1 + p_2 + \ldots + p_n},$$

where: $a_1, a_2, \ldots a_n$, represent the numerical values (scores), and $p_1, p_2, \ldots, p_n$ their corresponding weights. In other words, the weighted arithmetic mean is obtained by multiplying each value by its corresponding weight, summing the products, and dividing the result by the sum of the weights.

3. Results and Discussions

Analyzing the strategic directions of a sustainable development model framed within the process of bioharmony leads to the structuring of a set of indicators that must be quantified to ensure a comprehensive assessment of the mountain landscape. These indicators correspond to the "detailed indicators" embedded in the proposed formulas, while the key reference indicators are outlined in the scheme presented in Figure 1

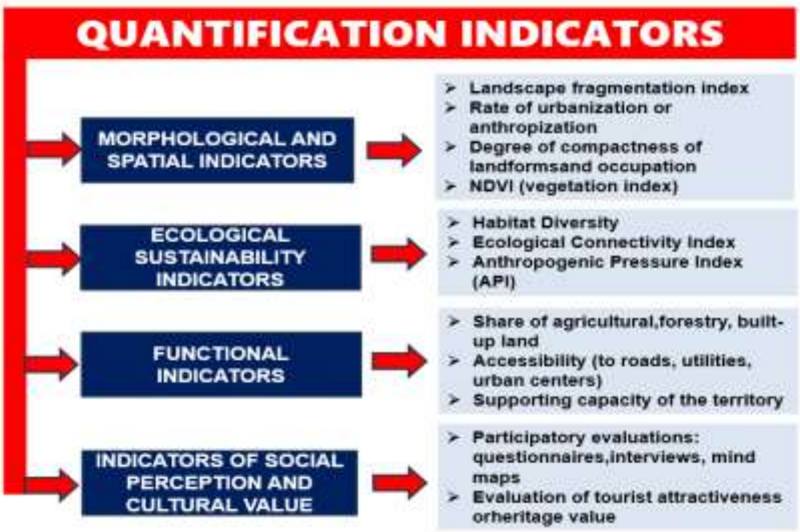


Fig. 1. Indicator groups for assessing the bioharmonization process in the sustainable development of mountain areas.

The synergy of these classical indicators is reflected within the Societal Bioharmonism Index (SBI), applied here to mountain landscapes. In fact, the SBI does not exclude classical indicators but reinterprets them through the lens of societal bioharmonism: it quantifies not only the physical and ecological condition of the landscape but also its capacity to support a sustainable and resilient dynamic balance between nature, community, and culture. The result is a holistic score that combines: - Physical and ecological structure (morpho-ecological); - Functionality and ecosystem services; - Cultural and social value.

Thus, the SBI becomes an ***integrated tool*** for evaluating mountain landscapes, with applicability in sustainable planning and rural mountain development strategies.

3.1. Defining the Index for the Objective Assessment of Societal Bioharmonism

The Societal Bioharmonism Index (SBI) essentially expresses the bioharmonization process as the sum of **Natural Capital**, estimated through the Territorial Landscape Potential Index (TLPI)—that is, the environment directly influencing the potential of **Human Capital**, which is numerically expressed by the Creativity and Economic Capacity Index (CECI), namely:

$$\mathbf{SBI} = \frac{w_1 \cdot \mathbf{CECI} + w_2 \cdot \mathbf{TLPI}}{2}$$

where: w_1 and w_2 represent the weights, which can be 50% vs. 50%, or, in a more sophisticated dynamic, may vary—for example, 40% CECI and 60% TLPI—depending on the creativity and economic capacity of the human population in the analyzed area (e.g., higher weight in urban and peri-urban zones) and the characteristics of the territorial landscape of the respective area (e.g., different levels if it concerns a protected area).

Note: Index values range from 0 to 1 (or 0–100%). The presented simulations are illustrative, using hypothetical data; real data are required for practical applications.

• Calculation Formula for the Creativity and Economic Capacity Index (CECI) / (Human Capital)

It expresses the capacity of the human society within a territory to generate sustainable development, innovation, and a sustainable local economy—that is, the "work of Man". The general formula is:

$$\mathbf{CECI} = \frac{w_1 \cdot I + w_2 C + w_3 \cdot T + w_4 \cdot S + w_5 L}{w_1 + w_2 + w_3 + w_4 + w_5}$$

where:

I = Innovation and Education (education level, access to knowledge, digital infrastructure)

C = Economic Capacity (local GDP, number of SMEs, local productive resources)

T = Efficiently Used Territory / Land (orchards, agroecology, regenerative farms, etc.)

S = Social Solidarity and Social Capital (local networks, community cohesion, social initiatives)

L = Local Leadership (efficient administration, community vision, democratic participation)

w = weight assigned to each component (the sum of weights is normalized to 1 or 100%)

Note: The index values range from 0 to 1 (or 0–100%). Weights can be adjusted depending on local conditions to reflect the relative importance of each component in generating sustainable development.

• Calculation Formula for the Territorial Landscape Potential Index (TLPI) / (Natural Capital)

It is calculated through multiple integration based on multi-criteria analysis, highlighting the "work of the Environment":

$$\mathbf{TLPI} = \frac{w_1 \cdot IB + w_2 \cdot IE + w_3 \cdot IH + w_4 \cdot IQ + w_5 \cdot IR}{w_1 + w_2 + w_3 + w_4 + w_5}$$

where:

IB = Biodiversity Index (species, habitats, cultivated diversity, etc.)

IE = Ecological Balance Index (soil, water, and air status; ecosystem connectivity; anthropogenic pressure)

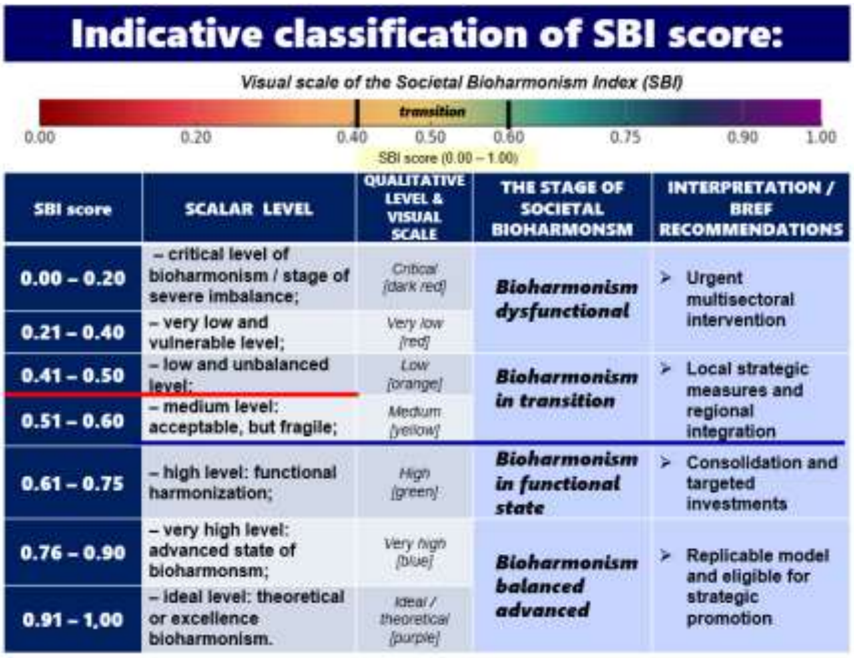
IH = Landscape Heterogeneity Index (agricultural, forest, and natural mosaic; land use; accessibility; territorial support)

IQ = Natural Resource Quality Index (water, air, soil)

IR = Ecosystem Natural Regeneration Rate Index (including the degree of bioharmonious compatibility / human–nature–technology synthesis)

w = weight assigned to each index (the sum of weights is normalized to 1, or 100%)

After establishing the formulas, the Societal Bioharmonism Index was calculated, and a series of preliminary simulations were conducted using normalized weights, without integrative adjustments for economic, infrastructure, or human/local capital factors. These simulations were necessary to define the scoring system and scale levels (Fig. 2).



SBI score	SCALAR LEVEL	QUALITATIVE LEVEL & VISUAL SCALE	THE STAGE OF SOCIETAL BIOHARMONSM	INTERPRETATION / BREF RECOMMENDATIONS
0.00 – 0.20	– critical level of bioharmonism / stage of severe imbalance;	Critical (dark red)	*Bioharmonism dysfunctional*	➢ Urgent multisectoral intervention
0.21 – 0.40	– very low and vulnerable level;	Very low (red)		
0.41 – 0.50	– low and unbalanced level;	Low (orange)	*Bioharmonism in transition*	➢ Local strategic measures and regional integration
0.51 – 0.60	– medium level: acceptable, but fragile;	Medium (yellow)		
0.61 – 0.75	– high level: functional harmonization;	High (green)	*Bioharmonism in functional state*	➢ Consolidation and targeted investments
0.76 – 0.90	– very high level: advanced state of bioharmonsm;	Very high (blue)	*Bioharmonism balanced advanced*	➢ Replicable model and eligible for strategic promotion
0.91 – 1,00	– ideal level: theoretical or excellence bioharmonism.	Ideal / theoretical (purple)		

Fig. 2. Bioharmonism scale levels in the studied territory

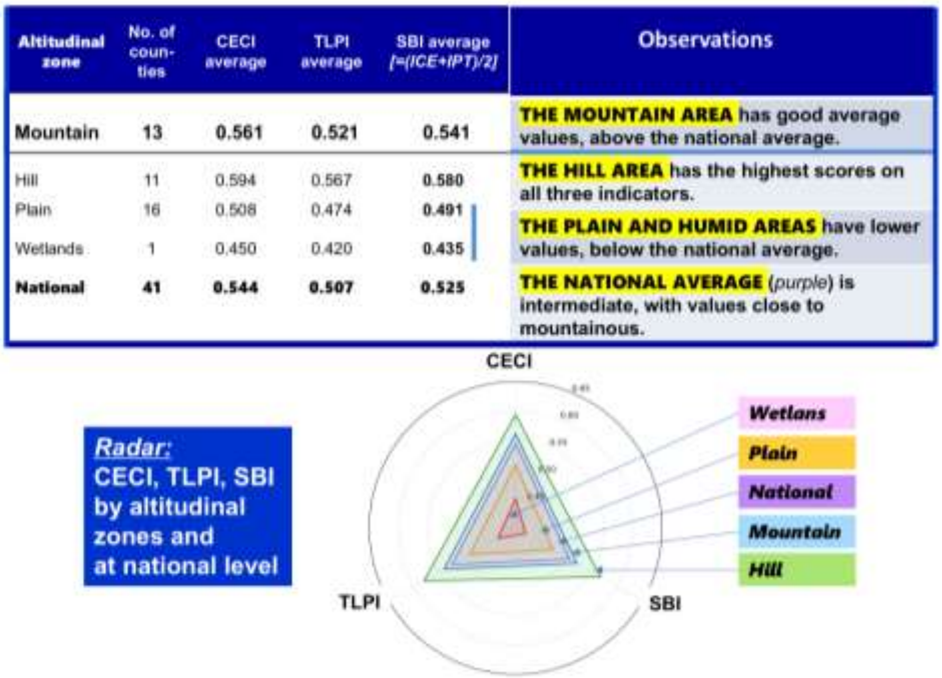
3.2. Practical Applications for Assessing Societal Bioharmonism in Mountain Regions

Taking into account the predominance of specific altitudinal gradients and the socio-economic characteristics associated with different relief types, an analysis was conducted across the counties of Romania. The results, organized by county groups, are summarized in Table 1.

Table 1. Classification of Romanian counties by altitudinal groups

No.	ALTIDUDE ZONE	COUNTIES INCLUDED	MAIN CRITERON FOR INCLUSION
1	**Mountainous area**	**Alba, Argeș, Bistrița-Năsăud, Brașov, Caraș-Severin, Covasna, Dâmbovița, Gorj, Hraghita, Hunedoara, Maramureș, Neamț, Suceava.**	**>50% of the territory mountainous relief / average altitude >600 m**
2	**Hill area**	**Bacău, Buzău, Cluj, Mehedinți, Mureș, Prahova, Sălaj, Sibiu, Vaslui, Vâlcea, Vrancea.**	**Dominant hilly relief / altitude 300-600 m**
3	**Lowland area**	**Arad, Bihor, Botoșani, Brăila, Călărași, Constanța, Dolj, Galați, Giurgiu, Ialomița, Iași, Ilfov, Olt, Satu Mare, Teleorman, Timiș.**	**Predominance of plains, high density / altitude <300 m**
4	**Wetlands**	**Tulcea (incl.Dealta Dunării, bălți, lacuri, grinduri)**	**Deltaic, lacustrine, lowland meadow ecosystems / share below 50 m altitude**

An initial simulation was conducted, generating a set of data that are presented in Fig. 3. These results provide a preliminary overview of the patterns observed in the analyzed territory.



Altitudinal zone	No. of coun-ties	CECI average	TLPI average	SBI average [=(ICE+IPT)/2]	Observations
Mountain	13	0.561	0.521	0.541	THE MOUNTAIN AREA has good average values, above the national average.
Hill	11	0.594	0.567	0.580	THE HILL AREA has the highest scores on all three indicators.
Plain	16	0.508	0.474	0.491	THE PLAIN AND HUMID AREAS have lower values, below the national average.
Wetlands	1	0.450	0.420	0.435	
National	41	0.544	0.507	0.525	THE NATIONAL AVERAGE (*purple*) is intermediate, with values close to mountainous.

Fig. 3. Average SBI indicators with a graphical view of mid-altitude area balance

Mountain areas are of particular interest due to their inherent fragility as well as their development potential, especially under the pressures of climate change and global warming. This highlights the importance of calculating the Societal Biodiversity Index within these territories. The simulation, detailing the counties within the mountain area group, reveals notable differences between individual counties (Table 2).

Table 2. Estimation of the societal bioharmony index in the Romanian mountain area, with complementary scores regarding the ratio between natural and human capital

County	CECI	TLPI	SBI
Brașov	0.66	0.62	0.640
Argeș *	0.62	0.58	0.600
Hunedoara	0.60	0.56	0.580
Alba	0.58	0.54	0.560
Suceava	0.58	0.53	0.555
Neamț	0.56	0.53	0.545
Bistrița-Năsăud	0.55	0.52	0.535
Harghita	0.54	0.52	0.530

Covasna	0.53	0.50	0.515
Dâmbovița *	0.52	0.50	0.510
Maramureș	0.52	0.49	0.505
Caraș-Severin	0.50	0.48	0.490
Gorj *	0.48	0.45	0.465
-Mountain zonal average (13 counties)	**0.561**	**0.521**	**0.541**
❖ **National average (41 counties)**	**0.544**	**0.507**	**0.525**
* Counties with predominantly mountainous relief, or significantly in the southern or central part			

It is noteworthy that the average mountain SBI for Romania reflects a moderate to fragile level of societal bioharmonism. This finding highlights the presence of local territorial imbalances within the mountain landscape and emphasizes the need for a differentiated mountain development strategy, particularly focused on rural areas and tailored to microregional contexts. In this regard, the formulation of an *Action Guide* is warranted, incorporating general principles applicable to mountain regions broadly, alongside specific recommendations adapted to individual mountain massifs.

3.3. Practical Approaches to Sustainable Development within the Bioharmonist Framework

The objective quantification of Romanian mountain area development through the ***BIO-ELCA Model*** proposed in this study offers multiple practical applications. The results, for instance, provide a reference point for the formulation of public policies and the design of implementation strategies through various Action Guides. A prominent example is the deployment of an Action Guide for Romania's mountain and submontane landscapes. Over the next decades, these territorial landscapes could effectively become a valuable "strategic reserve" for the balanced harnessing and adaptation of both natural and human potential, contributing to the construction of a resilient, sustainable, and bioharmonist society.

In summary, the following benchmarks are proposed as anticipated impacts by 2035: - An increase of 20–30% in the IBS of mountain areas; - Revitalization of over 300 mountain communes through bioharmonist initiatives; - Preservation of over 70% of local biodiversity in community-managed areas; - Enhanced engagement of youth and local enterprises in the sustainable mountain economy.

These objectives are concisely illustrated in Figure 4.

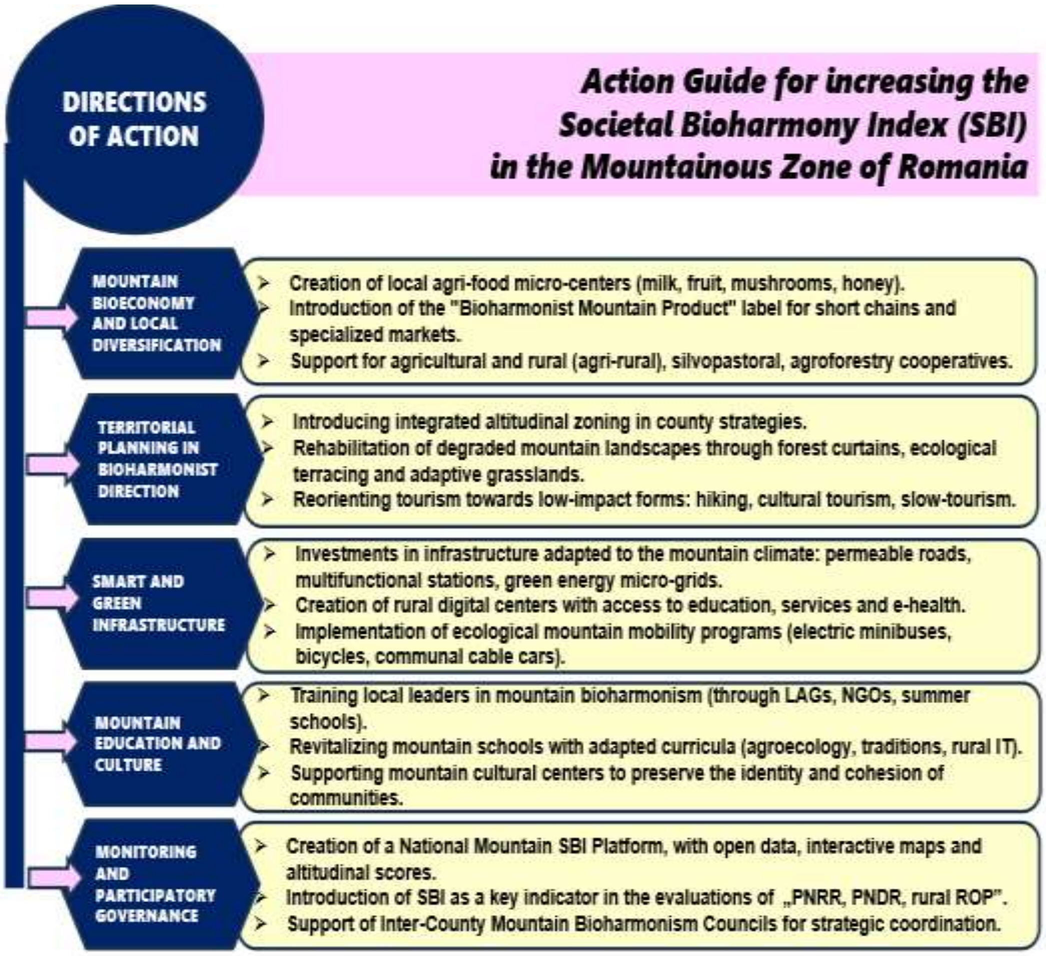


Fig. 4. Framework of the Action Guide for Objective Sustainable Development of a Mountain Regions

Without delving into details, it is important to note that the Action Guide also encompasses the concept of the "mountain product," a key element for the socio-economic development of high-altitude areas. Consequently, the evolution of the standard mountain product can be envisioned in the direction of a „bioharmonist" mountain product.

The BIOHARMONIST mountain product can be defined as one with demonstrable eco-biotechnical added value, produced without thermal or environmental stress, in bioresonance with the living ecosystem, aligned with natural rhythms and the local community microzone, and fully integrated with the agri-cultural calendar, as well as local rituals and spiritual traditions.

Conclusions

(1). When applied to mountain regions, societal bioharmonism transcends a mere strategy — it constitutes a paradigm for the regeneration of high-altitude life, centering on human life, community, nature, and ecological balance. This approach not only preserves but actively regenerates, adapts, and empowers mountain areas, positioning them as exemplary models for the future in a world confronted with ecological and identity crises. The *BIO-ELCA Model* offers an innovative framework for landscape evaluation, emphasizing not only visual or functional attributes, but also the „bio-psycho-socio-cultural" coherence of human habitats — ensuring the harmonious integration of communities within their landscapes.

(2). Mountain areas at mid-altitudes (800–1,600 m) demonstrate a relatively high SBI (~0.541), reflecting a robust harmony among ecological, economic, and socio-cultural components, and indicating significant potential to balance the conservation of natural capital with the sustainable utilization of resources. In contrast, high-altitude regions (>1,600 m) exhibit a slightly lower SBI, highlighting limitations in accessibility, infrastructure, and service provision, despite their elevated ecological value.

(3). County-level disparities in mountain SBI highlight pronounced differences in territorial development. Counties such as Brașov and Argeș exemplify high levels of balance, whereas Caraș-Severin and Gorj face challenges that necessitate targeted adaptive interventions.

(4). The Action Guide for Romania's mountain regions (800–1,600 m) indicates high SBI values, especially in proximity to foothill zones, reflecting a strong potential for ecological, economic, and social balance. Nonetheless, climate change, migration, underdeveloped infrastructure, and territorial fragmentation pose significant risks to these equilibria. Consequently, a strategically integrated, altitude-differentiated intervention is essential to harness the full potential of bioharmonism and mitigate structural vulnerabilities.

(5). In the long term, Romania's mountain regions have the potential to serve as a European benchmark for bioharmonism, provided the complementarity between tradition, technology, natural heritage, and the local economy is fully harnessed. This approach establishes an operational framework for coherent, quantifiable interventions (e.g., via SBI) that are carefully adapted to vulnerable altitudinal contexts. By embracing the societal bioharmonism model in mountain areas, Romania can transform these territories into living laboratories of human–nature co-evolution, innovatively rebalancing the interplay between rural, urban, and natural environments in a participatory and regenerative manner.

REFERENCES

[1] Amat, J.-P., La ressource iconique et l'étude des paysages des forêts meurtries par la guerre de 1914-18 dans l'Etat de la France. Colloque Image et Histoire Paris, mai 1986. Paris, Published, 1987, pp. 97-108, 12 fig. (1986).

[2] Brus, J., Deutscher, J., Bajer, A., Kupec, P., Olišarová, L. Monetary assessment of restored habitats as a support tool for sustainable landscape management in lowland cultural landscapes. Sustainability 2020, 12, 1341. (2020).

[3] Chiş, O., Coste, M. Developing socio-emotional skills of children. Applications in formative contexts. 5th Conference on Education, Reflection (ERD). European Proceedings of Social and Behavioural Sciences, XLI, 642-648. (2017).

[4] Dulamă, M.E., Ilovan, O.-R., Magdaş, I. The forests of Romania in scientific literature and in geography. Teachers' perceptions and actions. Environmental Engineering and Management Journal, 16(1), pp. 169-186, (2017).

[5] Dulamă, M.E., Magdaş, I. Analysis the competences and contents of "Mathematics and Environmental Exploration" subject syllabus for preparatory grade, Acta Didactica Napocensia, 7(2), pp. 11-24. (2014).

[6] Giurgiu, V. Considerații asupra stării pădurilor României. I. Declinul suprafeței pădurilor și marginalizarea împăduririlor. Revista pădurilor, 83, 2, pp. 3-16. (2010).

[7] Giurgiu V., Pentru o nouă legislație silvică, Revista pădurilor, 127, 36-42. (2012).

[8] Gaceu, L., Gruia, R., Gaceu, A.-M., Sisteme informatice în management, Ed. Infomarket Braşov, 208 p., 77-126. (2006)

[9] Gruia, R. Managementul eco-fermelor, Ed. Ceres Bucuresti, 187p., 126-159. (1998).

[10] Gruia, R., Modular agriculture – paradigm of globalization dynamics within the context of climatic and scientific changes, Environmental Engineering and Management Journal, "Gheorghe Asachi" Technical University Iasi, Vol.9, no.12, 1601-1606. (2010).

[11] Gruia, R., Study on energy resources integration and sustainability of the new modular agriculture pattern, Environmental Engineering and Management Journal, Gheorghe Asachi Technical University Iasi, Vol.10., no.8, pag.1213-1219. (2011).

[12] Gruia, R. Mountain modulization process, as bioeconomic revitalization element in the Romanian Carpathians, Journal of EcoAgriTourism, Publishing Transilvania University of Brasov, Romania, Vol.11, No.1, pag.9-20. (2015).

[13] Gruia, R. Bioarmonismul, de la teorie la o ideologie de viitor, Ed. Clarion, Brașov, p.27-84, 165-232. (2019).

[14] Gruia, R. Ideologia bioarmonistă - izvor de regenerare politică într-o lume în schimbare, Ed. Clarion Brașov, p.5-49. (2019).

[15] Gruia, R., Păstârnac, N. Ferma de animale tratată ca ecosistem zooproductiv, Ed. Ceres Bucuresti, 215 p., (1991).

[16] Gruia, R. (sub red.), Brătucu, Gh., Geamîn, V., Cofaru, C., Aspecte actuale ale ingineriei mediului în agricultură, Ed. Universităţii Transilvania Braşov, 242 p., 45-92.(2002).

[17] Gruia, R., Popescu, A., Gaceu, L. The bioharmonized reconnection of the agricultural system in Romania's territory in the process of administrative reorganization, Scientific Papers Series

Management, Economic Engineering in Agriculture and Rural Development, Vol. 24(3), 381-394. (2024).

[18] Gruia,R., Gaceu, L. Principles of policy and strategy development for the realisation framework model of the integrated mountain development, Journal of EcoAgriTourism, Vol. 19, No. 2, pp.26-35. (2023).

[19] Gruia, R., Gaceu, L. The development of reform policies based on bioharmonization of sustainable anthroposystems with the specific ecosystems of Romanian mountain areas, ESPERA 2024 / Session no. 13: Mountain areas sustainable development, Oct. 17-18, (2024).

[20] Ionaşcu, G. Dezvoltarea durabilă a habitatului montan. Analele Universităţii ”Valahia” Târgovişte, Seria Geografie, 3, pp. 237-243. M.E.N. (2013). Programa școlară pentru disciplina Matematica și explorarea mediului. Clasa pregătitoare, clasa I și clasa a II-a. Aprobată prin ordin al ministrului Nr. 3418/19.03.2013. Bucureşti.

[21] Kubalikova, L., Kirchner, K., Kuda, F., Machar, I. The role of anthropogenic landforms in sustainable landscape management. Sustainability 2019, 11, 4331. (2019).

[22] Mac, I. Peisajul geografic, conţinut şi semnificaţie ştiinţifică, București: Nicolae Bălcescu, Cercetări in dinamica Geografiei (sub.red. Dulamă, Maria şi Ilovan, Ioana), Acta didactica Presa Universitară Clujeană, Vol.8, 47-52 (1990).

[23] Machar, I., Vozenilek, V., Simon, J., Pechanec, V., Brus, J., Fulnecek, P., Vitek, T. Joining of the historical research and future prediction as a support tool for the assessment of management strategy for European beech-dominated forests in protected areas. Nat. Conserv. Bulg. 2017, 22, 51–78. (2017).

[24] Machar, I., Vozenilek, V., Kirchner, K., Vlckova, V., Bucek, A. Biogeographic model of climate conditions for vegetation zones in Czechia. Geografie 2017, 122, 64–82. (2017).

[25] Măciucă, A., Lupăștean, D. Considerații relative la procesul de stabilire a indicatorilor pentru evaluarea biodiversității forestiere. Analele Universității „Ştefan cel Mare” Suceava, Secțiunea Silvicultură, 2, pp.141-146. (2004).

[26] Métailié, J.-P. The « degradation of the Pyrénées » in the 19th-century : an erosion crisis ? International Conference on Geomorphology Manchester, 1985. Londres, J. Wiley, 1986, part II, pp. 533-544. (1985).

[27] Métailié, J.-P. Les sources photographiques et l'histoire du paysage montagnard : l'exemple des pâturages pyrénéens. Colloque Image et Histoire, Paris, 1986. Paris, pp. 109-115. (1987).

[28] Mihăşan, C.D. Managementul durabil al fondului forestier în România. Rezumatul tezei de doctorat. Cluj-Napoca: Universitatea de Științe Agricole și Medicină Veterinară. http://www.usamvcluj.ro/files/teze/mihasan.pdf. (2009).

[29] Oprsal, Z., Harmacek, J., Pavlik, P., Machar, I. What factors can influence the expansion of protected areas around the world in the context of international environmental and development goals? Probl. Ekorozw. 13, 145–157. (2018).

[30] Popescu, A.C. Formarea competenţelor de percepţie şi interpretare a unui peisaj geografic, Romanian Journal of Education, vol.1, no. 3-4, Cluj-Napoca, pp. 9-20. (2010).

[31] Precupețu, I.. Indicatori și indici ai calității vieții http://www.ince.ro/Evenimente/8_aprilie_2019_I_Preucupetu_ICCV_Indicatori_si_indici_ai_calitatii_vietii.pdf. (2019)

[32] Roman, M. Analiza multi-criterială. Manual, Proiect „Dezvoltarea capacităţii pentru Analiza Cost-Beneficiu”, cu co-finanţare din FEDR prin POAT. Academia de Studii Economice,

Facultatea de Cibernetică, Statistică şi Informatică Economică, Catedra Statistică şi Econometrie, pp.8-13. (2012).

[33] Simon, J., Machar, I., Bucek, A. Linking the historical research with the growth simulation model of hardwood f loodplain forests. Pol. J. Ecol. 62, 273–288. (2014).

[34] Simon, J., Machar, I., Brus, J., Pechanec, V. Combining a growth-simulation model with acoustic-wood tomography as a decision-support tool for adaptive management and conservation of forest ecosystems. Ecol. Inform. 30, 309–312. (2015).

[35] Tarot, I. Stabilité pastorale et dynamique forestière dans le Larboust, Mémoire de maîtrise, géographie, Université de Toulouse-Le Mirail. (1986).

[36] Teodosiu, M. Naturalitatea pădurii: concepte, caracteristici și implicații asupra conservării. Bucovina Forestieră, 14(1), pp. 68-76. Ungur, A. (2008). Pădurile Romaniei. Trecut, prezent (2014).

[37] Institutul National de Statistica, INS. Speranța de viață sănătoasă, https://insse.ro/cms/files/publicatii/speranta_de_viata_sanatoasa_2016.pdf, (2016).

[38] xxx Report on the state of Regionalisation / The Report (2017 edition), Assembly of European Regions (AER), https://aer.eu/aer-observatory-regionalisation/report-regionalisation/(2017).

[39] xxx Formule algebră, Metaonline/net, https://www.mateonline.net/matematica/ (2020).

[40] xxx Hărți ale României (fizică, administartivă sursa: https://www.google.com/ (2020).

[41] xxx Harta pădurilor din România, riscograma.ro - Business Intelligence. https://www.google.com/ (2020).

[42] xxx Romania categoriile terenurilor (Land Cover), https://www.google.com/ (2020).