

# THE ROMANIAN CARPATHIANS: SOILS, BIODIVERSITY AND SUSTAINABLE DEVELOPMENT IN THE CONTEXT OF GRASSLAND PROTECTION AND VALORISATION OF AGRO-FOOD “MOUNTAIN PRODUCTS”. CASE STUDY: DORNELOR BASIN

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## **Abstract**

Romania's Carpathians, covering over 7 million hectares, include diverse ecosystems ranging from forests to grasslands and meadows. The dominant soils are Cambisols (44.7%) and Spodosols (43.98%), characterized by low fertility but important for forest vegetation and mountain pastures. The biodiversity of soil microflora is a crucial factor, with algae, fungi and bacteria contributing to the decomposition of organic matter and soil regeneration. Mountain grasslands support a diverse flora, including many medicinal plant species, such as in the Apuseni Mountains. Although soils are vulnerable to erosion and scouring, nutrient accumulation processes in micro-depressions contribute to local soil fertility. The Dorna basin is an example of geological diversity, rich in mineral resources such as manganese and hydro-mineral waters, which support local industry and spa tourism. Dorna Emmenthal cheese, traditionally made from milk from natural pastures rich in minerals (Ca, Mg, Zn), is also a symbol of the valorisation of mountain resources. However, production was abandoned after 2020 due to economic problems. Radu Rey proposes an associative-cooperative model for the organization of mountain areas, based on interconnected local cooperatives to manage the production, the certification of “mountain products” and their marketing on foreign markets. Similar models in Switzerland, Italy and France have shown that this strategy could significantly increase the income of local farmers. For the sustainable future of the Romanian Carpathian Mountains, it is essential to support small farmers, protect biodiversity and maintain traditional farming practices, thus preventing the worrying ecological degradation and depopulation of mountain areas.

## **1. GENERAL CONSIDERATIONS**

The soils of Romania's Carpathian Mountains cover about 7,325,600 ha, of which about 4,005,000 ha are forests and forest vegetation, and about 2,894,000 ha are agricultural land - of which about 2.3 million ha are pastures and meadows. This distribution of soil resources reflects the interaction between topography, climate and traditional human activities.

Carpathian mountain soils are classified into two broad classes: Cambisols (44.70%) and Spodosols (43.98%). Cambisols are generally associated with mountainous regions throughout Central Europe, have low fertility and are commonly used for forest vegetation and mountain pastures (FAO 2015). Spodosols, characterized by the presence of an accumulation horizon of iron and aluminium compounds, are typical of coniferous montane areas, often affected by acidification and nutrient mobility (Johnson et al. 2014).

Vegetation is the result of the interference between soils and the mountain climate with harsh winters and sometimes very rainy summers leading to degradation by washing

and reaccumulation of nutrients in micro-depressions (low areas), which is found only in the first few centimetres (2-5), which manage to accumulate more significant amounts of humic acids. On whatever rocks they are formed, mountain soils are characterized by shallowness and low fertility. The ancestral, inherited way of maintaining mountain meadows preserves a high biodiversity because they have not been subjected to chemical usage and microbial biodiversity loss. The health of the soils in Romania's mountain areas is thus also due to the maintenance of a high biodiversity of soil microflora (made up of algae, fungi and bacteria), which, through symbiosis with the plants making up the vegetation cover, provide a wide variety of species. These species can be highly sensitive to changes in soil chemistry. Observing their dynamics over time can be expressed as an indicator of habitat health. The variety and abundance of medicinal plants occurring in the herbaceous mountain flora is mainly due to the microbial biodiversity and the high degree of naturalness of the relatively well-preserved meadows.

- The Southern and Occidental Carpathians, the Banat Mountains present the full range of bioclimatic and soil stages, with the most extensive alpine pastoral domain.
- The Oriental Carpathians - present sectors: crystalline, sedimentary, eruptive - with andosols.
- The Apuseni Mountains: complicated petrographic constitution with other modest soils: alternating eruptive, metamorphic and sedimentary rocks.

## **2. CLIMATIC FACTORS AND THEIR IMPACT ON SOIL FERTILITY**

The mountain climate of the Carpathian Mountains is characterized by harsh winters with significant precipitation in the form of snow and rainy summers. These conditions favour soil erosion and nutrient-washing processes, which contribute to low soil fertility. Research shows that, in the mountainous areas of the Carpathians, nutrients such as nitrogen and phosphorus tend to accumulate in micro-depressions, leading to significant local variations in soil fertility. For example, studies in the Bucegi Mountains have shown that pasture areas located at medium altitudes have increased accumulations of organic matter and humic acids, which are essential for maintaining plant productivity (Florea 2012), (Marușca 2022), (Rey 2023).

## **3. MICROFLORA BIODIVERSITY AND SOIL HEALTH**

A key factor in the health of mountain soils in Romania is the biodiversity of the microflora. Soils that have not been exposed to the massive chemization processes characteristic of intensive agriculture have a variety of beneficial organisms such as algae, fungi and bacteria. These contribute to the biological cycles of decomposition and mineralization, thus fostering a symbiotic relationship with the plants in the vegetation cover. For example, in the Apuseni Mountains, herbaceous vegetation is associated with a high diversity of nitrogen-fixing bacterial species, which ensures natural soil regeneration (Marușca 2022).

The diversified vegetation of mountain pastures, including numerous medicinal plant species such as dandelion (*terexacum* of.), St. John's wort (*Hypericum perforatum*) or thyme (*Thymus serpyllum*), etc., is due to the maintenance of a high degree of naturalness of the ecosystems. Research carried out in the Southern Carpathian area has shown that over 45% of the herbaceous plants identified are used in traditional medicine, reflecting significant biodiversity (National Strategy and Action Plan for Biodiversity Conservation, 2014).

#### 4. DIVERSITY OF BIOCLIMATIC AND PEDOLOGICAL STAGES

The Southern and Western Carpathians, together with the Banat Mountains, show a great diversity of bioclimatic stages and soil types, including Cambisols and Andosols, the latter being commonly found in the volcanic areas of the Eastern Carpathians. The alpine pastoral domain in these regions is one of the most extensive in Eastern Europe, supporting an ancient pastoral tradition that contributes to the maintenance of natural landscapes and habitats for numerous plant and animal species (Marușca 2017).

In the Oriental Carpathians, the volcanic soils of the eruptive sectors are dominated by Andosols, soils formed on volcanic ash and pyroclastic materials, which, although having a moderate to low natural fertility, are suitable for high altitude vegetation. The Apuseni Mountains, known for their petrographic complexity, also include Cambisols and skeletal soils formed on alternating eruptive, metamorphic and sedimentary rocks. These soils are modest in terms of fertility but are essential for the maintenance of endemic species and sensitive mountain habitats (Rusu 2006) (Fig. 1).

Recent studies emphasize that maintaining microbial diversity and natural grasslands is essential for the conservation of biodiversity in the Carpathian Mountains. The complex interaction between soils, climate and vegetation reflects a fragile balance threatened by climate change and anthropogenic pressures. Sustainable management of mountain soils thus involves measures to support traditional grazing practices and prevent degradation of mountain ecosystems.

#### 5. CASE STUDY: “THE DORNA BASIN”, SUCEAVA COUNTY, ORIENTAL CARPATHIANS/ROMANIA (SIZE: 220.456 HA., 12 ATUS, ~50.000 INHABITANTS)

##### 5.1. Geological and soil evolution

The geologic and soil evolution of the “Dorna Basin” is closely related to the historical development of the mountain system of the Oriental Carpathians, formed by the collision of tectonic plates and the obduction process that led to the superposition of complex tectonic units. These events took place during the Mesozoic and Cenozoic periods, determining a varied petrographic configuration, characteristic of the crystalline-Mesozoic zones (Săndulescu 1984).

##### 5.2. Geological substratum and petrographic variety

The geological substratum of the “Dorna Basin” reflects the richness and diversity of the rocks and minerals present. This area is known for the presence of important deposits of hydrominerals (mineral and thermal waters), manganiferous deposits, sulphur, peat and other mineral resources. The Central-East-Carpathian plains, part of the middle dacities, consist of metamorphic rocks (crystalline schists), sedimentary rocks (limestones, sandstones, clays) and volcanic rocks (andesites and basalts), which gives them significant economic potential.

Geo-structurally, the perimeter under study corresponds to **the crystalline-Mesozoic zone of the Oriental Carpathians**, consisting of the so-called **Central-East-Carpathian layers of the middle dacite space**. Manganese deposits can be found all over the territory of the “Dorna Country”. From a geochemical point of view, manganese is found in combinations with Fe and Cu. **The Dorna area also presents a strong correlation of mineralization, among which we mention: Cu-Pb, Cu-Mc, Bi-As, Zr-Ti,**

**Zi-Rb, Cu-Zr, Ti-Cu, Cu-Rb, Zi-Bi, Zn-As, Pb-Zr, Pb-Rb, Sr-Ti, Mo-Rb, Ag-Ca, Ti-Rb.** The exploitation of manganese, pyrite and chalcopyrite deposits in the Dorna area has been an important supplier to the metallurgical, **armament and oil industries**.

Studies in the literature indicate that this petrographic variety has influenced both soil diversity and mineralization phenomena. In many places, Cambisols and Spodosols dominated by intense nutrient flushing processes are found on volcanic or sedimentary substrata, being of ecological importance for grasslands and mountain forests. At the same time, hydromorphic soils on peat bogs are used for peat extraction, with applications in both agriculture and industry. (Săndulescu 1984).

### **5.3. Geochemical correlations and mineralization**

Manganese deposits, together with pyrite and chalcopyrite, are ubiquitous in the Dorna area, and the associated geochemical combinations include economically important minerals such as Cu, Pb, Mo, Ti and Ag. Manganese, frequently found in combination with iron (Fe) and copper (Cu), has been exploited since the inter-war period and is of major importance in the iron and steel and chemical industries. Geochemical analyses indicate a well-correlated spatial distribution of combinations such as Cu-Pb and Cu-Mo, which points to the existence of polymetallic mineral deposits.

Studies in the Călimani Mountains, an integral part of the basin, have shown that the mineralization zones are associated with ancient volcanic activity and that heavy metal deposits, such as zinc and copper, are the result of hydrothermal processes. Specifically, combinations such as Cu-Zr or Pb-Zr are often found in metamorphic rocks of the Carpathian layers, forming metalliferous veins that have been exploited for copper and lead.

For example, between 1950 and 1990, the intensive exploitation of manganese deposits in the Dorna Basin provided raw materials for the metallurgical industry, the production of special alloys and military equipment. At the same time, pyrites in the area were used as a source of sulphur for the chemical industry, and chalcopyrite was used to extract copper, essential in the production of electrical cables and industrial equipment (ROSCI0010 Bistrița Aurie Site Management Plan 2016).

### **5.4. Environmental issues and sustainable resource management**

However, intensive resource exploitation has in the past led to problems of ecological degradation, including heavy metal contamination of soils in mining areas. According to studies, soils near former manganese mines show high levels of Cu, Pb and Zn contamination, exceeding the limits allowed by environmental protection legislation. Thus, ecological reconstruction projects are essential to prevent long-term effects on ecosystems and population health.

Current resource management strategies include ecological restoration projects on former mining sites and the development of alternative economic activities such as ecotourism and sustainable agriculture. Recent studies suggest that the use of phytoremediation techniques, involving the use of plants to extract heavy metals from the soil, could contribute to the recovery of affected areas (Coman 2010).



**Figure 1. Fertile topsoil layer - v. thin**

*Source: Radu Rey (2022)*



**Figure 2. A meadow degraded after 10 years without organic fertilizers**

*Source: Radu Rey (2021)*

### **5.5. Hydro-mineral resources and their economic importance**

In addition to its solid resources, the Dorna Basin is recognized for its hydro-mineral deposits. The mineral waters from resorts such as Vatra Dornei are used both for drinking and in spa treatments. According to studies, the mineral springs are rich in Ca, Mg and

bicarbonate compounds, with curative and therapeutic properties recognized nationally and internationally.

The existence of these resources has led to the development of an important tourism sector, with spa treatment centres and leisure facilities. Spa tourism has contributed to the economic development of the area and the hydromineral resources continue to be a strategic source of income for local communities.

A particular wealth of the “Dorna Country”, mineral waters, carbonated and still water, have led to the development of an economically important area, as well as national and international tourism. The existence of the mineral waters in the Dorna country is related to the post-volcanic activity of the eastern edge of the Călimani Mountains. The natural volcanic rocks date back more than 10 million years, and at great depth a mixing of meteoric water with CO<sub>2</sub> takes place, followed by a long-lasting natural filtration that occurs deep in the Oriental Carpathians.

An important factor that contributed to the distribution and formation of soils was the very varied relief structured in altitude steps (depression, mountain and alpine) ranging from 701 m to over 1200 m (mountain domain) (Petrescu 2008).

## **5.6. Vegetation and traditional dairy production in the Dorna Country: the interaction between soil, biodiversity and economic tradition**

### ***5.6.1. Vegetation cover structure of the Dorna Country***

The Dorna Country is characterized by a remarkable ecological diversity, with significant areas of forest vegetation (71% of the territory) and agricultural areas covering the remaining 29%. The mountain forests, predominantly composed of mixtures of broadleaved and coniferous trees, are essential for the stability of the local ecosystem, playing an important role in climate regulation and biodiversity conservation. Pasture and meadow areas, which represent 15% (26,650 ha) and 8.8% (15,630 ha) of the agricultural area, respectively, constitute the main habitat for extensively farmed animals, thus favouring the production of quality milk and cheese (Fig. 2).

In addition, a small part of the land (6.6%) is given over to potato crops, vegetable gardens and man-made land, which plays a secondary role in the local economy. The soils in this region, which are rich in nutrients and minerals due to the diverse geological substratum, directly influence the quality of vegetables and fodder. Studies conducted in the grasslands of the Oriental Carpathians have shown that the diversity of grass and grass species in this area contributes significantly to the nutritional content of milk and derived products (Antonescu 2023), (Marușca 2017).

### ***5.6.2. The economic and traditional importance of “Dorna” Emmenthal cheese production***

An essential aspect of the economic tradition of the Dorna Country has been the production of Emmenthal cheese, known locally as “Dorna Swiss cheese”. This activity has been one of the most prestigious craft traditions in the area for over 100 years. At its peak, production amounted to 100 wheels of cheese of approx. 70-80 kg per day, of which approx. 50 % of the cheese was produced in the communal sections (6), providing significant income for the local communities. Emmenthal cheese from Dorna was prized for its superior quality, thanks to the influence of natural fodder rich in minerals and nutrients and the absence of any form of chemical treatment.

However, due to economic considerations and structural changes in the agricultural market, Emmenthal production was abandoned after 2020, causing cultural and economic losses for the Dorna area. Changing agricultural production patterns and high processing

costs were among the main causes of this decline (Necula 2022). Practically, more than 8000 small and medium-sized mountain farms were left without any form of industrialization by the closure of the cheese factory, except for a few small local, private initiatives.

### ***5.6.3. Macroelements and microelements in milk from the Dorna Country***

The nutritional quality of the milk and dairy products from this region is closely linked to the type of pasture on which the animals are fed. The milk produced here contains a wide range of essential macro-elements (Ca, Mg, Na, K, P, Cl) and microelements (Fe, Cu, Zn, Se), which are often associated with other ions or organic molecules that contribute to the nutritional benefits of these products.

Research in the mountain pastures of the Oriental Carpathians has shown that mineral-rich soils, due to volcanic and sedimentary geological formations, lead to an increased accumulation of macro- and microelements in the plants that make up the fodder. For example, studies carried out in the Călimani Mountains, part of the Dorna Country, have shown a direct correlation between the calcium and magnesium content of the soil and their concentrations in raw milk collected from cattle.

The high content of calcium and phosphorus in milk produced in this region is an important factor for bone health and the prevention of diseases associated with nutritional deficiencies. In addition, selenium, an antioxidant essential for immunity, is found in higher amounts in milk from mountainous areas compared to lowland areas, due to the natural mineralization of the soil (Necula 2024).

### ***5.6.4. Impact of farming practices and recommendations for sustainability***

Although the Dorna Country has a long tradition of sustainable use of pastures and meadows, recent changes in agriculture have had an impact on biodiversity and natural forage productivity. Traditional extensive grazing practices, characterized by seasonal rotation of animals, have helped to preserve floral diversity and maintain healthy soils. However, the abandonment of certain grazing areas and the reduction of traditional farming activities can lead to the degradation of the local ecosystem.

In order to prevent such effects, it is recommended to implement conservation measures, such as the protection of natural pastures and the encouragement of organic farming. In addition, support programs for local dairy producers could help revitalize the production of traditional cheeses, thus promoting the economic and ecological sustainability of the region (Marușca 2012), (Marușca 2022).

### ***5.6.5. Worrying new situations***

A particularly worrying phenomenon that has taken hold in the last approx. 15 years, is the gradual **disappearance of a significant number of mountain sheepfolds** (estimated at over 2000 sheep, cow or mixed sheepfolds), as a consequence of the declining interest of mountain farmers, and in particular of young mountain farmers, in the rearing and use of ruminant animals and, consequently, of **organic fertilizers**, which are essential for the formation and maintenance of the rich polyflora of mountain pastures and meadows and of the biodiversity, which is socially useful, of the herbaceous corollary, with the lowest production costs. In the absence of organic fertilizers, there is a change in the floral structure, to the detriment in particular of protein-rich plants (trifolium sp., gizdei, etc.) and an invasion of plants with little or no forage value (weeds), including poisonous plants and forest vegetation.

In interpreting this natural phenomenon, in order to understand its seriousness and the urgent need for preventive intervention, it is useful for decision-makers to understand

that the current polymorphic, forage, valuable mountain flora is the result of centuries of grazing with ruminant animals (sheep, cattle, goats) and the annual application to the same plots of land of **organic fertilizers**, which have a major effect on soil humus and alkalinity, thus ensuring the two fundamental economic cycles - **grazing** (pasture) and **wintering** (hay), without which the mountain agro-zootechnical economy **cannot exist**.

Among the main causes that have generated this state of affairs, which worsens every year, we find: insufficient support for mountain farmers, especially small farmers, who from the sum of small flocks in the households constitute, annually, with well-tested traditional systems, sheepfolds of 5-600 sheep or mixed and cattle farms, with qualified staff "on the job", the shepherds and especially the caretakers, the real administrators, managers and connoisseurs of traditional technologies, traditional cheese making, etc.

For example, an error that left mountain farms with less than 60 sheep without subsidies and the setting of a subsidy threshold of only 5 cows, under pressure from large landowners, combined with some exaggerated restrictions on access to forest land for animals, have led, in about 20 years, to a dramatic decrease in the number of herds and, consequently, in organic fertilizers, which are the basis for maintaining the mountain forage polyflora.

At the same time, the discouraging prices practiced by the food industries (e.g.: 0.60-0.80 lei/l. milk), have generated, cumulatively, a general discouragement of livestock farming in the mountain area, especially of young farmers, the factor that should have ensured the continuity of an economic system that was created and has resisted for centuries.

For example, in the micro-region of the Dorna Basin, Suceava county, it went from 30,000 sheep (1994) to approx. 3,300 sheep in 2020, with the disappearance of the majority of the pastures.

The gravity of the situation lies in the fact that this complex phenomenon **can no longer be recovered**, young rural mountain people are leaving farming, migrating to cities and abroad and to other occupations, and the hope of them returning, even with new opportunities, is becoming semi-illusory. The population that still raises livestock is aging and mountain villages are threatened with depopulation.

The phenomenon is occurring relatively **insidiously**, and this at a time when the most worrying crisis, the **food** crisis, is the subject of major concern at global and implicitly national level, the main idea being that **any area of land that can produce food should be brought into a condition to produce** food sustainably.

## **6. THE ORGANIZATION OF MOUNTAIN AREAS IN ROMANIA IN A COOPERATIVE SYSTEM FOR THE VALORISATION OF "MOUNTAIN PRODUCTS"**

Whereas in Romania the Agricultural **Production** Cooperatives in the lowland areas (former CAPs) functioned for more than 60 years, **the mountain area remained uncooperativized** (under the influence and failure of the former "associations"), but under the tacit threat of collectivization, profoundly rejected by private mountain farmers, and since this social resentment, at the mass level, has persisted in the collective mentality even after 1989, the first issue that needs to be clarified, "face to face" with today's farmers, is "what kind of cooperative? ". It is essential for farmers to understand that the proposed form of cooperative does not affect ownership of private means of production, but is an association solely for the purpose of making better use of the "raw material" ("mountain product" - guaranteed), with the aim of increasing "added value", for the direct

benefit of the farmers (and not the intermediaries), who are free to join or leave the cooperative of their own free will.

We find encouraging examples of success through the creation of two such cooperatives in the ATUs of Șaru Dornei (SV) and especially in Sângiorz-Băi (BN), where the price of milk, a raw material, increased from 0.60 lei/l to 2.5 lei, through microprocessing and sale as a “mountain product”, with growth prospects through marketing as certified “**premium**” products.

Attempts to create multiple cooperatives at the level of an ATU have failed, among the causes being distrust and the absence of credible leaders.

The Romanian mountain area organization scheme proposed by Radu Rey (Fig. 3) represents an innovative model for harnessing the economic potential of mountain regions, through an integrated cooperative system dedicated to the sustainable development of mountain areas. This vision emphasizes the interconnection of local farmers, traditional producers and other economic actors, in a collaborative mechanism that supports the production and marketing of certified “mountain products”, such as dairy products, meat, live animals, honey or berries or fruit.

This scheme focuses on the creation of **an integrated structure of mountain agricultural cooperatives**, which facilitates the optimal valorisation of mountain products through short supply chains and quality certification. The model suggests collaboration between local cooperatives, **united under an agricultural inter-cooperative association** (at microregional level), which coordinates the production, processing and marketing of products (Rey 1979).

### 6.1. Cooperative structure within the micro-region<sup>1</sup>

According to the works of Radu Rey (Rey 1985), (Rey 2013), (Rey 2023), the scheme involves the creation of “pyramid” cooperative structures, in which individual farmers are organized at the local level in agricultural cooperatives, which are subsequently integrated into a centralized structure, at the micro-regional level. This organization allows for the efficient coordination of the production, processing, certification and marketing of mountain products. Thus, the basis of the scheme is the mountain households and small farmers, which are the main production units of the guaranteed raw material “mountain products”. They deliver the raw products to local cooperatives, which ensure the supply of a cooperative food industry (dairy, meat and vegetable products factory (“mountain products”), which deals with processing and distribution. The micro-regional structure facilitates cooperation between the different cooperatives, the management of common resources and the promotion of products on national and international markets. According to the scheme, each involved administrative-territorial unit (ATU) has its own mountain agricultural cooperative, which ensures efficient decentralization of production and good local knowledge of resources. The cooperatives would be associated within a larger structure – the *Intercooperative Mountain Agricultural Association “Țara Dornelor”*, which functions as a central point of coordination and support for micro-regional activities.

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<sup>1</sup> **Traditional microregion:** a group of settlements located in a similar natural-geographic, cultural-economic and traditional space.

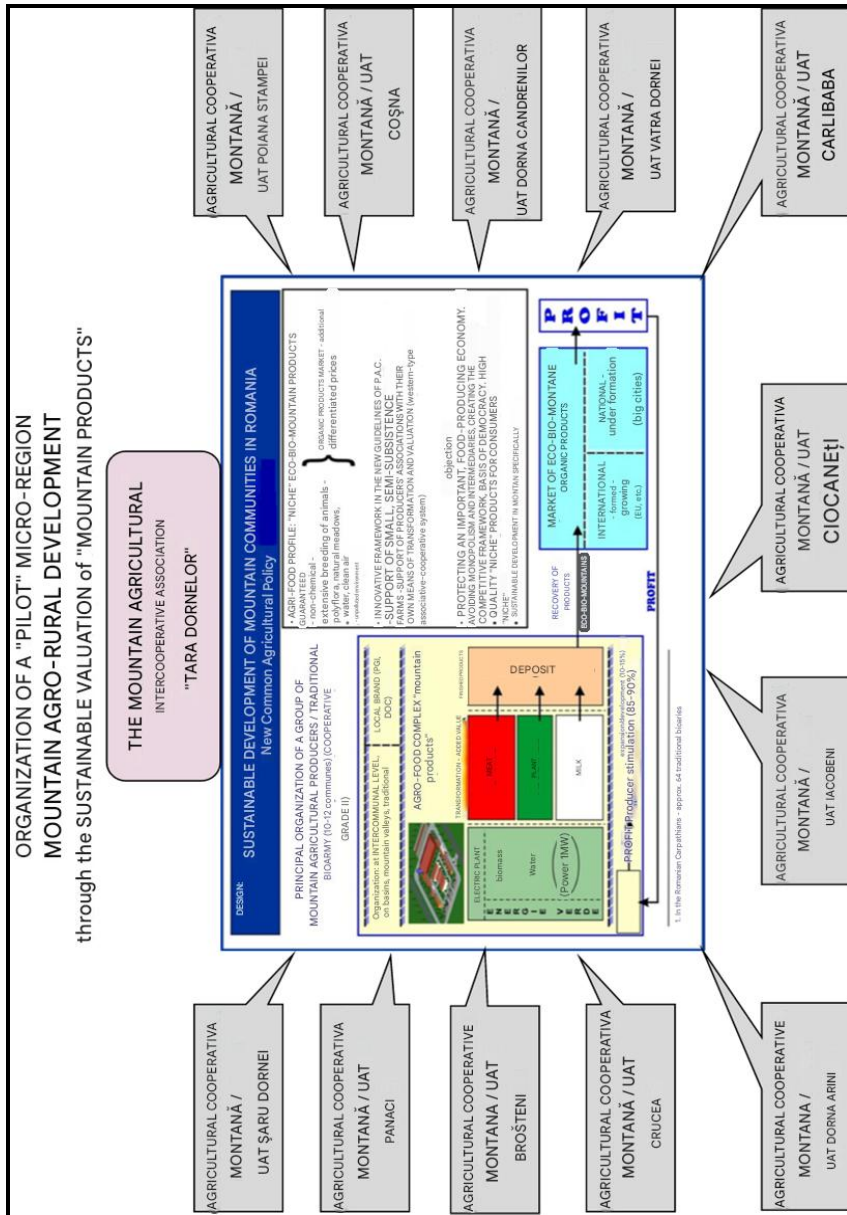


Figure 3. An organizational scheme for the valorisation of “mountain products” in an agro-cooperative - mountain system – Source: Radu Rey, 2023

This “vertical” organization is based on the proposed principles, according to which small producers and agricultural households are integrated into larger economic networks, which provide them with **access to external markets and opportunities for superior and sustainable valorisation** of mountain products (Rey 2013). Through this mechanism, certified mountain products can penetrate larger markets, **with premium prices**, thus ensuring higher incomes for farmers and local communities.

**The Swiss example** is cited by Rey (2023) in his work, due to the success achieved by Swiss mountain cooperatives in integrating local agricultural production into international supply chains. The Swiss model emphasizes the importance of a well-organized structure, in which each level of production and processing is optimized and coordinated.

## 6.2. Mountain product categories and short supply chains

A central element of the scheme is the acquisition and use of the “mountain product” certification, which assures consumers that the products comply with strict quality standards and come from officially recognized mountain areas. Radu Rey emphasizes that this certification is essential for differentiating mountain products from those from the plains and for obtaining premium prices on the market (Rey 2013). For example, milk and cheese produced in the Dorna Country or the Apuseni Mountains have a superior quality due to grazing on nutrient-rich soils and traditional processing practices. The “mountain product” certification is regulated by European and national legislation, and its implementation in Romania can have a significant positive impact on the income of local farmers. Studies conducted in other European countries, such as Switzerland/Italy or France, show that certified mountain products could bring farmers 20-30% higher incomes compared to similar uncertified products.

Short supply chains are essential for reducing distribution costs and keeping a larger share of added value locally. Local cooperatives play a crucial role in collecting and processing raw products, which are then distributed to the local trade network or to regional and national markets. A specific example can be found in the *Vatra Dornei cooperative*, which focuses on the production of traditional dairy products such as matured cheese, cream and organic milk. By processing locally, products can be promoted under authentic brands, such as “Țara Dornelor”, which contributes to increasing their value on the market.

## 6.3. The benefits of the cooperative system

The implementation of the cooperative system in mountain areas, focused on certified “mountain products”, brings numerous economic, social and environmental benefits. On the economic level, direct cooperation between farmers and processing structures reduces production costs and increases access to markets, both national and international. The creation of short supply chains between producers and consumers also contributes to keeping a large part of the added value at the local level (Rey 2023).

Socially, this system supports the cohesion of mountain communities, preventing youth migration and providing **sustainable** economic opportunities. Environmentally, traditional agricultural practices in mountain areas contribute to biodiversity conservation, and extensive grazing has a low environmental impact. For example, sustainably managed pastures can support a high diversity of plant and insect species, which is essential for maintaining a healthy ecosystem. It is worth noting that after the entry into operation of such a system, the need for state support will decrease.

## 6.4. Scheme objectives: Economic development and sustainability

The proposed scheme sets as its main objectives:

- Creating a functional economic system based on farmer collaboration;
- Increasing agricultural income and reducing dependence on subsidies;

- Preserving biodiversity and local traditions by maintaining traditional agriculture;
- Certification and promotion of mountain products at national and international level.

This approach integrates the principles of sustainable development, as defined by various European studies. By promoting certified mountain products, the scheme helps to protect the environment and maintain traditional mountain landscapes, while providing economic support for rural communities.

### **6.5. Challenges and proposed solutions**

Although the proposed cooperative scheme is promising, there are major challenges that need to be addressed for its effective implementation. These include the lack of adequate infrastructure in many mountainous regions, limited access to financing, and the lack of personnel qualified in managing cooperatives.

Several solutions are suggested to overcome these obstacles, such as government support for infrastructure modernization, the creation of vocational training programs, and facilitating access to European funds through the National Rural Development Program.

A good practice example is the cooperatives in the Swiss Alps and the mountains of Italy, where local governments and agricultural organizations have collaborated to develop the infrastructure for processing and marketing mountain products, thus creating a sustainable production network and ensuring the co-interest of the essential segment: the farmers, agricultural suppliers of raw materials obtained in mountain areas.

### **6.6. Conclusions and perspectives**

Organizing the mountain areas of Romania in a cooperative system can represent a viable solution for the sustainable exploitation of natural resources in these traditional micro-regions. The “mountain products” certification and their promotion on premium markets are key tools for increasing farmers’ incomes and preserving local traditions. For the success of this model, it is essential that the actors involved collaborate effectively, and that the authorities provide adequate support for infrastructure development and access to funding. The implementation of this system could significantly contribute to the sustainable economic development of the Romanian mountain areas. The organization scheme of the “Țara Dornelor” pilot micro-region could be a model to follow with adaptations to the particularities for other mountain micro-regions in Romania. Through the efficient organization of cooperatives and the optimal exploitation of certified “mountain products”, this system could contribute to the economic revitalization of rural mountain areas, preventing depopulation and the permanent loss of extremely valuable agricultural traditions, generating sustainability.

To ensure the success of such a concept, the contribution of all stakeholders – farmers, local authorities and support organizations – is necessary in order to build a resilient and sustainable mountain agricultural ecosystem. The initial conduct of **studies** that also highlight micro-regional/some accentuated particularities becomes the necessary “first step” towards a Horizon 2050.

## **CONCLUSIONS**

For the natural mountain meadows (pastures and hayfields) in the Romanian Carpathians and any other mountains, the “key” to the production of **agri-food products** -

**therefore human food**, on the lands with the lowest fertility (III-IV-V), with the lowest investments, lies in the relationship between **MAN - Ruminant Animals - Organic Fertilizers - Polymorphic Flora → “mountain product”** (EU Regulations 1151/2012 and 665/2014); **100/100 natural** conditions, with **“zero chemicalization”, unpolluted water**; mineral salts and vitamins from the mountain polyflora, semi-extensive systems for raising and exploiting animals - in motion, with the elimination of aflatoxins through sweating, clean, ozone-rich air - all these realities lead to the production of **human food**, especially **protein-rich** (dairy products, meat products), which bring **health to consumers' homes**.

Compared to the food resources that are being created worldwide through the increased use of chemical fertilizers and pesticides, dyes and preservatives, etc. – food **“mountain products”** have emerged as **“food – medicine”**.

High-quality (“niche”) foods, with the observation that they are **“high niche”**, both nationally and internationally.

Not supporting animal husbandry and reducing livestock numbers in mountain areas is a serious error, in the current and future high-risk conditions, regarding **food, energy and climate change crises**. It is imperative that countries that have mountains and **still have mountain farmers** assume **distinct mountain policies**, in order to **maintain and develop this type of “mountain agriculture”, within the limits adapted to the natural mountain conditions**, where **small farms are irreplaceable**.

• A specially designed **organizational system** for mountain agro-zootechnics, which would ensure **consistent motivation for the younger generations of mountain farmers, in the solution of cooperatives equipped with medium-sized food industries, focused on the valorisation of “mountain products”**, could represent a solution to avoid the loss of an economy with considerable value for the future. From the studies undertaken in the Romanian Carpathians - a **reduction of cattle herds by approx. 60%, and sheep by up to 85%! (in small, traditional farms), with the verified effect of a major reduction in organic fertilizers and the abandonment of sheepfolds and “short pendulum” mountain pastoralism and the reinvasion of mountain meadows with species without social value, in a maximum of 10 years. In the conditions of the 21st century - the loss becomes irrecoverable!**

The efforts made by the UN/FAO - through **the Mountain Partnership, by Euromontana** - to convince governments to take **concrete measures to stop the degradation of mountain agro-zootechnics are deeply responsible** and should be intensified, and at the level of the European Union, **a distinct and efficient “mountain policy” should be implemented**, with **motivating support measures** for the younger generations of mountain farmers (“the last of the Mohicans!...”).

Mountains are integrated, from the start, into the provisions of the **European Green Plan**, and the urgency targets the mountain areas in the countries newly acceding to the EU and those considered in the future.

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