



ASSESSMENT OF GRASSLAND STATE AND PRODUCTIVITY IN KORAB – KORITNIK PROTECTED AREA

Study

Elvin Toromani



October, 2025



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in the framework of the project
***“Protection and Sustainable Use of Protected Areas in Sharr
Mountain, Mavrovo, and Korab-Koritnik”***

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Foreword

“When we live in harmony with nature, both people and the land thrive.”

Sharr - Korab massif stands as one of the most inspiring landscapes in the Western Balkans, a place where people, nature, and tradition have coexisted for generations. The rolling grasslands of Korab are not only the foundation of local livelihoods but also an essential part of the region's natural heritage and ecological balance.

It is within this spirit that the project *“Protection and Sustainable Use of Protected Areas in Sharr Mountain, Mavrovo and Korab-Koritnik”* was born an effort to bring together people, knowledge, and institutions across borders, working toward a shared vision of conservation and sustainable use. The project, financed by the **Prespa Ohrid Nature Trust (PONT)** and implemented by the *Albanian Local Capacity Development Foundation (ALCDF)* in partnership with *Center for Sustainable Community Development (CSCD)* in North Macedonia and LAG *“Dibra Turistike”* in Albania, covers more than 180,000 hectares of protected areas across AL and MK.

Our joint aim has been clear: to strengthen cooperation and dialogue across the Sharr-Korab region, ensuring that the ecological richness of these mountains continues to support both biodiversity and human well-being. Through the establishment of cross-border platforms, comanagement structures, and local surveillance networks, the project has helped connect park administrations, communities, and technical experts in a shared effort of stewardship.

Within this framework, the *“Assessment of Grassland State and Productivity in Korab – Koritnik Protected Area”* represents a crucial milestone. It offers an informed picture of the condition of the pastures, their productivity, the pressures they face, and the opportunities for restoration and better management. This assessment goes beyond numbers and maps; it reflects the voices of shepherds, the experience of local communities, and the commitment of all those who depend on these lands.

This study can become a reference document in the management of the Protected Areas. It can also be used from the Parks' Administration, donors, institutions and other projects under implementation in the targeted Protected Area.

The study was led by Prof. Dr. Elvin Toromani (Expert for Forests and Pastures from Agricultural University of Tirana (UAT), the Faculty of Forests Sciences), in collaboration with Dr. Dhimiter Peci (Expert for Vegetation from Faculty of Natural Sciences) and MSc. Elson SALIHAIJ (GIS expert and Remote Sensing from the

UAT, Faculty of Forestry Sciences), whose expertise and dedication have been invaluable. Working closely with the ALCDF project team, the experts led field expeditions, stakeholder consultations, awareness sessions with shepherds, and laboratory analyses combining scientific rigor with community engagement and local knowledge.

I would like to express my sincere gratitude to all partners, experts, and community members who contributed their time, knowledge, and goodwill to this process. Their collaboration is a testament to the power of shared purpose proof that sustainable management of natural resources can only be achieved when people work together, across borders and beyond institutional boundaries.

As we look ahead, we hope this report will not only serve as a scientific reference but also as an invitation to continue investing in the vitality of these landscapes where nature's generosity meets human care and responsibility.

Lindita Manga

Executive Director

Albanian Local Capacity Development Foundation (ALCDF)

1. Executive Summary

The **Korab-Koritnik Natural Park**, spanning over **55,500 hectares** in the northeastern Albanian Alps, represents one of Albania's most ecologically and culturally significant landscapes. Characterized by rugged peaks, deep valleys, and diverse alpine and subalpine ecosystems, the park is home to **species-rich grasslands, forests, and high-altitude habitats**, supporting both biodiversity and traditional pastoral livelihoods. Grasslands cover approximately **22,578 hectares** and are central to livestock grazing, medicinal plant collection, and eco-tourism, while also providing essential ecosystem services such as **water regulation, soil protection, and carbon sequestration**.

The **Albanian Local Capacity Development Foundation (ALCDF)**, in collaboration with local partners and under the **PONT-funded project on the Protection and Sustainable Use of Protected Areas in Sharr Mountain, Mavrovo and Korab-Koritnik**, commissioned this assessment to evaluate the **state and productivity of grasslands** in the park and provide guidance for sustainable management.

Objectives

The assessment aimed to:

- Evaluate the **current condition of grasslands**, including productivity, biodiversity, and degradation levels.
- Align **livestock requirements with pasture availability** for sustainable grazing.
- Identify **key drivers affecting grassland health**, including climate change, overgrazing, soil erosion, and invasive species.
- Recommend **management and restoration interventions** to ensure long-term ecological and socio-economic sustainability.

The study was conducted by **Dr. Elvin Toromani** from the **Agricultural University of Tirana, Faculty of Forestry Sciences**, in close collaboration with the ALCDF project team and local communities. It combined **field surveys, laboratory analyses, stakeholder consultations, and awareness sessions with shepherds**, ensuring a holistic understanding of both ecological and socio-economic factors influencing pasture management.

Methodology

A **multi-faceted approach** was applied to ensure comprehensive and reliable results:

- **Field Surveys:** Biomass sampling and vegetation analysis were conducted at representative plots to measure productivity and species composition.
- **Remote Sensing and GIS Mapping:** Satellite imagery (Landsat TM, Sentinel-2) and spatial analyses, including NDVI, LULC classification, and slope assessment, provided insights into **spatial variability and degradation patterns**.
- **Participatory Assessment:** Local herders and stakeholders were engaged through interviews, consultations, and workshops, contributing traditional ecological knowledge and validating technical findings.
- **Laboratory Analysis:** Forage quality and biodiversity indicators were analyzed to support recommendations for grazing and restoration planning.

Key Findings

- **Grassland Productivity:** Alpine meadows at higher elevations have lower biomass but high **species diversity**, while subalpine pastures are more productive and heavily used for grazing.
- **Carrying Capacity:** Some subalpine areas are **overgrazed**, whereas alpine pastures remain underutilized due to terrain constraints.
- **Grassland Quality:** Degradation signs include reduced plant diversity, shrub encroachment, and soil erosion. Well-managed pastures show higher structural and ecological integrity.
- **Threats:** Climate change, overgrazing, burning of Juniperus shrubs, wildfire risk, and soil erosion were identified as major pressures.
- **Socio-Economic Context:** Grasslands are critical to **livestock production, cultural heritage, and eco-tourism**, with local communities actively involved in pasture management.

Recommendations

- **Adaptive Grazing Management:** Implement rotational grazing and optimize stocking rates to reduce overuse and maintain biodiversity.
- **Restoration and Conservation:** Rehabilitate degraded areas, manage invasive species, and protect high-value habitats.
- **Fire and Soil Management:** Develop fire prevention strategies and stabilize soil on steep slopes.
- **Monitoring and Mapping:** Continue using GIS, remote sensing, and participatory monitoring to track grassland health.
- **Community Engagement:** Strengthen participatory governance, provide training for sustainable pasture management, and promote eco-tourism and medicinal plant harvesting.
- **Cross-Border Cooperation:** Coordinate with North Macedonia for joint management of transboundary ecosystems and biodiversity conservation.

Conclusion

The Korab–Koritnik grasslands are **vital for biodiversity, ecosystem services, and local livelihoods**. This assessment demonstrates that combining **scientific analysis, remote sensing, and local knowledge** provides a strong foundation for informed decision-making. By implementing the recommended measures, stakeholders can ensure the **long-term sustainability, resilience, and productivity** of these unique alpine and subalpine landscapes, benefiting both nature and local communities.

2. Introduction

The Korab protected extends in Kukes and Dibra regions, from the border with Kosovo in North-East Albania to the Deshati Mountain in southern bordering with Macedonia. It is part of the Central Mountainous Region, situated in the eastern range of this massive, so called Eastern Albanian Alps. From the Geological point of view, the region is part of South-Eastern Europe line and so it is included in the eastern alpine compressed area. The massif is part of the inner Albanides in the line Dinarido-Albanido Hellenides range mountains.

Many mountain peaks are occasionally ruptured by radial tectonics in the shape of blocks that ends in forms of gorges and valleyslike these between Koritniku and Gjallica e Lumës, Gjallica and Kolesiani (Canyon of Bicaj) and Serakoli Mt., and Grama Mt. (Bushtrica Valley). These blocks occasionally have steep slopes that build up from 300 m up to 2,485 m (Vanaj George). Remarkable are also the alpine area of Gjallica e Lumës and Korabi peaks with several sheer and hardly approachable peaks or White Mt. with many eroded slopes. The most abundant habitat within the area is grassland land and meadows, occupying around 26358.5 ha. This habitat is composed mainly by natural grassland, heath-land and herbaceous vegetation. Forests mainly located in the northern part of the natural park and the eastern-southern part of the territory cover around 19,264 ha. Agricultural lands are typically located close to inhabited villages these occupy approximately 8,670.9 ha in the natural park. Another type of habitat within the NP is composed by rocky mountain areas and eroded land, together occupying around 4,530.8 ha. These are open areas with no or little vegetation cover. Urban areas are mainly situated in the south-east of the area close to the borders of the natural park. These areas cover a limited surface of the total protected area (385.6 ha). Water bodies within the Natural Park occupy about 120.6 ha of the total surface of the park area.

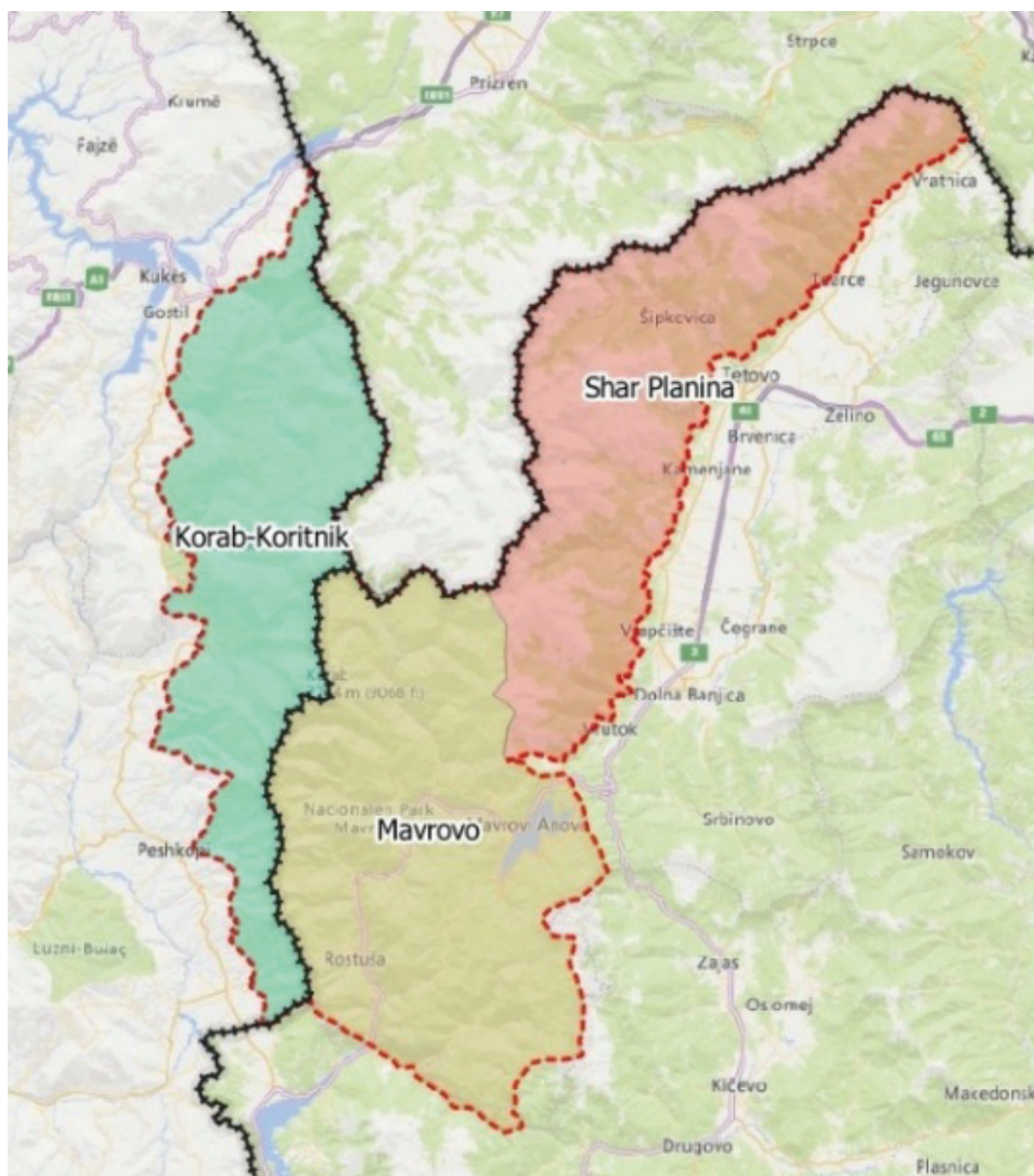


Figure 1. Location map of Korab protected area

3. Physical, ecological and socio-economic characteristics of the Korab protected area

3.1. Physical and ecological characteristics of the focus area

3.1.1. Location of the study area

The Korab-Koritnik Nature Park (Albanian: Parku Natyror i Korab-Koritnikut) is a nature park in eastern Albania that is part of the European Green Belt. This belt is a safe place for plants and animals that are in danger. The Korab protected area along the border with Kosovo and North Macedonia is part of our study. It includes 53,350 ha in northeast Albania, declared by DCM No. 60 (26.01.2022) composed of alpine mountains, valleys, rivers, glacial lakes, caves, canyons, and thick forests of both coniferous and deciduous trees.

The Korab protected area starts in the north, near the Kukes-Prizren highway (N 42°9'8.26"; E 20°33'3.47"; elevation 402 m a.s.l.). It continues in the west, in the Kukes and Diber regions (N 41°51'14.08"; E 20°24'46.78"; elevation 1175 m a.s.l.). In the south and east, it is close to the border with North-Montenegro (south: N 41°33'47.39"; E 20°31'4.04"; elevation 773 m a.s.l.; east: N 41°47'19.89"; E 20°34'25.37"; elevation 2533 m a.s.l.).

There are many mountain peaks in the area that was studied. Sometimes, radial tectonics breaks them up into blocks that form gorges, canyons, and deep valleys. The Gjallica and Kolesiani (Canyon of Bicaj), Bjeshka e Tejes and Sorakoli Mt. (Lapaj george), and Grama and Deshati (Blliça valley) are all different from each other. The blocks sometimes have steep slopes that go from 300 m to 2485 m (Vana George, Mustafaj, and Lapaj Canyons).

The Gjallica e Lumës and Korabi peaks are also impressive. They have many steep, hard-to-reach peaks and many eroded slopes. The area is mostly made up of siliceous substrate (Shishtavec platea, Kallabak-Gryka e Kazanit-Sorokol-Kulla e Zyberit, parts of Korabi, Grama, Deshati, and Bjeshka e Hinoskës) and limestone formations that make up the mountains of Koritnik and Gjallica and parts of Korabi Mt. There are several places with a lot of plants and flowers, like Pelpeneku Mt, Bjeshka e Vrenjtë, and Cerjan-Zagrad, that are made up of gypsum substrates.

The study encompasses the limestone pastures of Gjallica Mts, Shishtavec, and Buzëmadhe, alongside Kallabaku Mt (situated on silicate substrate), the grasslands of Sarokol-Kulla e Zyberit-Korabi field, all characterized by flushes and silicate substrate (refer to Table 1), Panairi field, and Bjeshka e Shehut, on limestone; the

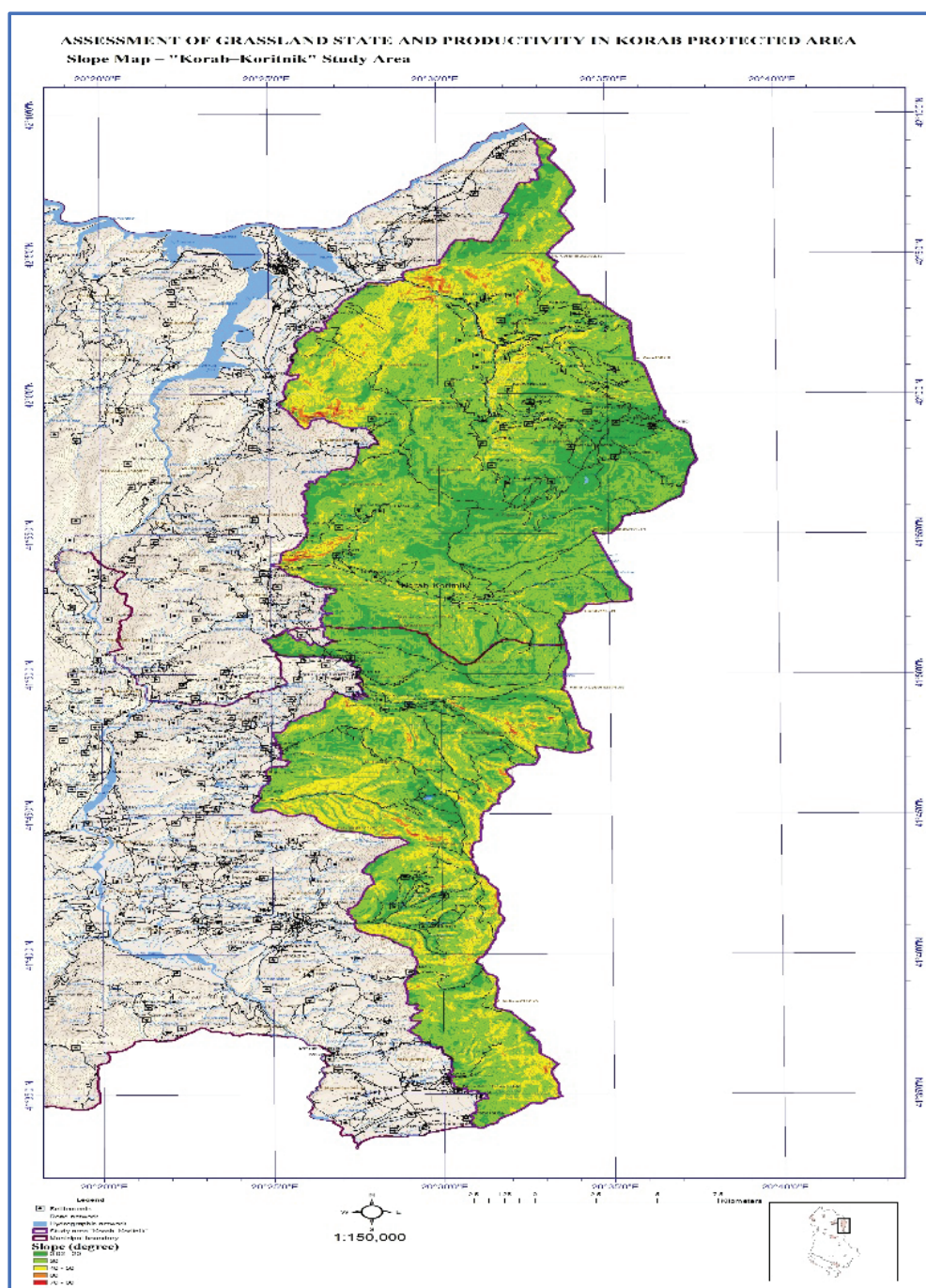
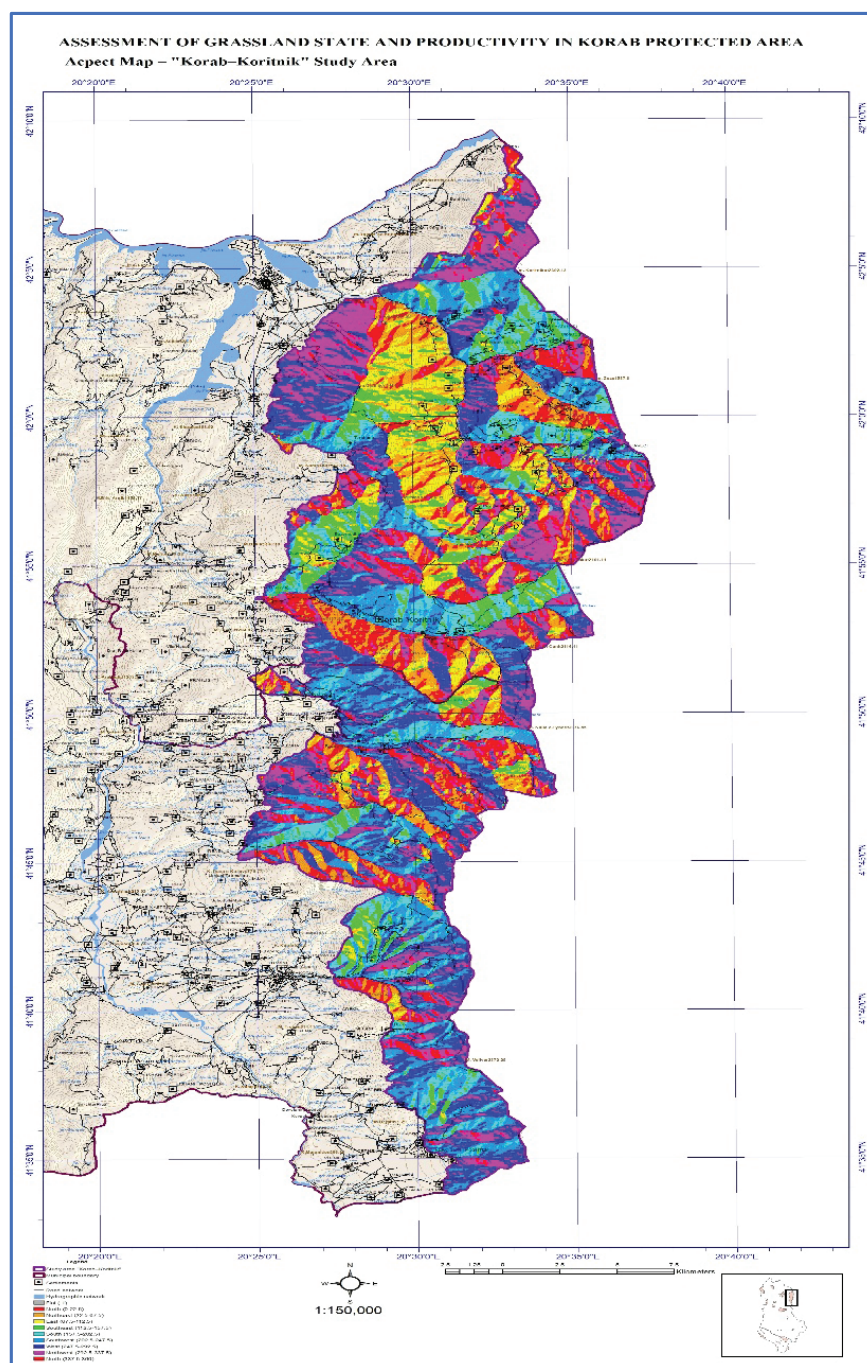


Figure 2. Mapping of slopes in Korab protected area

grasslands of Grama, Pelpeneku Mt, and Cerjan-Zagrad, on silicate and gypsum substrate; and the Hinoska pastures, on silicate substrates.

In the center of the Natural Park occur Korabi Mt with the greatest geomorphological diversity of substrate and the highest peaks, so the focus of our observations was paid on these parts. From geomorphological point of view, Korabi Mt is composed



by conglomerate, silicate, clay, sandstone and alevrolite formations. In this "mosaic" composition, great role had played the intensive neotectonic movements of the quaternary that are active in current days, too. As a result, major part of the anticline structures faced with air-hoist with high amplitude, were taken a type of horst (Korab, Serakol-Kulla of Zyberi and Bjeshka of Teja-Guri i Mengjesit).

3.1.2. Climate

The area of study is in the Mediterranean Mountainous East Climate Zone. The Mediterranean climate has a big effect on the western and southwestern lower parts of the Korab–Koritnik Landscape, especially the western slopes of Gjallica Mt. This climate comes through the Drini valley or its branches (George of Vana and Bushtrica). The biggest parts of the landscape have a modified continental climate (warm continental), while the highest parts (above 2000 m a.s.l.) have a mountainous climate. The territory has a wide range of climates, plants, and animals because the elevation changes so much.

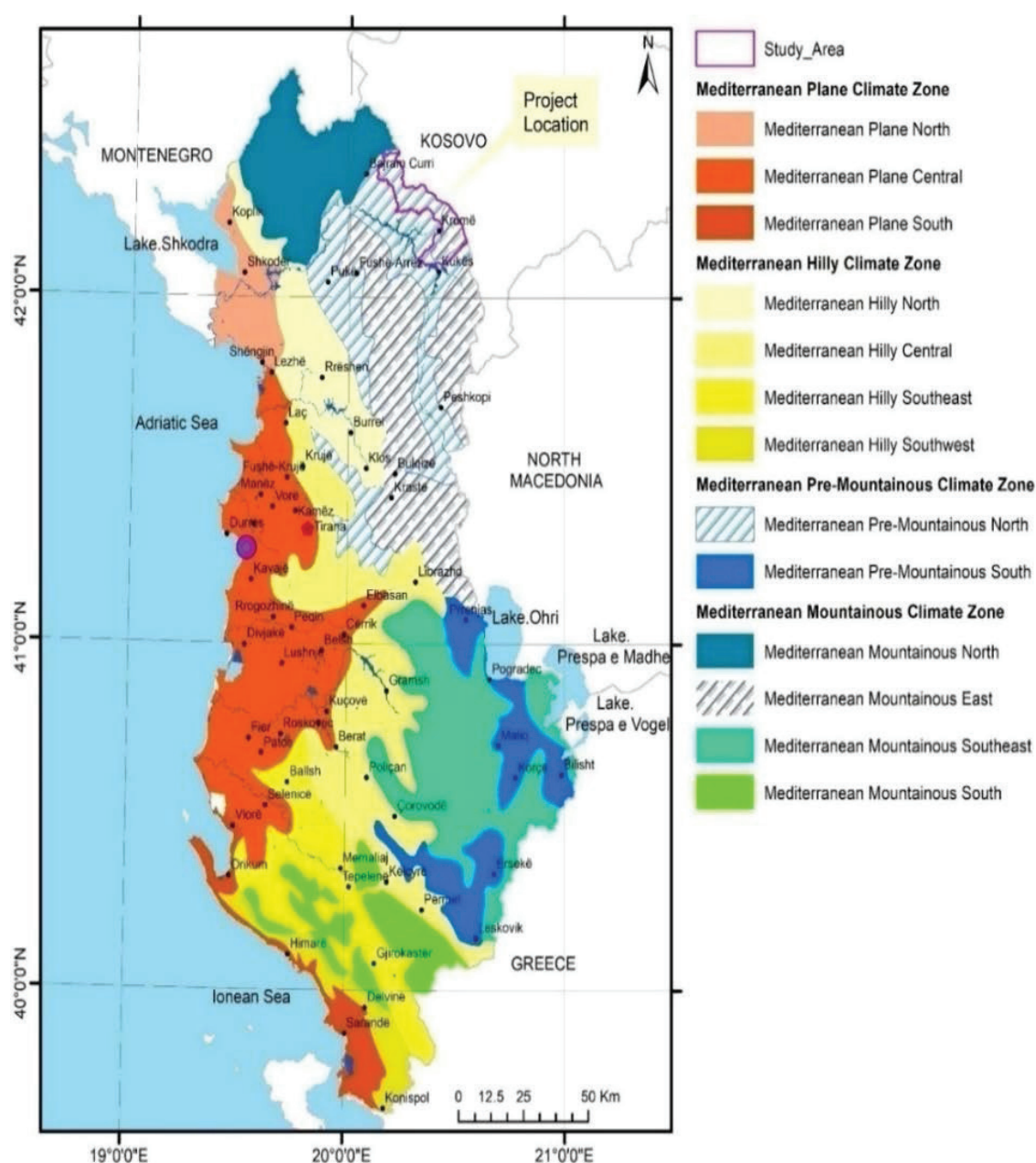


Figure 4. Climatic zones in Albania

The Mediterranean climate has the most effect at altitudes between 500 and 1500 m. Above that, the Mediterranean-mountainous and continental climate makes the average annual temperatures in the lower parts of the PA range from 7 to 10°C, and from 2 to 6°C at altitudes above 1500 m or 2 to 3°C around the Korabi peaks (Shuka, 2010). The average amount of rain that falls each year is a little less than that of the northern Albanian Alps. At the average altitudes, it ranges from 1300 mm to 1800 mm, but at higher altitudes, like on the western slopes of the mountains, it can reach 2000 mm per year. Different climate models say that the water and precipitation cycles in the mountains of Europe and the rest of the area will change a lot¹.

3.1.3. Vegetation in Korab protected area

3.1.3.1. Forest vegetation

Due to a great variability in elevation, a rich diversity of flora and fauna can be found within the territory. It is in the Palearctic temperate broadleaf and mixed forests biome, which includes the Dinaric Mountains mixed forests and the Balkan mixed forests. There are many different kinds of deciduous and coniferous trees in the forests, as well as a wide range of wildflowers. There are different types of vegetation at different heights. For example, oak forests grow between 400 and 900 meters above sea level, while conifers and beech forests grow between 1,000 and 2,000 meters above sea level. Most of the mountain meadows' slopes are covered in trees that lose their leaves in the fall. The park has a lot of silver fir (*A.alba* Mill.), austrian pine (*P. nigra* Arn.), bosnian pine (*P.heldreichii* Christ.), macedonian pine (*P.peuce* Griseb.), and black alder (*A.glutinosa* Gaertn.). There are oak forests at lower elevations, such as the oriental hornbeam (*C.orientalis* Mill.), downy oak (*Q.pubescens* Willd.), macedonian oak (*Q.trojana* Webb.), and field maple (*A.campestre* L.).

3.1.3.2. Grassland vegetation

Subalpine and alpine grasslands are the most common types of land above the tree line (1350–1500 m). The Korab–Gjallica–Koritnik protected area is home to Albania's biggest and highest dry and mesophilic grasslands, which are spread out over subalpine and alpine zones. These are xerophyllous, mesoxerophyllous, and psychromesophyllous grasslands, as well as psychrophilous shrubs. They cover more than half of the Koritnik–Korab landscape (Buzo, 1989; Rakaj & Shehu, 2012). Summer grasslands include all meadows, which can be found at elevations of over 2500 m. The grasslands in Korab–Koritnik Nature Park are a complex mix of habitats that are very important for conservation. Three of them are priority types that need special care. Field surveys found ten types of habitats:

1. Chapter 8: Water Cycle Changes | Climate Change 2021: The Physical Science Basis

- 1) **6210 Semi-natural dry grasslands and scrubland on calcareous substrates (Festuco–Brometalia) (important orchid sites)**
- 2) **6230 Species-rich *Nardus* grasslands on siliceous substrates**
- 3) **6240 Sub-Pannonic steppic grasslands**
- 4) **62A0 Eastern sub-Mediterranean dry grasslands (*Scorzoneralia villosae*)**
- 5) **62D0 Oro-Moesian acidophilous grasslands**
- 6) **6410 *Molinia* meadows on calcareous, peaty, or clayey-silt soils;**
- 7) **6430 Hydrophilous tall herb fringe communities (montane to alpine levels);**
- 8) **6510 Lowland hay meadows;**
- 9) **6520 Mountain hay meadows;**
- 10) **7230 Alkaline fens**

Prior research identifies predominant plant communities, including *Vaccinio–Seslerietum comosae*, *Daphno–Festucetalia*, *Festucetalia valesiaca*, *Poetum violacea*, and *Edraiantho–Seslerion* (Amidžić et al., 2020; Vasiliev et al., 2024). These are mostly in the class *Festuco–Brometea*, which includes dry and dry-mesophilous grasslands above the beech forest zone.

Festucion valesiaca, which is made up of *Festuca valesiaca*, *Chrysopogon gryllus*, *Poa pratensis*, *Agrostis capillaris*, and *Bromion erecti*, which is made up of *Bromus erectus*, *Cynosurus cristatus*, *Festuca koritnicensis*, and *Sesleria korabensis*. *Agrostieta capillaris–Thymus striatus* and *Seslerion comosae* are two other important communities that grow on shallow siliceous soils at higher altitudes.

The hygromesophilous meadows along the valleys in Shishtavec, Grama, and Hinoska are part of the *Molinio–Arrhenatheretea* class. The main plants in this class are *Molinia caerulea*, *Deschampsia caespitosa*, *Agrostis capillaris*, *Alopecurus pratensis*, and *Sanguisorba officinalis*. Wet meadows (Order *Deschampsietalia*) have plants like *Deschampsia caespitosa*, *Festuca pratensis*, and *Mentha pulegium*. Higher wet meadows (Order *Trifolio–Hordeetalia*) have plants like *Trifolium resupinatum*, *Poa bulbosa*, and *Lotus corniculatus*.

Nardion strictae communities are made up of long-grazed mountain grasslands that are mostly made up of *Nardus stricta*. They can be found all over Korabi Field, Sarokol, and Shishtavec. These are *Festuca rubra*, *Phleum alpinum*, *Geum montanum*, and *Vaccinium myrtillus*.

Elyno–Seslerietea is a type of grassland that grows on shallow, cold soils at higher altitudes. The main associations are *Sesleria coerulans*–*Carex kitaibeliana*, *Carici–Narthecium scardici*, and *Sesleria coerulans*–*Geranium cinereum*. These are characterized by Balkan and arctic–alpine endemics like *Narthecium scardicum*, *Festuca bosniaca*, and *Trifolium alpestre*.

Other important associations are *Nardus stricta*–*Geum montanum*, *Festuca bosniaca*–*Genista tinctoria*, *Festuca bosniaca*–*Bromus erectus*, and *Festuca bosniaca*–*Thymus cherlerioides*. These plants grow on dry slopes and ridges between 1400 and 2000 m.

Dwarf shrubs that grow in subalpine and alpine areas

There are two NATURA 2000 habitat types in Korab–Koritnik that have subalpine and alpine dwarf shrubs:

- **4060 Alpine and Boreal heaths**
- **5130 *Juniperus communis* formations on heaths or calcareous grasslands**

On the upper slopes, there are large groups of Alpine juniper (*Juniperus communis* subsp. *alpina*) that are often mixed in with bilberry and bog bilberry dwarf heaths (*Vaccinium myrtilli*, *Vaccinium uliginosi*). These habitats are mostly found in limestone areas of Koritnik, Gjallica, and Korab. However, fire scars show that they are burned from time to time to “clear grasslands.” The characteristic association of *Juniperus communis* subsp. *alpina* + *Luzula* spp. (Alliance *Juniperion nanae*) comprises *Campanula scheuzeri* and *Viola schariensis*.

Dwarf heath communities (*Loiseleurio procumbentis*–*Vaccinietea*) are very important for biodiversity and preventing erosion. They are *Vaccinium myrtillus*, *V. uliginosum*, *Bruckenthalia spiculifolia*, and *Arctostaphylos uva-ursi*, and they are grouped into units like: • Bilberry dwarf heath (*Vaccinium myrtilli*) — e.g., *Vaccinium myrtillus*–*Chamaecytisus triflorus* in Shishtavec; • Bog bilberry dwarf heath (*Vaccinium uliginosi*), with *Androsace hedraeantha* and *Minuartia recurva*; • *Bruckenthalia* dwarf heath (*Bruckenthalion spiculifoliae*), near Kallabak, featuring *Gentianella bulgarica*, *Dianthus superbus*, and *Succisa pratensis*.



*The peak of Korab, view from Vraca Mts range
(Dry grasslands of Korab Mts)*



*Plant community of Nardus stricta + Festuca sp.
div. (The ridge of Serakol-Kulla e Zyberit)*



*Plant communities of Sesleria coerulans –
Geranium cinereum with dominance of Dryas
octopetala*



*4060 Alpine and Boreal heaths, Arctostaphylos
uva-ursi in between Daphne oleoides*

3.1.3.3. Land use and habitats in the Korab National Park

The Korab protected area is part of IUCN category IV and is an important plant area in the Emerald network and a possible Natura 2000 site. There are rare and native species growing in this protected area, which makes it a great place for biodiversity. The EU habitat Directive says that there are five Annex I grassland habitats in this protected area. The Korabi protected area's grasslands are known for their high biodiversity value at the EU and global levels. The Natural Park area that is on state-owned land has water bodies, industrial and economic areas, and a small part of forests and grasslands. The rest of the park area is owned by communes and private individuals. Most of the area is rural, with grasslands and forests covering 75% of the land. Agriculture (10%) is a secondary but still important part of people's lives. Urbanization is very low (0.2%), and degraded or non-productive land (8%) shows that land management is difficult. The landscape is mostly made up of pastoral forests, which have a lot of potential for ecosystem services but also problems with land degradation that need to be fixed and managed in a way that is good for the environment.

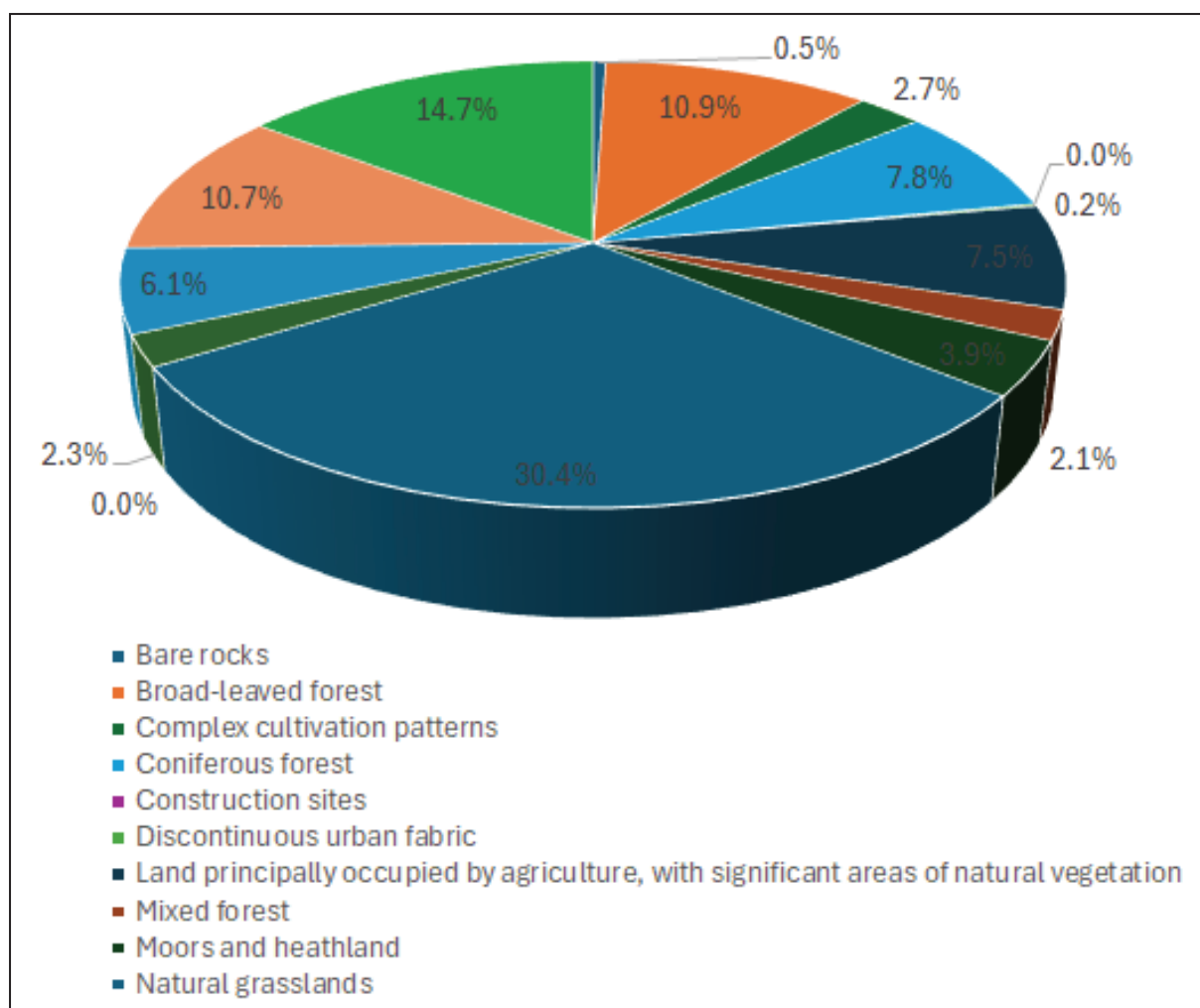


Figure 5. Land use distribution in Korabi nature park

The area comprises a high diversity of terrestrial habitats ranging from different forest types due to altitudinal gradients and slopes orientated north, east, south and west. Its northern part is characterized by typical alpine landscape with steep rocky peaks while the landscape of its southern part is gentler. This gives rise to a high diversity of habitats in the area. Forests mainly located in the northern part of the park and the eastern-southern part of the territory occupies a considerable surface. Agricultural areas are typically located close to inhabited villages. Grassland and meadow habitats, the first used mainly for grazing, are also present in the area. Rocky mountain areas cover a considerable area of the natural park. There are open areas with no or little vegetation cover. Urban areas are mainly situated in the south-east of the area close to the borders of the natural park. The table below presents the habitat types present in “Korab – Koritnik” Natural Park area. In the table are shown the Natura 2000 habitat type, respective code and the habitat name in Albanian language.

Table 2. Habitat types in Korab protected area

Code	Habitat type	Albanian name
40	Temperate heath and scrub	Shqopishte dhe kaçubishte të zonave me klimë të moderuar
4060	Alpine and Boreal heaths with Juniperus communis subsp. Nana	Shqopishte të zonave alpine dhe boreale me Juniperus communis subsp. Nan
51	Sub-Mediterranean and temperate scrub	Kaçubishte sub-mesdhetare dhe të zonave me klimë të moderuar
5110	Stable xero-thermophilous formations with Buxus sempervirens on steep slopes	Formacione kserotermofile me bush (Buxus sempervirens) në shpate shkëmbore
61	Natural grasslands	Kullota natyrore
6170	Alpine calcareous grasslands	Kullota alpine të rajoneve me natyrë gëlqerore
65	Mesophile grasslands	Kullota mesofile
6510	Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)	Livadhe të zonave të ulëta (Alopecurus pratensis, Sanguisorba officinalis)
6520	Mountain hay meadows	Livadhe të zonave malore
82	Rocky slopes with chasmophytic vegetation	Shpate shkëmbore me vegetacion hazmofitik
8210	Vegetated calcareous inland cliffs with casmophytic vegetation	Shkëmbinj gëlqerorë të brendshëm të populluar nga vegetacion hazmofitik
8215	Alpine and sub-mediterranean calcareous cliffs	Shkëmbinj të thepisur gëlqerorë të zonave alpine dhe submesdhetare
91	Forests of Temperate Europe	Pyje të Europës me klimë të moderuar
9130	Neutrophilous (Asperulo-Fagetum) beech forests	Pyje ahu neutrofile (Asperulo-Fagetum)
9110	Illyrian oak – hornbeam forests (Erythronio Carpinion)	Pyje ilirike të përzier dushku dhe shkoze (Erythronio Carpinion)
91M0	Pannonian-Balkan turkey oak-sessile oak forests	Pyje të përzier dushqesh {kryesisht qarri (Quercus cerris), shparthi (Q. Frainetto) dhe bunge (Q. Petraea)} të Panonisë dhe Ballkanit
92	Mediterranean deciduous forests	Pyje gjetherënës Mesdhetarë
9220	Apennine beech forests with Abies alba	Pyje ahu të Apenineve me bredh të bardhë Abies alba
925A	Hop-hornbeam, oriental hornbeam and mixed thermophilous forest	Pyje me mëllezë, shkozë dhe pyje të përzier termofilë
95	Mediterranean and Macaronesian mountainous coniferous forests	Pyje malorë halorësh Mesdhetarë dhe të Makaronezisë
9530	(Sub-) Mediterranean pine forests with endemic black pines (Pinus nigra)	Pyje halorësh (Sub-) Mesdhetarë të dominuar nga pisha e zezë endemike (Pinus nigra)
9540	Mediterranean pine forests with endemic Mesogean pines, including Pinus mugo and Pinus leucodermis	Pyje mesdhetarë pishash endemike Mesogean të zonave të larta malore, ku përfshihen Pinus mugo dhe Pinus leucodermis

3.1.4. Fauna in Korab protected area

The fauna is represented by 37 species of mammals. Large mammals such as the brown bear (*U. arctos* L.), grey wolf (*C. lupus* L.), balkan lynx (*L. lynx balcanicus* Bures.), roe deer (*C. capreolus* L.), wild boar (*S. scrofa* L.), weasel (*M. nivalis* L.), European pine marten (*M. martes* L.), and red squirrel (*S. vulgaris* L.) can be found in the area. It also contains a variety of suitable habitats that support dense populations of birds such as the golden eagle (*A. chrysaetos* L.), western capercaillie (*T. urogallis* L.), peregrine falcon (*F. peregrinus* Tunstall.), common buzzard (*B. buteo*

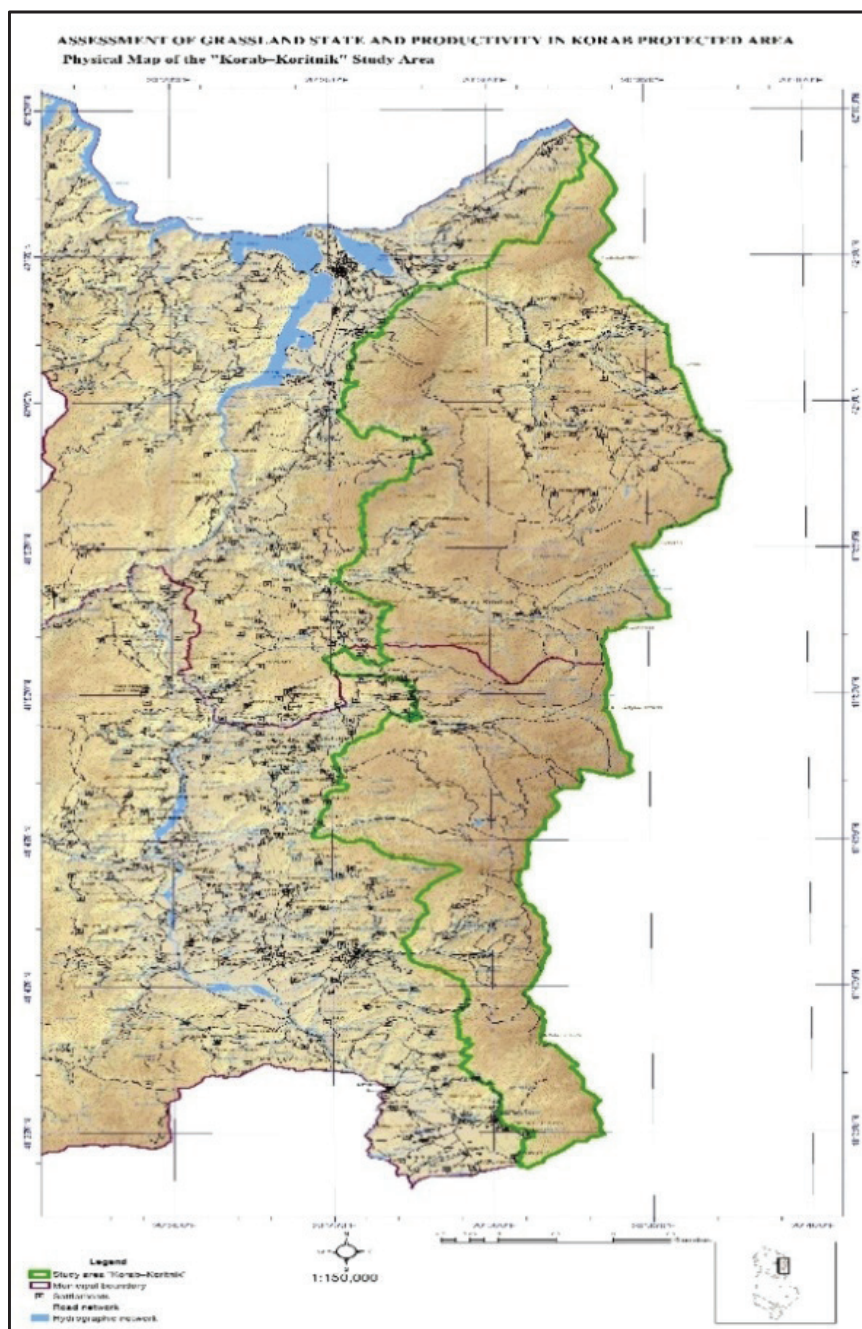


Figure 6. Physical map of Korab protected area

L.), accipiter gentilis (*A. gentilis* L.), Eurasian eagle-owl (*B. bubo* L.), Hazel grouse (*T. bonasia* L.) and many other.

3.1.5. Population within Korab protected area

About 19,000 people live within the natural part boundaries. This is a very small part of the population of Kukes and Diber qarks. The people who live in this mountain area are mostly poor and live in rural areas. They are also very affected by structural unemployment. The situation is much better in the nearby plain or foothill areas.

Table 1. Administrative borders and surface of the Koran natural park

District	Commune	Village	Surface (ha)
Kukës	Bicaj	Tërshana	2,358.60
	Bushticë	Bushticë	490.26
	Grykë Çaje	Çaje; Shehe, Shkinak, Buzëmadhe dhe Fshat	9,021.24
	Shtiqen	Shtiqen	2,096.39
	Shishtavec	Shishtavec (Bafa), Novosej, Dishaj, Shtreza, Kollovozi, Oreshka, Borja, Cernaleva	5,961.23
	Tërthore	Tërthore	2,602.53
	Topojan	Turaj, Allarej, Topojan, Xhaferaj, Brekija, Nimca, Teja, Lojmja, Pershkila, Torocic	7,113.58
	Ujmisht	Ujmisht	229.14
	Zapod	Zapod; Belja; Pakishti; Orgjesti; Orickla; Kosharishti	4,365.67
Surface Kukes District			34,238.64
Diber	Kalaja e Dodës	Radomira (Stordok), Radomira (Rade), Radomira, Radomira (Derbac), Radomira (Cerniev), Cereni, Ploshtani, Vasia	7,466.44
	Kastriot	Kastriot	1,102.68
	Maqellarë	Kërcishti i Epërm	2,814.92
	Melan	Zagradi; Rabdishti; Bellova; Cerjani	4,328.26
	Sllovë	Venishti	3,873.35
	Tomin	Tomin	25.85
Surface Diber District			19,611.50
Total Mountains Natural Ecosystem "Korab - Koritnik Natural Park"			53,850.14

4. Study of grasslands in Korab protected area

4.1. Ecological and socio-economic importance of grasslands in the project area

It is very important to study the alpine and subalpine grasslands in Korabi National Park because they are important for the environment, culture, and climate. In Albania's highest and one of its most important protected areas, understanding how they work helps protect biodiversity, use resources wisely, and deal with climate change. The Korab–Koritnik Natural Park protects a wide range of mountain landscapes, such as postglacial relief shapes, deep gorges, and rock formations. Alpine and subalpine grasslands are home to many rare, native, and specialized plant species that have adapted to live in very harsh conditions. Korabi, the tallest mountain in Albania, is home to these communities in a way that no other place can. Many mammals, birds, and invertebrates, including some that are in danger of extinction, use them as places to eat and breed. These species depend on open high-altitude ecosystems. Grasslands help to control the water cycle, stop soil erosion on steep slopes, and store carbon, which helps to slow down climate change. Changes in temperature and precipitation have a big effect on alpine ecosystems. Keeping an eye on these grasslands can help us spot signs of climate change before they happen. People have always used subalpine grasslands to graze their animals in the summer. This is an important part of the local economy and culture. These meadows are home to many useful medicinal and fragrant plants that help people make a living by harvesting them in a way that doesn't harm the environment. Alpine landscapes are one of the most beautiful things about Korabi National Park. They attract hikers, climbers, and nature lovers.

4.2. Objectives of the grassland assessment

The objectives of the assessment of Korab-Koritnik grasslands were;

- Evaluation of the current conditions of grasslands (e.g., productivity, degradation level, biodiversity).
- Matching of animal requirements and grasslands production
- Accurately assessment of feed requirements and feeding needs
- Identification of the main drivers influencing grassland health and productivity (climate, grazing pressure, soil erosion, invasive species, etc.).
- Identification of sustainable grassland management and restoration interventions.

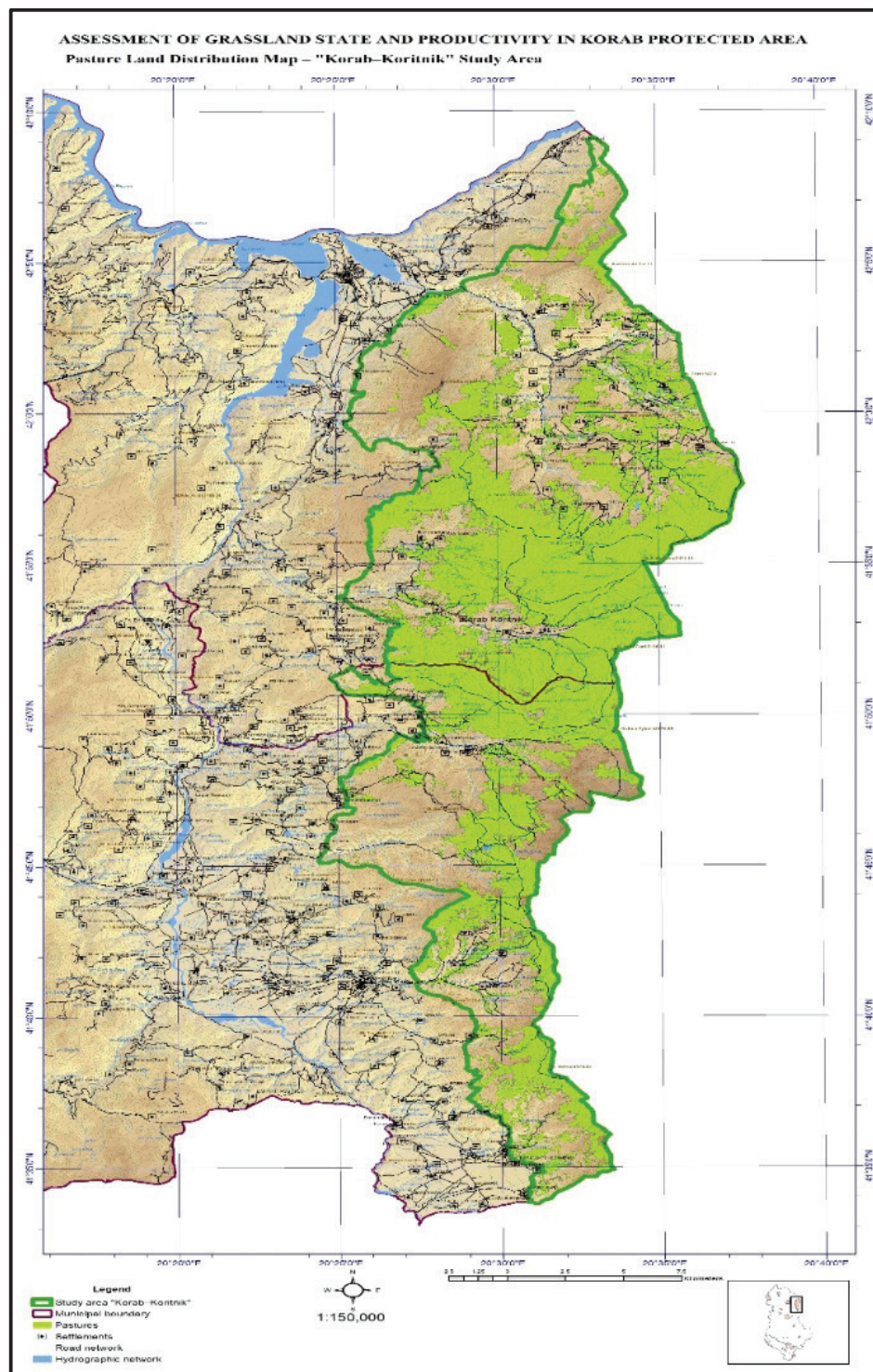


Figure 7. Pasture distribution in the Korab protected area

5. Methodology used for grassland assessment

5.1. Introduction

Farmers need to know how to monitor and map pasture biomass in large grazing systems so they can make timely decisions about how to manage their livestock, such as how much pasture to give them each day, how many animals to keep on each field, or how often to move them between fields. Estimating how productive a pasture is at different points in its growth cycle is an important part of planning and figuring out how much forage is needed and how to supplement feeding. This is a key step in making grazing systems more efficient. You can measure how productive a pasture is by using direct or indirect methods. The traditional (direct) method involves collecting biomass from certain sampling areas, which takes a long time and costs a lot of money because a lot of samples are needed to accurately represent a field. Farmers can't do this every day as part of their regular management. Because this method doesn't work well on farms, other indirect methods have come up that can quickly give an estimate of productivity and its spatial variability over large areas. This is one of the most important things that needs to be done before new Precision Agriculture strategies can be put into action. With recent advancements in information technologies, remote and proximal sensing, and geospatial analyses supported by global positioning systems, it is increasingly feasible to identify and analyze the temporal and spatial variability within fields to optimize yield and safeguard the environment.

5.2. Grassland assessment using remote-sensing and satellite data

One proposed method for quantifying and mapping the variability in pasture production relies on the measurement of spectral vegetation indices, primarily the NDVI (Normalized Difference Vegetation Index) and Equation (1), which is derived from assessing the reflectance of radiation emitted by plants at specific wavelengths through satellite imagery^{2,3}.

This information was collected by satellite remote sensing imagery (RS), unmanned aerial vehicles (UAV) or by means of ground-based vehicle mounted proximal

2. Edirisinghe, A.; Hill, M.J.; Donald, G.E.; Hyder, M. Quantitative mapping of pasture biomass using satellite imagery. *Int. J. Remote Sens.* 2011, 32, 2699–2724.

3. Louhaichi, M.; Hassan, S.; Clifton, K.; Johnson, D.E. A reliable and non-destructive method for estimating forage shrub cover and biomass in arid environments using digital vegetation charting technique. *Agrofor. Syst.* 2018, 92, 1341–1352

sensors⁴. NDVI is a reliable indicator for vegetation vigor, chlorophyll activity, and overall biomass production. The NDVI (Normalized Difference Vegetation Index) is calculated as:

$$NDVI = \frac{(NIR - RED)}{(NIR + RED)}$$

where: **NIR** – near-infrared reflectance (Sentinel-2 Band 8, ~842 nm)

RED – red reflectance (Sentinel-2 Band 4, ~665 nm)

Table 2. NDVI values used in the interpretation

NDVI value	Ecological interpretation
< 0.1	Bare soil, rock or water surfaces
0.1 – 0.3	Sparse or degraded vegetation, dry pastures
0.3 – 0.5	Moderate vegetation (semi-dense grasslands)
0.5 – 0.8	Dense and healthy vegetation (lush alpine meadows, forest edges)

The Sentinel-2 L2A imagery used in this study represents selected dates that capture vegetation dynamics through different seasons and years.

Date	Seasonal context	Usage
21 July 2017	Early summer – baseline reference	Initial comparison
25 Aug 2017	Late summer, vegetation peak	NDVI maximum reference
30 June 2020	Warm, early summer period	Post-wet-season analysis
14 Aug 2020	Dry season	Post-fire and drought evaluation
24 June 2025	Early summer – vegetation recovery	First seasonal comparison
24 July 2025	Vegetative maturity	Mid-season reference
28 Aug 2025	End of summer, possible water stress	End-season comparison
30 Aug 2025	After local rainfall	Final control image

4. Nawar, S.; Corstanje, R.; Halcro, G.; Mulla, D.; Mouazen, A.M. Delineation of soil management zones for variable-rate fertilization: A review. *Adv. Agron.* 2017, 143, 175–245.

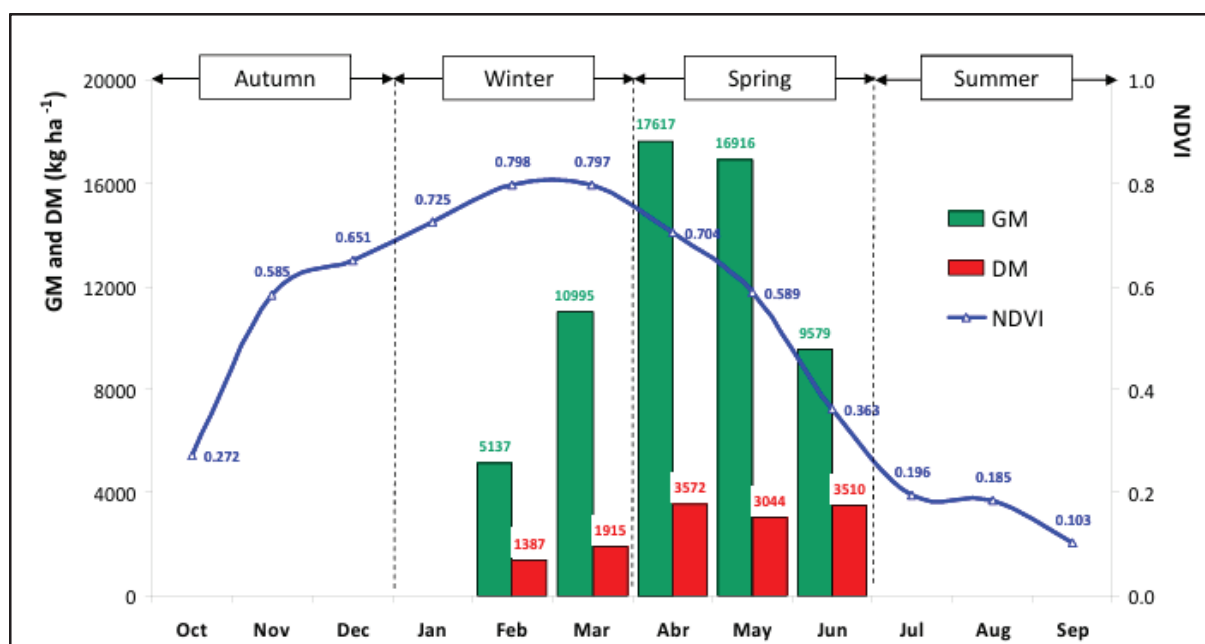


Figure 8. Seasonal change of Fresh and dry grass biomass, and NDVI

Although the use of satellite imagery is a very promising, low-cost and non-destructive technique, it has its own limitations. The restrictions known for applications of remote sensing systems in farm management include the following:

- (a) the gathering and delivery of images in an exceedingly timely manner;
- (b) the shortage of high spatial resolution, image interpretation and data extraction issues; and
- (c) the combination of those data with agronomic knowledge into expert systems.

5.3. Direct method to estimate the grassland productivity

We used both field evaluations and remote-sensing techniques to figure out how productive the grasslands were in the protected area of Korabi. We conducted our field survey according to the methodology put forth by Gintzburger and Saïdi (2008). This method includes vegetation surveys that look at the ecology, the types of plants, the percentage of perennial vegetation cover (VC) using intercept data, and the aboveground biomass of perennials, annuals, and ephemerals. Because we didn't have a lot of time or money, we used random sampling with the LIM (Line Intercept Method) and the QM (Quadrat Method) for all the main types of herbaceous vegetation.

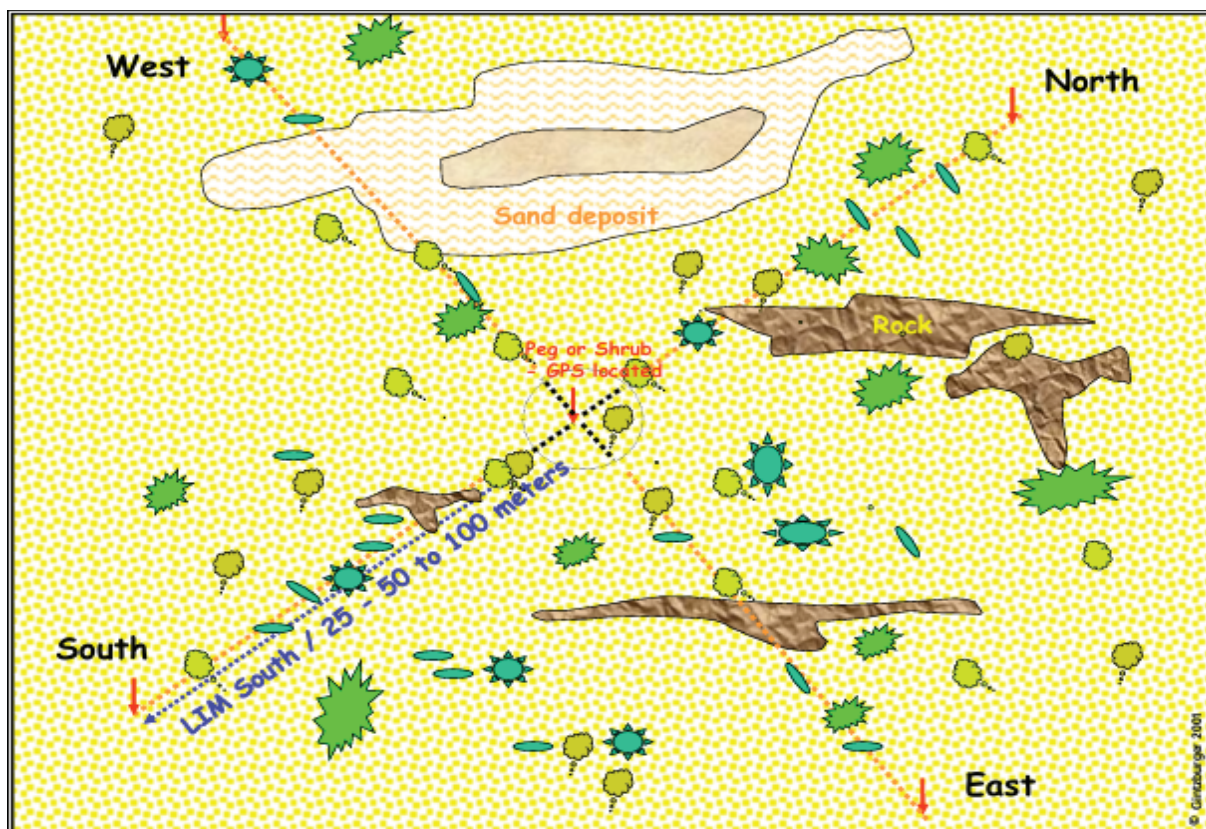


Figure 9. Field out of the Line Intercept Measurement (LIM)

The dataset maps high-altitude sampling points across Kukës and Dibër, mainly within the Korab–Koritnik mountain range. Elevations range from **1582 m** (Kroi Hasan Begut, Kukës) to **2149 m** (Gurrë e Zezë/Çajë, Kukës) indicating these are **subalpine to alpine ecosystems**. The highest peaks (Grame, Illicë, Gurrë e Zezë/Çajë) correspond to **alpine grasslands, rocky outcrops, and biodiversity-rich high mountain habitats**.

Table 3. Location of the sampling plots to assess the pasture productivity

Nr	Local name	Region	Elevation (m a.s.l.)	Geographical coordinates	
				East	North
1	Guri Mengjezes	Kukes	1713	20.60820	41.94660
2	Guri Mengjezes	Kukes	1679	20.53691	41.93315
3	Guri Mengjezes	Kukes	1778	20.51071	41.93477
4	Kroi Hasan Begut	Kukes	1582	20.51372	41.98730
5	Kroi i Bardhe	Kukes	1783	20.48701	41.95594
6	Llakator	Kukes	1584	20.46130	41.96026
7	Gurre e Zeze/Caje	Kukes	1651	20.45278	41.79858
8	Gurre e Zeze/Caje	Kukes	2149	20.51818	41.82780

9	Kufiri Kukes/Diber	Kukes	1893	20.47124	41.86702
10	Bjeshka e Carakollit	Diber	1990	20.48015	41.86082
11	Grame	Diber	2145	20.50255	41.84642
12	Illice	Diber	2000	20.51980	41.65796
13	Illice	Diber	2045	20.51610	41.66184
14	Illice	Diber	1925	20.51942	41.65318

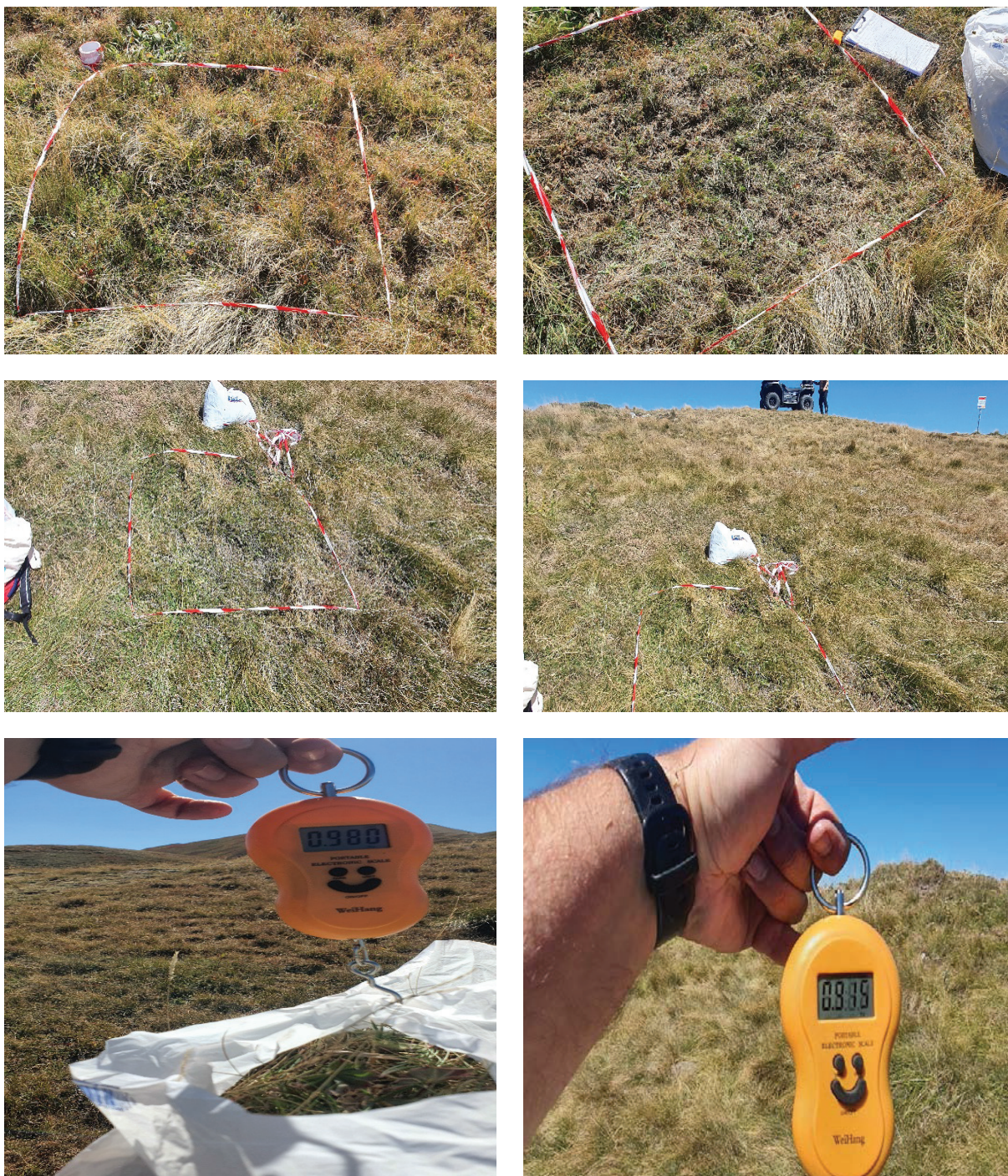


Figure 11. Field sample plot establishment and grass weighing



Figure 12. Grass samples sent to laboratory for dry biomass determination

5.4. Remote Sensing and GIS Mapping

We made a baseline model of the grasslands in the Korab–Koritnik area using GIS technology and satellite images that were available, like Landsat TM and Sentinel-2. This model was used to look at the current state of grasslands and to help figure out the best ways to manage and intervene. The evaluation concentrated on the following essential elements:

1. Satellite Imagery and NDVI Analysis

Normalized Difference Vegetation Index (NDVI) was applied to track vegetation health and biomass productivity over time. NDVI, derived from multispectral imagery (e.g., Sentinel-2, Landsat 8/9), is a reliable indicator of green vegetation density. **Seasonal NDVI comparisons** will help to distinguish differences in biomass among months in one year and then to adapt pasture management strategies. **Time-series NDVI trends** (5–10 years) were analyzed to evaluate long-term changes in grassland productivity linked to **climate variability, land use shifts, or overgrazing**.

2. Land Use / Land Cover (LULC) Classification

LULC change detection was used to provide insights into the spatial distribution of grassland areas, the extent of degradation, and opportunities for restoration. This analysis supports **spatial planning** and guide interventions in the most affected areas.

5.5. Participatory Assessments of grasslands conditions in Korab-Koritnik

A participatory method was used to check the health of the grasslands, and local herders and farmers were actively involved as the main sources of information. This made sure that traditional ecological knowledge added to technical assessments and helped the community feel like they owned future land management plans.

Several pastoral communities in the park were the sites of in-depth interviews. The talks were mostly about seasonal grazing practices, how much grassland is available, how much livestock pressure there is, and how visible signs of degradation or regeneration are. We talked to a lot of people and had meetings with them to get useful information about grasslands and bring up current problems. We did interviews and meetings with a number of important people in addition to the field surveys to get information about grasslands and find out what the main problems are right now.



Figure 13. Meeting and interviewing of local stakeholders in Kukes region

The participants represented both institutional stakeholders and local users of the grasslands:

Table 4. List of Interviewed persons

No	Name Surname	Municipality/location	Profession
1	Lefter Gjana	Kukes	Head of RAPA Kukes
2	Agim Noka	Shishtavec/Kukes	Head of the Forest & Pasture User Association
3	Visar Mataj	Kolesjan	Ranger at RAPA Kukes
4	Gjelen Hoxha	Shishtavec/Kukes	Shepherd
5	Shaban Murati	Shishtavec/Kukes	Shepherd
6	Xhevdet Murati	Shishtavec/Kukes	Shepherd
7	Denisi	Matranxh-Bushtrice/Kukes	Shepherd
8	Rauf Spahiu	Shkinak	Ranger at RAPA Kukes
9	Ulvi Fido	Illice/Diber	Shepherd
10	Bekim Qosja	Peshkopi	RAPA Diber

Herders shared their experiences and highlighted several concerns, including:

- Increasing presence of unpalatable or invasive plant species.
- Climate variability affecting grassland conditions.
- Soil compaction and erosion around water sources and livestock shelters due to concentrated grazing.

Participants also informed us about the traditions of transhumance, the state of traditional grassland governance, and the increasing competition for grazing land. Elders and herders talked about how the grasslands have changed over time, giving us site-specific information about long-term changes in the environment. The main topics of discussion were:

- The state of high-altitude grasslands and the number of livestock and related infrastructure;
- Grazing near settlements as a sign of localized overuse of natural resources;
- The current state of medicinal and high-nutrition forage species in grazed grasslands.

These insights showed how changes in society and the economy, like young people moving away and fewer people herding livestock, have had a big effect on how grasslands are used and managed.

6. Results of the study

6.1. Grassland productivity in sampling points

The dataset includes 14 grassland sampling points in the Kukës and Dibër regions, with elevations between 1582 m and 2149 m a.s.l. We measured the sample area (mostly 1 m², but one plot was 4 m²) and the weight of the fresh grass for each plot. The fresh biomass is measured in grams per plot and then converted to quintals per hectare (kv/ha). The table and graph below show how productive the grasslands were at 14 sampling points in the Korab protected area. These numbers show that grassland productivity can vary a lot, even in the same area (for example, the Illicë plots range from 12.5 to 98 kv/ha). Grassland productivity in Kukës and Dibër varies greatly from place to place, with yields ranging from 12.5 to 112 kv/ha.

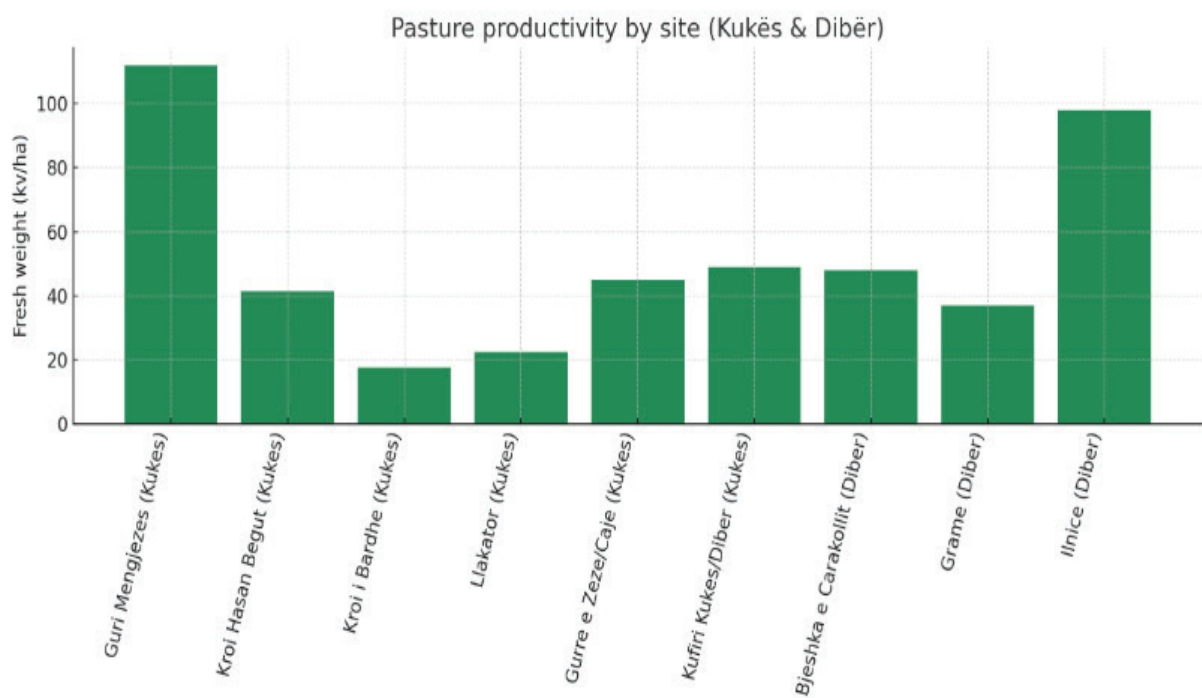


Figure 14. Pasture productivity by sites in the study area

Dibër grasslands generally have higher average productivity, while Kukës grassland productivity shows more variability. Some sites (e.g., *Kroi i Bardhë*, *Llakator*) appear heavily degraded or overgrazed, reflected in their very low yields. The wide variation within *Illicë* suggests heterogeneous grassland condition in the same locality. The scatter plot shows how productivity (fresh weight) varies with elevation:

- **Class IV** sites (high productivity) have the **highest yields** (≈90–112 kv/ha) and are often found at **higher elevations (≥1900 m)**.
- **Class II** sites (moderate productivity) are the most common, averaging around **40–50 kv/ha**.
- **Class I** sites (very low productivity) cluster around **lower productivity (12–25 kv/ha)**, scattered across elevations.

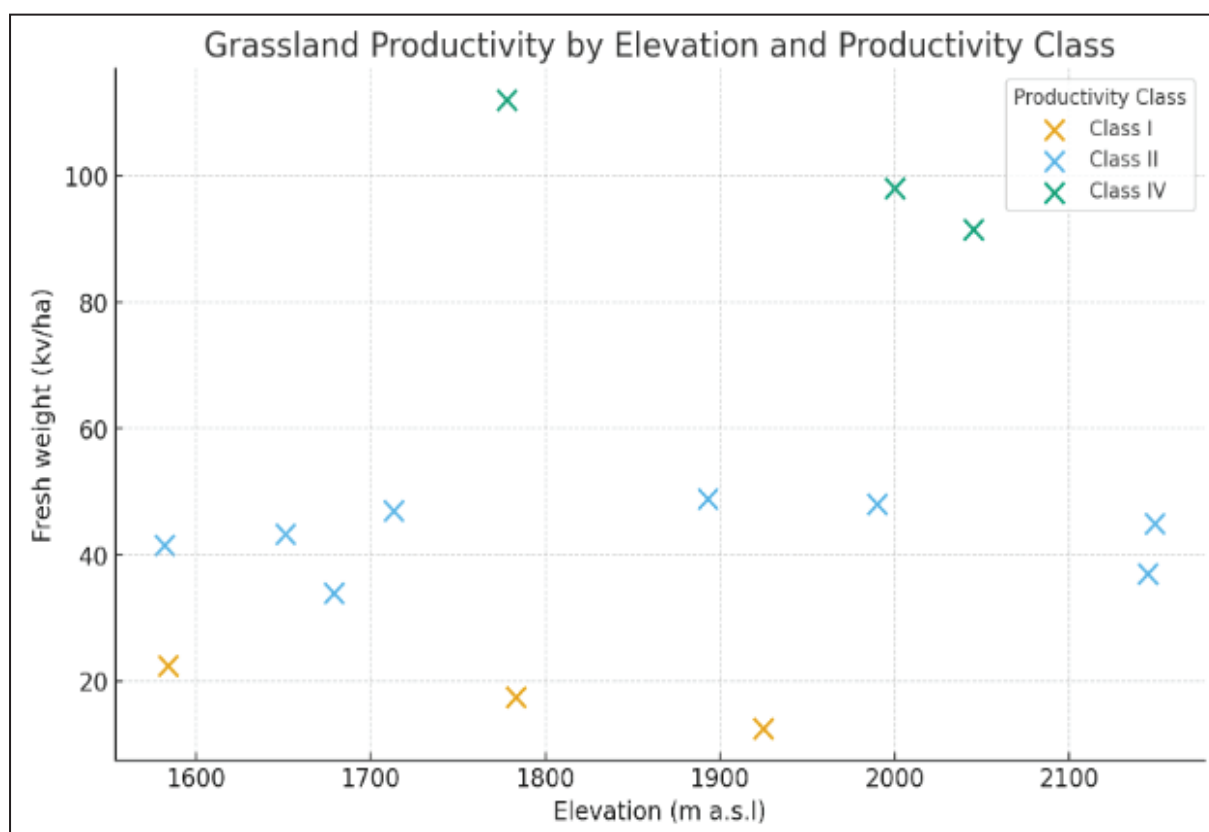


Figure 15. Grassland productivity by elevation and productivity class

Although there is no direct linear correlation between elevation and productivity, **high-elevation areas (1900–2100 m)** tend to include more **productive (Class IV)** grasslands, likely due to favourable soil and moisture conditions.

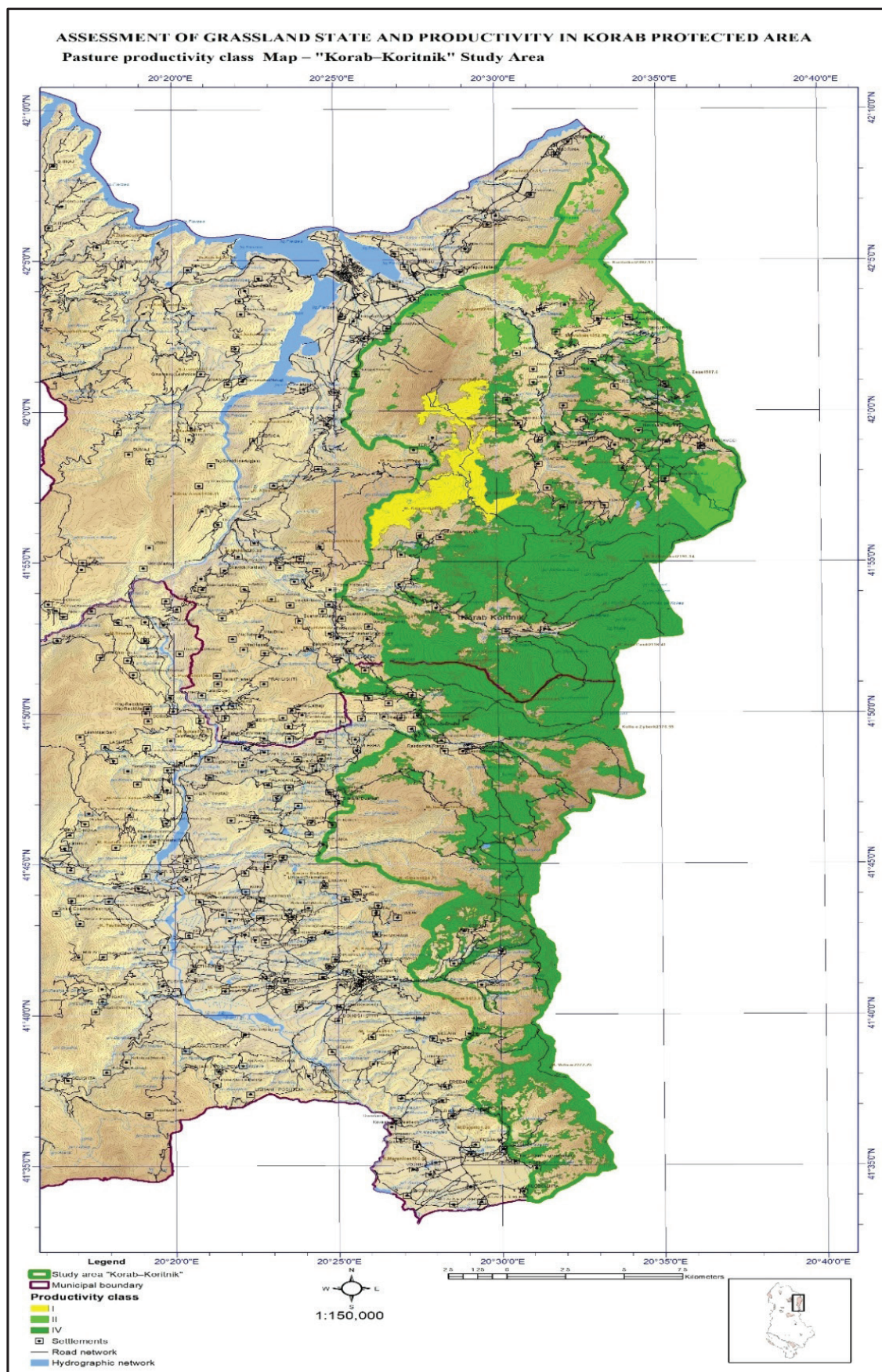


Figure 16. Grassland productivity across Korabi protected area

Table 5. Location and fresh weight of grass in sampling points

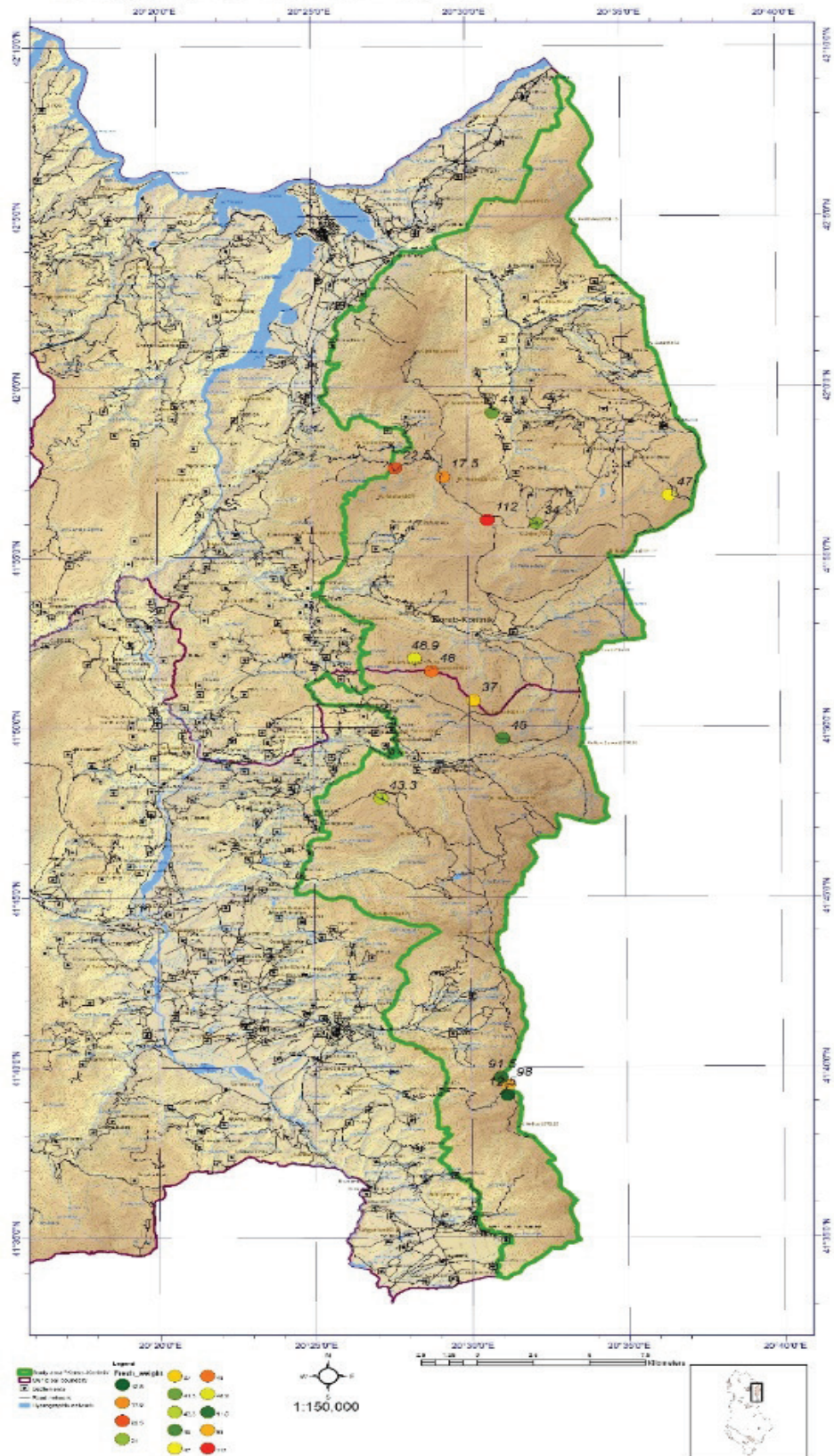
No	Local name	Region	Elevation (m a.s.l)	Geographical coordinates		Sample plot area (m ²)	Fresh weight of grass (gram)	Fresh weight (kv/ha)
				East	North			
1	Guri Mengjezes	Kukes	1713	20.6082	41.9466	1	470.0	47.0
2	Guri Mengjezes	Kukes	1679	20.5369	41.9332	1	340.0	34.0
3	Guri Mengjezes	Kukes	1778	20.5107	41.9348	1	1120.0	112.0
4	Kroi Hasan Begut	Kukes	1582	20.5137	41.9873	1	415.0	41.5
5	Kroi i Bardhe	Kukes	1783	20.4870	41.9559	1	175.0	17.5
6	Llakator	Kukes	1584	20.4613	41.9603	1	225.0	22.5
7	Gurre e Zeze/Caje	Kukes	1651	20.4528	41.7986	4	1730.0	43.3
8	Gurre e Zeze/Caje	Kukes	2149	20.5182	41.8278	1	450.0	45.0
9	Kufiri Kukes/Diber	Kukes	1893	20.4712	41.8670	1	489.0	48.9
10	Bjeshka e Serakollit	Diber	1990	20.4802	41.8608	1	480.0	48.0
11	Grame	Diber	2145	20.5026	41.8464	1	370.0	37.0
12	Ilnice	Diber	2000	20.5198	41.6580	1	980.0	98.0
13	Ilnice	Diber	2045	20.5161	41.6618	1	915.0	91.5
14	Ilnice	Diber	1925	20.5194	41.6532	1	125.0	12.5

The average grassland productivity in the Kukes area is about 43 kv/ha, but most values are between 22 and 49 kv/ha. The median grassland productivity in the Kukes region is higher, at about 48 kv/ha, but the box shows more variation.

The values for grassland productivity range from very low (12.5 kv/ha) to very high (98 kv/ha). These data show that the Dibër grasslands are more varied, with some areas being very productive and others being degraded.

We observed that grassland productivity was not contingent upon elevation. Elevation does not always affect the productivity of grasslands. There are both high and low yields at mid (1600–1800 m) and high (2000–2150 m) elevations. This means that things like soil fertility, grazing pressure, water availability, and species composition have a bigger effect on grassland productivity than elevation. The differences show that factors that are specific to each site, like management, grazing pressure, species composition, and micro-climate, are important for determining the condition of grasslands, not just elevation.

ASSESSMENT OF GRASSLAND STATE AND PRODUCTIVITY IN KORAB PROTECTED AREA
Fresh weight (kv/ha) Map – "Korab-Koritnik" Study Area



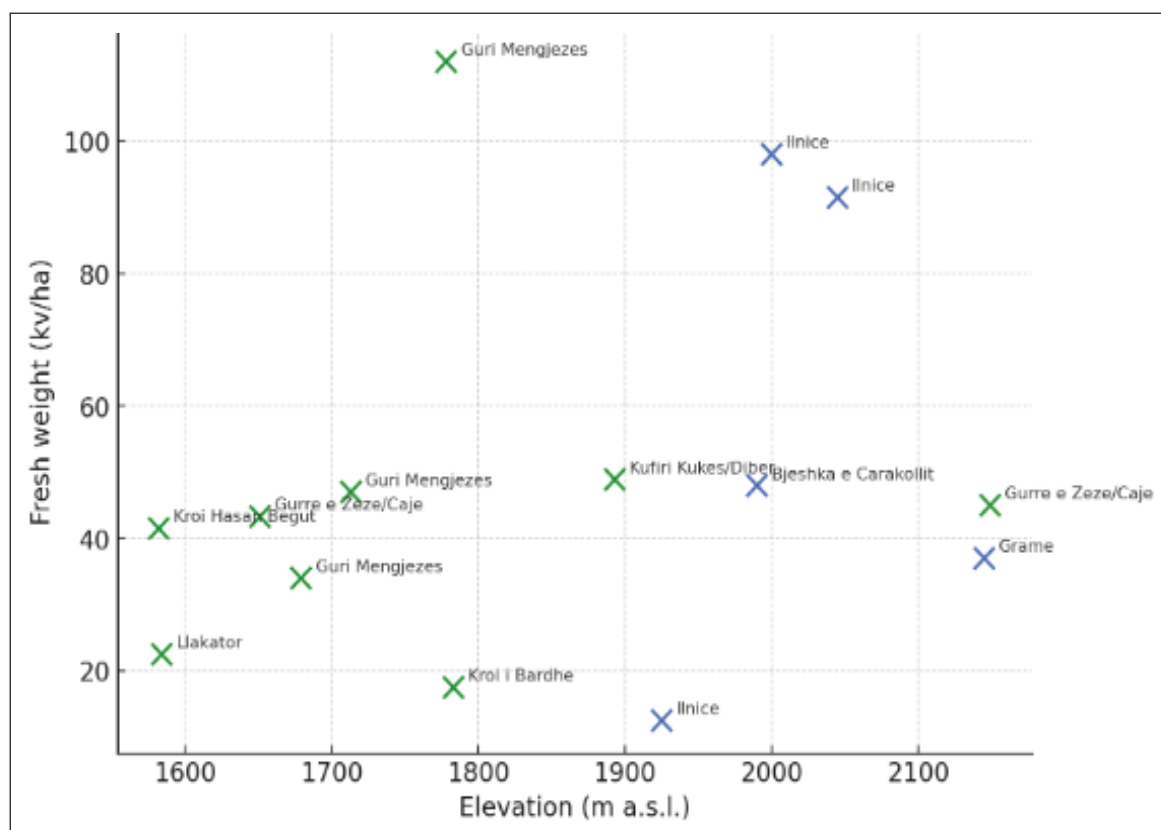


Figure 18. Relationship between elevation and pasture productivity in the Korab nature park

6.2. Carrying capacity and stocking rate of grasslands in Korab protected area

The carrying capacity of a pasture is the maximum number of livestock that can be sustained on it over a long period without degrading the land. It is determined by the amount of forage a pasture can produce, which is influenced by factors like soil, climate, and the type of plants. The stocking rate is the number of animals that are currently grazing in a certain area. The data gathered in the field shows that there are currently 23,300 animals grazing in the grasslands, with sheep being the most common type.

Table 3. Number of livestock raised by farmers in Korab nature park

No	Location	Number of Livestock			Number of shepherds
		sheep	goat	cow	
1	Gryke Çaje	8000		500	15
2	Buzemadhe	2000		500	35
3	Fshat	5000		400	9
4	Shkinak	4000		700	12
5	Ilnice	200			1
6	Hinoske	2000		300	5
	TOTAL	21200	0	2100	77





Figure 19. Main animals grazing in Korab grasslands (photo by authors)

To calculate the stocking rate, we normally express it as the number of Livestock Units (LSU) per hectare of grazing land. We first need to convert data on the table above them into standardized livestock units using the following conversion coefficients:

- 1 sheep = **0.15 LSU**
- 1 goat = **0.15 LSU**
- 1 cow = **1 LSU**

Table 4. Calculation of the stocking rate by locations within Korab nature park

No	Location	Number of Livestock			LSU
		sheep	goat	cow	
1	Gryke Çaje	8000		500	1700
2	Buzemadhe	2000		500	800
3	Fshat	5000		400	1150
4	Shkinak	4000		700	1300
5	Illice	200			30
6	Hinoske	2000		300	600
	TOTAL	21200	0	2100	5580

The stocking rate per hectare is:

$$\text{Stocking rate} = \frac{\text{Total LSU}}{\text{Total Grazing Area}} = \frac{5.590}{26,358.5} = 0.21 \text{ LSU/ha}$$

The overall stocking density in Korab grasslands is low to moderate, which is what you would expect to find in mountainous and semi-natural pastures. A range of 0.2–0.4 LSU/ha is usually thought to be sustainable in well-managed alpine systems. The Korab grasslands now have about 0.21 LSU/ha (5580 LSU over 26358.5 ha). Even though this is within the acceptable range for mountain pastures, signs of degradation suggest that the system may already be working at or above its sustainable carrying capacity.

When you look at stocking rates by area, it's easy to see that they are very different. Buzemadhe and Shkinak are both above the average value (0.21 LSU/ha), which means that there are more grazing pressure and a higher risk of overuse. Ilnicë, on the other hand, has the lowest stocking rate, which is much lower than average. This suggests that the grazing intensity is low. Other areas, like Fshat, Gryke Çaje, and Hinoskë, are close to the overall average, which means that the grazing pressure is pretty even.

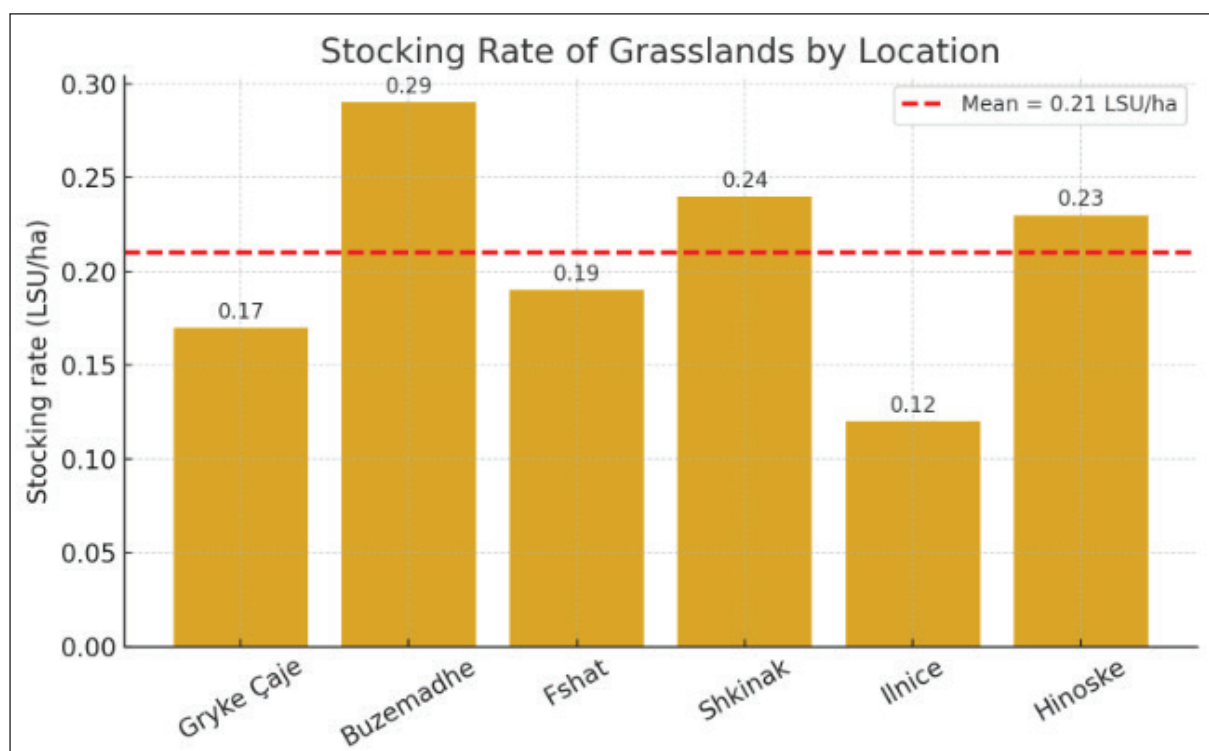


Figure 20. Estimated stocking rate in each zone in Korab grasslands

Carrying capacity of grasslands in Korab protected area was determined using the following equation:

$$K = \frac{P}{R \times D} = \frac{2,620}{1.5 \times 195} = 9 \text{ krerë/ha}$$

where: **P** – Pasture yield in kg/ha;

R – Daily grass ration in kg per 1 animal;

D – Duration of the grazing season (time) in days.

The carrying capacity at park level is around **237227 heads**. Based on the local site conditions (soil, slope, rainfall, management), the table shows that pasture productivity can vary a lot. The carrying capacity is between 1 and 17 heads per hectare. We observed that identical locations (e.g., Guri Mengjezes, Ilnice) exhibit significantly varied yields contingent upon the sampling area, attributable to disparities in micro-conditions or grazing pressure. Capacity is about 8 to 9 heads per hectare on average across all sites. If the stocking rates go above this, there is a risk of overgrazing. The bar chart shows how many animals can fit in each pasture (heads/ha).

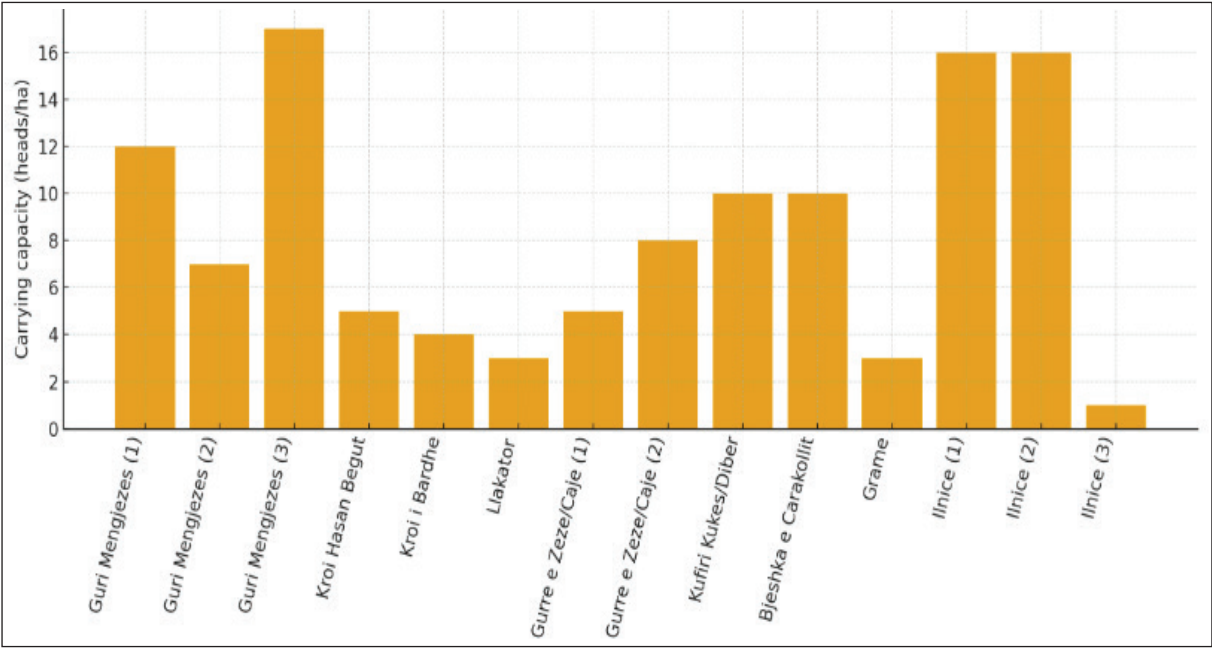


Figure 21. Carrying capacity of grasslands by location

Management should balance grazing pressure to avoid overuse of weak pastures and take advantage of the more fertile ones. We combined the data of pasture yield and carrying capacity and the results showed that carrying capacity is proportional to pasture yield. From graph we see that sites with high yield (e.g., *Guri Mengjezes* (3), *Ilnice* (1,2)) providing food for the most animals, while low-yield pastures (*Ilnice* (3), *Grame*, *Llakator*) can barely sustain livestock.

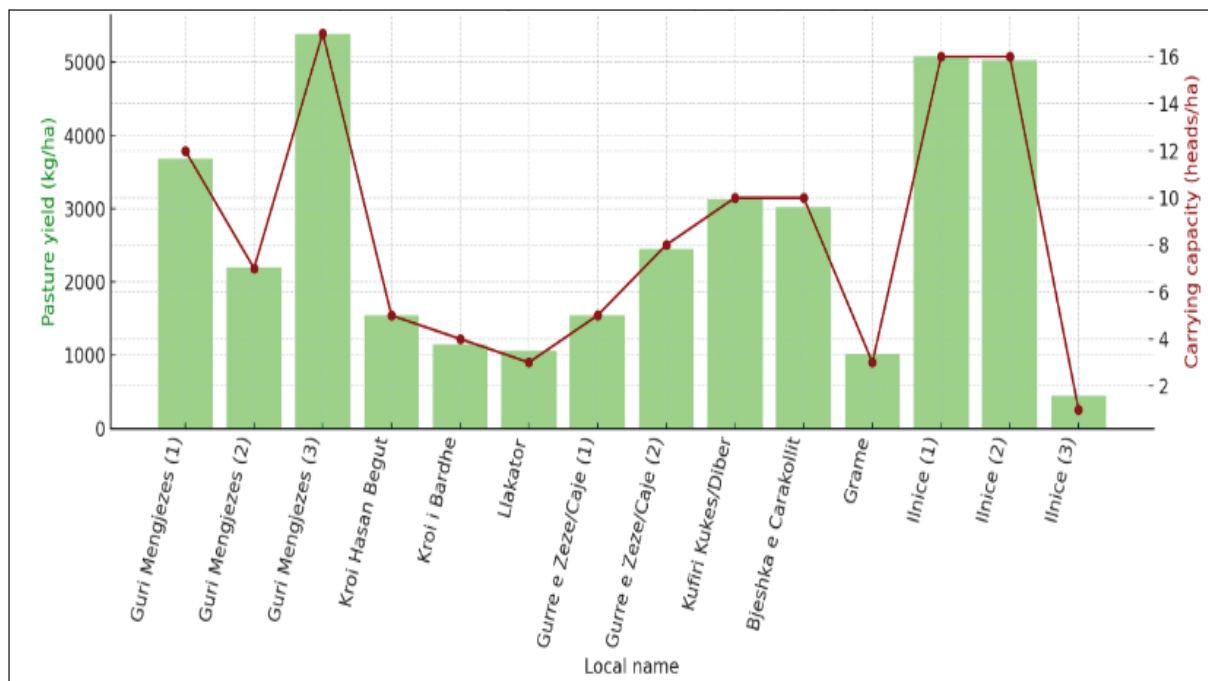


Figure 22. Comparison of forage yield and carrying capacity by location

6.3. Quality assessment of grassland in Korab protected area

6.3.1. Assessment of grassland types by locations

The quality of a grassland is ultimately determined by how close it is to a natural or high-value semi-natural state. High-quality grasslands are typically ancient, unimproved, and rich in native species. We applied a combination of rapid and botanical assessment referring using the indicators presented in Table 5:

Table 5. Quality assessment criteria and indicators for grasslands in Korab protected area

Assessment Criteria	High Quality Indicators	Low Quality Indicators
Species Richness	High. Many different species in a small area.	Low. Dominated by a few grass species.
Positive Indicators	Many present. Habitat-specific specialist species are common.	Few or absent. Only common, widespread species.
Negative Indicators	Absent or rare.	Abundant. Especially competitive grasses and weeds.
Sward Structure	Diverse and varied. Mix of heights and structures.	Uniform and dense. Like a lawn or a rye-grass ley.
Soil & History	Unplowed, unimproved. No history of fertilizer or reseeded. Shallow, low-fertility soil.	Plowed, reseeded, improved. Deep, fertile soil.

Management	Light grazing, late mowing , cuttings removed.	Heavy stocking, silage cutting , frequent fertilizer use.
Evidence of Disturbance	Minimal . No drainage, poaching, or pesticide use.	Obvious . Drainage ditches, vehicle ruts, nutrient runoff.

Below we have presented the quality assessment results of all grasslands types in the study area:

Site 1: Guri i Mengjezes

In this location, we discovered a combination of high-quality, semi-natural indicators (e.g., *Thymus* spp., *Polygala vulgaris*, *Festuca* spp., *Dianthus* spp.), one fertility indicator (e.g., *Arrhenatherum elatius*), and mesic/dry grassland elements represented by *Poa*, *Potentilla*, and *Cyperus*. This composition suggests a transitional grassland between dry calcareous and mesotrophic grasslands — often referred to as semi-natural dry grassland with mesic tendencies. The EUNIS Habitat Classification says that this grassland is EUNIS code: E1.26 — Semi-natural dry calcareous grassland (*Festuco-Brometalia*). The EU Habitats Directive 92/43/EEC says that the same habitat type is 6210 – Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*).

Species	Type / ecological meaning
<i>Poa karabenthis</i>	A <i>Poa</i> (bluegrass), often indicates mesic, moderately productive grassland .
<i>Dianthus</i> spp.	Wild pinks, typical of dry, calcareous, species-rich grasslands .
<i>Thymus</i> spp. / <i>Thymus praecox</i>	Thyme, a dry, nutrient-poor, calcareous indicator .
<i>Cyperus</i>	Sedge, sometimes indicates slightly damp to mesic soils , depending on species.
<i>Potentilla</i> spp.	Often found in moderately dry, well-drained grasslands .
<i>Festuca</i> spp.	Fescues are key components of semi-natural grasslands , especially dry, low-fertility types.
<i>Polygala vulgaris</i>	Milkwort, high-quality indicator of unimproved, species-rich grassland .
<i>Arrhenatherum elatius</i>	False oat-grass, tall, coarse grass typical of improved or more fertile grasslands .
<i>Genista sagittalis</i>	Woadwaxen, acidic or dry poor grassland indicator .

They indicate that site is transitional between species-rich, semi-natural dry grassland (*Festuca-Thymus-Dianthus* type) and mesotrophic, slightly improved grassland (*Arrhenatherum-Poa* type). Based on the common European grassland quality criteria we determined the ecological values of grasslands in this site:

Quality class	Description	Fit for your species list
High-quality (species-rich calcareous / dry grassland)	Dominated by <i>Festuca</i> , <i>Thymus</i> , <i>Polygala</i> , <i>Dianthus</i> , <i>Genista</i> ; few tall coarse grasses	✓ Most species indicate this
Medium-quality (semi-improved grassland)	Still has some indicator species but with increasing <i>Poa</i> , <i>Arrhena therum</i> , <i>Cyperus</i>	✓ Some species indicate this
Low-quality (improved / fertilized)	Dominated by <i>Arrhena therum</i> , <i>Poa</i> , without herbs	✗ Not the case here

Based on the presence of characteristic species like *Festuca*, *Thymus*, and *Dianthus*, this is a good-to-high quality, semi-natural, dry to mesic grassland growing on moderately dry, low-fertility soil that requires continued low-intensity grazing or mowing without nutrient inputs to conserve its biodiversity.

Site 2: Kroj i Hasan Begut

These species are typical of mountain hay meadows or subalpine tall-grass communities found in the Alps, Carpathians, or central European mountain regions. They are growing on fresh to moist soils with moderate fertility and are species-rich grasslands.

Species	Ecological indication
<i>Veratrum nigrum</i> (black false hellebore)	A montane to subalpine forb, prefers fresh to moist, nutrient-rich mountain soils, often in tall-herb or fresh mountain meadow communities.
<i>Festuca</i> spp.	Grasses typical of many grassland types; alpine and subalpine <i>Festuca</i> (e.g., <i>Festuca rubra</i> , <i>F. pratensis</i>) indicate moderately fertile meadows.
<i>Cerastium</i> sp.	Chickweeds, usually montane/alpine, common in well-drained grasslands.
<i>Phleum alpinum</i> (alpine timothy)	Strong indicator of montane–alpine, moist or mesic meadows. Prefers cool climates, not lowland dry grasslands.
<i>Geum montanum</i>	Classic subalpine/alpine forb of mountain meadows, mesic to moist, moderately nutrient-rich soils.

The EUNIS classification puts this grassland in the habitat type E2.3, which is a mountain hay meadow. The EU Habitats Directive calls it a mountain hay meadow (Polygono-Trisetion). Based on the species found, this grassland can be seen as a high-value, traditionally managed mountain hay meadow that is in good shape. Its ecological health depends entirely on the continuation of its specific, low-intensity farming methods.

Site 3: Kroj i Bardhe

This grassland is a semi-improved, mesic (moderately moist) pasture on neutral to calcareous soil. It is in a state of transition or conflict between high-naturalness grassland and land that is managed more intensively. It has a valuable ecological core, but it looks like it has been changed in the past.

Species	Ecological meaning / indicator traits
<i>Poa pratensis</i> (smooth meadow-grass)	Common grass of moderately fertile, mesic to moist pastures, often improved or grazed swards.
<i>Dactylis glomerata</i> (cock's-foot)	Tall, competitive, nutrient-loving grass → signals fertile soils, often semi-improved or fertilized grasslands.
<i>Juncus inflexus</i> (hard rush)	Indicates periodic soil wetness, moist-wet neutral soils; typical of poorly drained pastures.
<i>Cynosurus cristatus</i> (crested dog's-tail)	Characteristic of old, semi-natural grasslands on moderate fertility soils — a positive indicator of traditional management.
<i>Melica ciliata</i>	Dry, calcareous grassland species, adapted to well-drained slopes, prefers low fertility.

Dactylis glomerata (cock's-foot) is a good sign of moderately high soil fertility, which is usually the result of past fertilization or nutrient input. *Poa pratensis* is a common grass in productive, managed pastures, which supports this. The presence of *Cynosurus cristatus* (crested dog's-tail) is a significant positive indicator. It is a classic species of old, traditionally managed grasslands, which means that this is not a new ley. This is the "semi-natural" pasture. The presence of *Melica ciliata*, a common plant in dry, low-fertility, calcareous grasslands, is very important because it shows that there are still areas of higher naturalness, probably on slightly drier, well-drained microsites like knolls or slopes. *Juncus inflexus* clearly shows that the soil gets too much water or doesn't drain well, making some parts of the field wet or moist. This grassland can be restored very well. The goal should be to lower the soil's fertility by stopping the use of fertilizers and removing cuttings if they are mowed. If possible, the moisture levels should also be kept under control. This would help the valuable *Cynosurus* and *Melica* grow better than the more competitive *Dactylis*, which would make the whole pasture better quality and more diverse. EUNIS classifies this pasture as E2.2 – Lowland mesic grassland (*Cynosurion* *ristate* or *Arrhenatherion* *elatoris* type), while the EU Habitats Directive (Annex I) classifies it as part of habitat type: 6510—Lowland hay meadows (*Arrhenatherion* *elatoris* type).

Site 4: Llakator

This group of species describes a high-quality, semi-natural, montane to subalpine calcareous grassland of the *Festuco-Brometalia* type. It is a habitat with a lot of different species on dry, sunny, base-rich slopes with poor soil fertility that is kept up by a lot of grazing. The combination of *Poa alpina* and *Plantago atrata* is a clear sign. These species are not common; they are specialists that live in montane-subalpine calcareous grasslands in major European mountain ranges like the Alps and Carpathians. This puts the habitat at a high altitude right away, on limestone or dolomite rock. The foundation grasses (*Festuca* spp.), the dwarf legume *Chamaecytisus hirsutus*, and the thermophilous *Achillea holosericea* are all classic signs of dry, sunny, calcareous slopes with low nutrient availability. The fact that they are common shows that the habitat is “dry grassland.” The presence of *Achillea millefolium* and *Hypericum perforatum* suggests a history of light disturbance, probably from heavy grazing. These species can handle grazing pressure and are often found in well-kept, semi-natural swards. The fact that they are there with the more sensitive specialists suggests that the grazing regime is just right.

Species	Ecological indication
<i>Festuca</i> spp.	Key component of semi-natural dry or mesic mountain grasslands, especially <i>Festuca ovina</i> , <i>F. rubra</i> , <i>F. valesiaca</i> . Indicates low fertility, grazed meadows/pastures.
<i>Poa alpina</i>	Characteristic of montane-subalpine grasslands, tolerant of cool climates and moderate moisture.
<i>Achillea millefolium</i>	Common forb of semi-natural mesic grasslands, tolerant of grazing and moderate fertility.
<i>Plantago atrata</i>	Strong indicator of montane-subalpine calcareous grasslands (Alps, Carpathians); prefers dry to fresh, nutrient-poor, well-drained soils.
<i>Achillea holosericea</i>	Thermophilous mountain species, occurs on dry, sunny, calcareous slopes — typical of <i>Festuca-Bromus</i> type swards.
<i>Chamaecytisus hirsutus</i>	Dwarf legume of warm, dry, base-rich slopes; frequent in submontane to montane calcareous grasslands.
<i>Hypericum perforatum</i>	Widespread forb, common in semi-natural, moderately dry grasslands, often an indicator of light disturbance or past grazing.

It is a very specific and important type of habitat (Montane/Subalpine Dry Calcareous Grassland, which is EU Habitat Directive 6210/6210, or E1.26 – Central and Eastern European Dry Calcareous Grassland, which is *Festuco-Brometalia* according to EUNIS classification). The ecological status is high to very high because there are many typical, stress-tolerant species and no signs of improvement or high fertility, which means the ecosystem is well-preserved and semi-natural. The main goal is to keep things the way they are. Management must avoid any kind of fertilization,

stop scrub encroachment (by continuing to graze lightly), and fight against any intensification or abandonment. This grassland is the result of a specific, long-term balance in the ecosystem.

Site 5: Gurre e Zeze/Caje & Ilnice

This group of plants is a high-quality, semi-natural, montane to subalpine calcareous grassland of the *Festuco-Brometalia* type. It is a habitat with many different kinds of plants and animals on dry, sunny, base-rich slopes with low soil fertility. This is kept up by a lot of grazing. The combination of *Poa alpina* and *Plantago atrata* is a clear sign. These species are not common; they are indicator of living conditions in montane-subalpine calcareous grasslands. This puts the habitat at a high altitude right away, on limestone or dolomite rock. The foundation grasses (*Festuca* spp.), the dwarf legume *Chamaecytisus hirsutus*, and the thermophilous *Achillea holosericea* are all classic signs of dry, sunny, calcareous slopes with low nutrient availability. Their abundance confirms that the area is “dry grassland.”

Species	Ecological indication
<i>Festuca</i> spp.	Key component of semi-natural dry or mesic mountain grasslands, especially <i>Festuca ovina</i> , <i>F. rubra</i> , <i>F. valesiaca</i> . Indicates low fertility, grazed meadows/pastures.
<i>Poa alpina</i>	Characteristic of montane–subalpine grasslands, tolerant of cool climates and moderate moisture.
<i>Achillea millefolium</i>	Common forb of semi-natural mesic grasslands, tolerant of grazing and moderate fertility.
<i>Plantago atrata</i>	Strong indicator of montane–subalpine calcareous grasslands (Alps, Carpathians); prefers dry to fresh, nutrient-poor, well-drained soils.
<i>Achillea holosericea</i>	Thermophilous mountain species, occurs on dry, sunny, calcareous slopes — typical of <i>Festuca</i> – <i>Bromus</i> type swards.
<i>Chamaecytisus hirsutus</i>	Dwarf legume of warm, dry, base-rich slopes; frequent in submontane to montane calcareous grasslands.
<i>Hypericum perforatum</i>	Widespread forb, common in semi-natural, moderately dry grasslands, often an indicator of light disturbance or past grazing.

The presence of *Achillea millefolium* and *Hypericum perforatum* suggests a history of light disturbance, probably from a lot of grazing. These species can handle grazing pressure and are often found in well-kept, semi-natural swards. The fact that they are there with the more sensitive specialists suggests that the grazing system is working well. This is a very specific and important type of habitat (Semi-natural dry calcareous grassland (*Festuco*–*Brometalia*) Variant: Montane–subalpine calcareous grassland with *Plantago atrata*, which is in line with EU Habitat Directive 6210/6210*). The main goal is to keep things the way they are now. Management must avoid any kind of fertilization, stop scrub encroachment (by continuing to graze lightly), and not let things get worse or give up. This

grassland is the result of a long-term balance in the ecosystem. The different types of grassland associations form a line from dry calcareous slopes to mesic pastures to moist montane hay meadows. The grassland sites in the Korab Protected Area exhibit clear variation along several ecological gradients, reflecting differences in moisture, altitude, soil fertility, management intensity, and species richness.

Table 6. Ecological gradient overview of grassland sites in Korab protected area

Gradient	From → To	Grassland sites
Moisture	Dry → Mesic → Moist → Subalpine	1, 5 → 3 → 2
Altitude	Lowland → Montane → Subalpine	3, 5 → 1, 4 → 2
Fertility	Low → Moderate → Higher	1, 4 → 5 → 3
Management intensity	Extensive grazing → Hay meadow → Semi-improved	1, 4 → 2, 5 → 3
Species richness trend	Very high → high → moderate	1, 4, 2 → 5 → 3

Overall, the Korab Protected Area grasslands demonstrate a **clear ecological gradient**:

- **Dry, low-fertility, extensively grazed montane sites** (1 and 4) support high species richness and semi-natural habitat quality.
- **Mesic to semi-improved lowland grasslands** (3 and 5) show increased fertility, more intensive management, and lower species diversity.
- **Subalpine, moist, traditionally managed sites** (2) maintain very high species richness despite harsher climatic conditions, reflecting the resilience of semi-natural subalpine meadows.

These gradients highlight the importance of **altitude, moisture, fertility, and management intensity** in shaping grassland composition and biodiversity, providing essential guidance for conservation and management planning within the protected area. Our results indicate that high quality pastures dominate in Korab protected area. Thus, 13 out of 14 sampling sites have been classified as high quality grasslands. High-quality pastures occur across a wide elevation range from 1582 m to 2149 m above sea level. These are mostly semi-natural grasslands on dry to mesic, calcareous soils with low to moderate fertility. High-quality grasslands are consistent across elevations, suggesting adaptation to diverse alpine-subalpine conditions rather than altitude limitation. The moderate-quality pasture (Kroi i Bardhe, Kukes) lies at 1783 m, characterized by species-rich grassland with variable moisture. This moderate-quality site shows greater moisture variability, possibly due to local hydrological conditions rather than elevation. This analysis showed that both Kukes and Diber regions predominantly have high-quality pastures. Only one site in Kukes (Kroi i Bardhe) is classified as moderate quality.

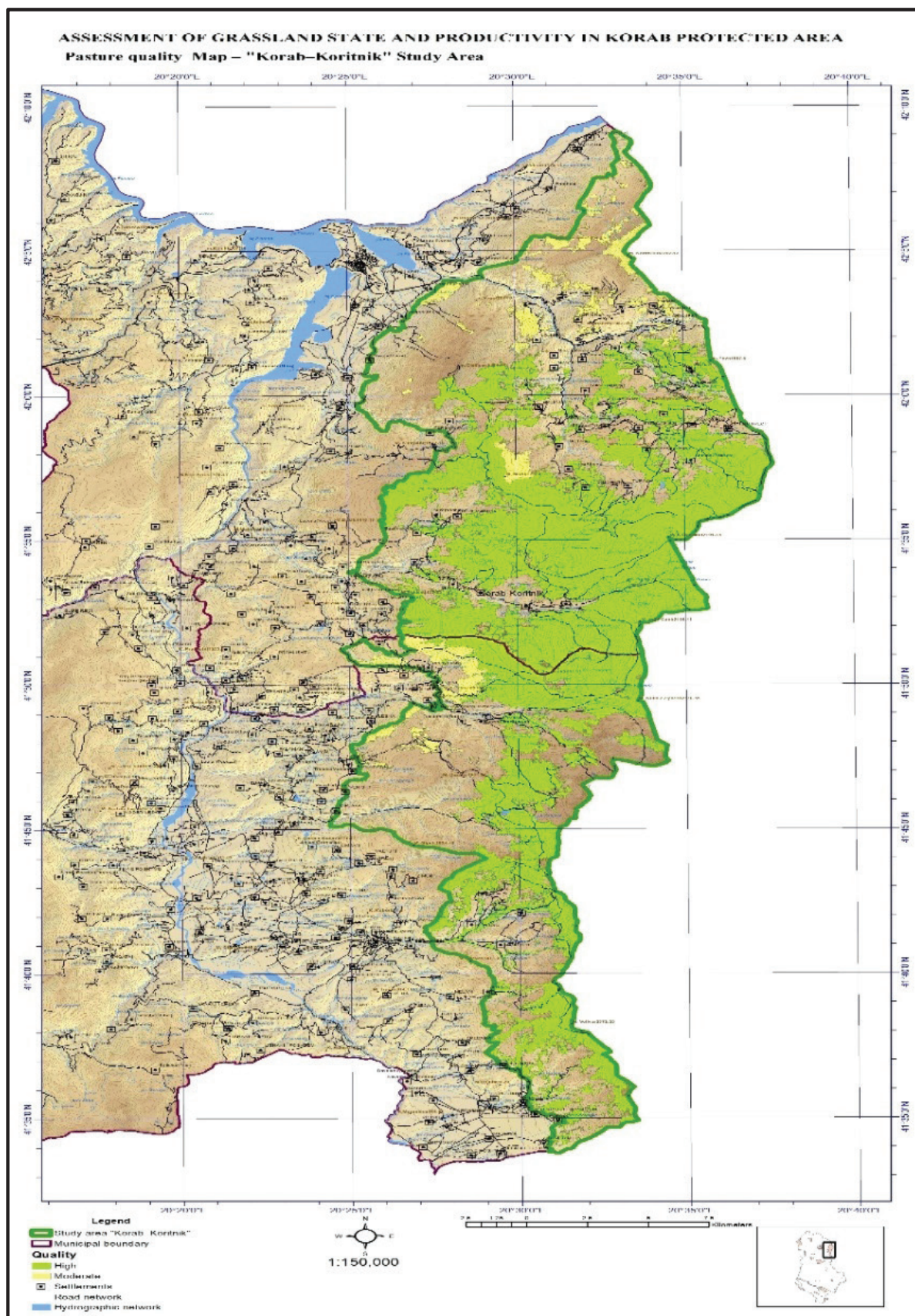
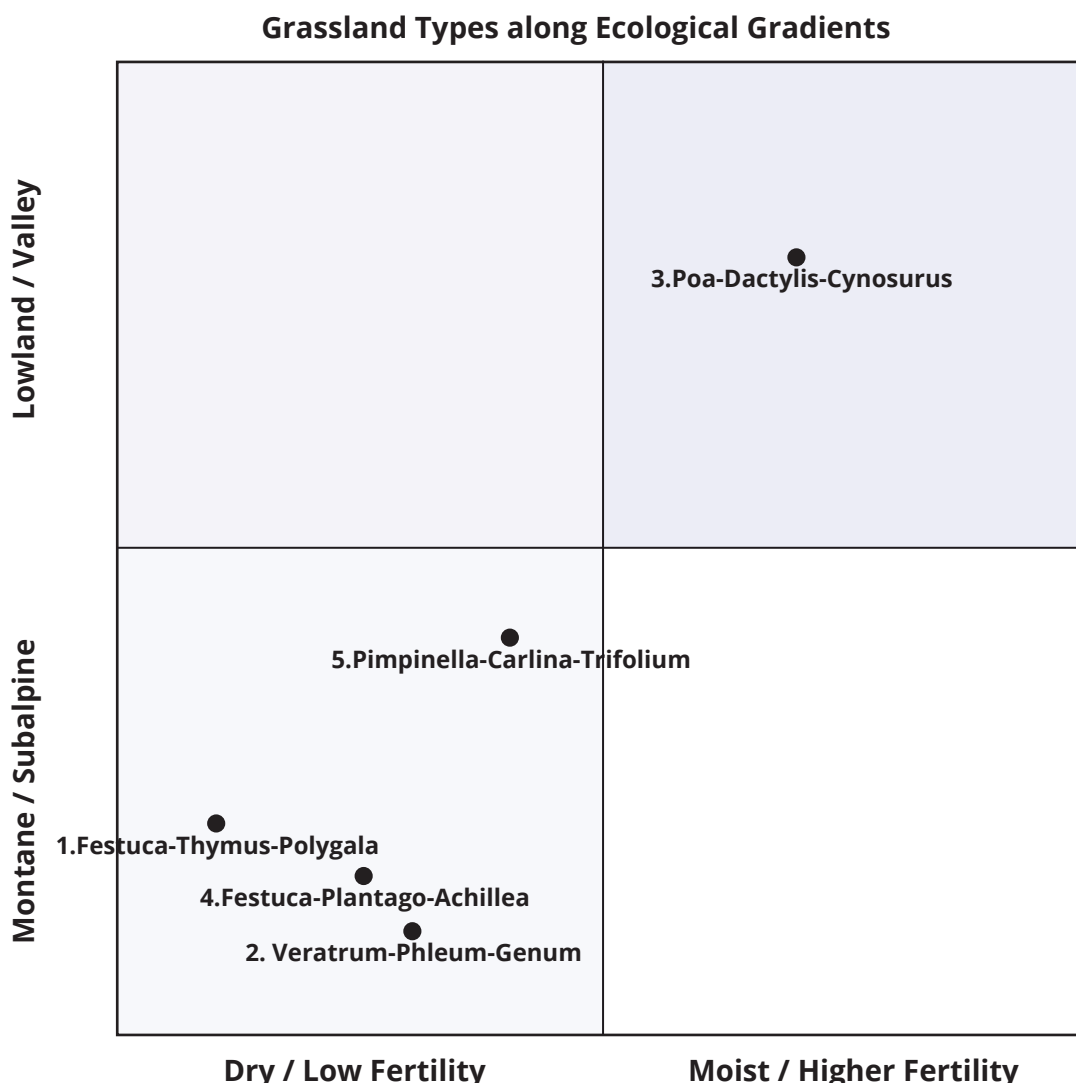


Figure 23. Pasture quality distribution across the study area

6.3.2. Conceptual Ecological Gradient of Grassland Types

The diagram below illustrates the typical position of each grassland type on a sloping hillside, from the dry, low-fertility summit to the moister, more fertile valley bottom.



From the interpretation of the diagram, we conclude that:

- 1. Festuca-Thymus-Polygala & 4. Festuca-Plantago-Achillea:** These are both dry calcareous grasslands (E1.26, 6210) with low fertility. They are positioned on the dry, low-fertility side (left). The key difference is altitude: Type 4 is placed higher as it is explicitly a *montane/subalpine* type, while Type 1 is more typical of lower slopes.
- 2. Veratrum-Phleum-Geum Meadow:** This is a montane hay meadow that requires fresh to moist soils. It is placed high on the y-axis (montane) but shifted to the right of the dry grasslands because it requires more moisture and has moderate fertility.

3. **Poa-Dactylis-Cynosurus Pasture:** This is a semi-improved mesic grassland. "Mesic" means medium moisture, and "semi-improved" indicates higher fertility than the natural types. It is positioned in the lowland/valley area (bottom) where soils are deeper and moister, and towards the moister/more fertile side (right).
4. **Pimpinella-Carlina-Trifolium Grassland:** This is the transitional type. It is ecologically between the dry calcareous grasslands and the mesic meadows. It is placed centrally on the moisture/fertility gradient and at a mid-altitude, reflecting its intermediate status and "partial improvement".

6.3.3. Ellenberg-Style Indicator Analysis

We calculated the mean indicator value for Moisture (F), Soil Reaction (R - pH), and Nutrients (N) for each grassland type using its diagnostic species. The scale for each value is:

- F (Moisture): 1 (Extremely dry) to 12 (Water plant)
- R (Reaction/pH): 1 (Strongly acidic) to 9 (Alkaline)
- N (Nitrogen/Soil Fertility): 1 (Very infertile) to 9 (Extremely fertile)

Table 7. Scoring of indicators value for each grassland type and species

Grassland Type	Diagnostic Species	F (Moisture)	R (Reaction)	N (Nutrients)	Notes
1. Festuca-Thymus	<i>Thymus spp.</i>	2	8	2	Very dry, calcareous, low N
	<i>Dianthus spp.</i>	3	8	3	Dry, calcareous, low N
	<i>Festuca spp. (dry)</i>	3	7	3	Dry, base-rich, low N
	<i>Polygala vulgaris</i>	4	6	3	Dry to fresh, acidic to neutral
	<i>Poa karabenthis</i>	4	7	4	Assumed similar to other dry <i>Poa</i>
	<i>Genista sagittalis</i>	3	5	2	Dry, slightly acidic to neutral, very low N
2. Veratrum-Phleum	<i>Veratrum nigrum</i>	6	7	5	Fresh, calcareous, moderate N
	<i>Phleum alpinum</i>	6	6	5	Fresh, slightly acidic to calcareous

	<i>Geum montanum</i>	5	7	4	Fresh, calcareous, low N
	<i>Festuca spp.</i> (montane)	5	6	4	Montane counterpart
	<i>Cerastium sp.</i>	5	7	5	Assumed montane species
3. Poa-Dactylis	<i>Poa pratensis</i>	5	6	6	Mesic, neutral, fertile
	<i>Dactylis glomerata</i>	5	6	7	Mesic, neutral, very fertile
	<i>Cynosurus cristatus</i>	5	6	5	Mesic, neutral, moderate N
	<i>Juncus inflexus</i>	7	7	6	Moist, calcareous, fertile
	<i>Melica ciliata</i>	4	8	4	Dry, calcareous, low N
4. Festuca-Plantago	<i>Festuca spp.</i> (alpina)	4	7	3	Dry, calcareous, low N
	<i>Poa alpina</i>	5	7	4	Fresh, calcareous, low N
	<i>Plantago atrata</i>	5	8	3	Dry-fresh, highly calcareous, low N
	<i>Achillea holosericea</i>	4	8	3	Dry, calcareous, low N
	<i>Chamaecytisus hirsutus</i>	4	7	2	Dry, calcareous, very low N
5. Pimpinella-Carlina	<i>Pimpinella saxifraga</i>	4	8	4	Dry, calcareous, low N
	<i>Carlina acaulis</i>	4	7	3	Dry, calcareous, low N
	<i>Trifolium alpestre</i>	4	8	3	Dry, calcareous, low N (N-fixer)
	<i>Dianthus monspessulanus</i>	3	8	3	Very dry, calcareous, low N
	<i>Vicia tenuifolia</i>	5	7	4	Fresh, calcareous, low N (N-fixer)
	<i>Phleum pratense</i>	5	6	6	

Based on the data presented in the table 6 we calculated Mean Ellenberg values per each grassland type.

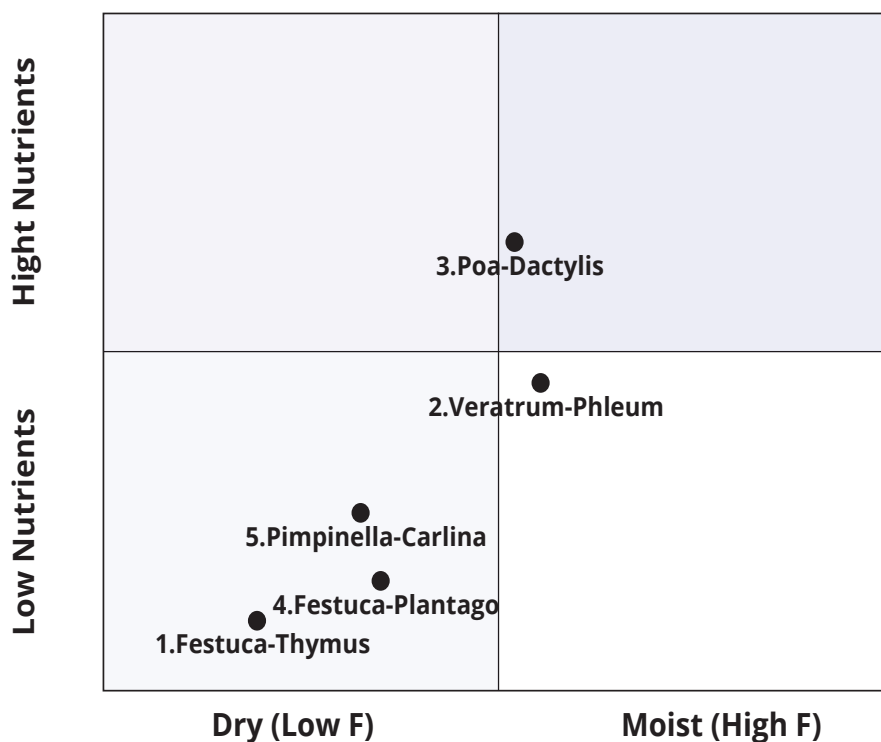
Table 8. Mean values of Ellenberg estimated for each grassland type

Grass-land No.	Grassland Type	Mean F (Moisture)	Mean R (Reaction)	Mean N (Nutrients)
1.	Festuca-Thymus-Polygala	3.2 (Dry)	6.8 (Calcareous)	2.8 (Very Low)
2.	Veratrum-Phleum-Geum	5.4 (Fresh)	6.6 (Calcareous)	4.6 (Low-Moderate)
3.	Poa-Dactylis-Cynosurus	5.2 (Me-sic-Fresh)	6.6 (Calcareous-Neutral)	5.6 (Moderate)
4.	Festuca-Plantago-Achillea	4.4 (Dry-Fresh)	7.4 (Highly Calcareous)	3.0 (Low)
5.	Pimpinella-Carlina-Trifolium	4.2 (Dry-Fresh)	7.3 (Highly Calcareous)	3.8 (Low)

This Ellenberg-style analysis successfully quantifies the ecological niches of these grasslands. It provides robust, species-based evidence for their management:

- Types 1, 4, and 5 require low-nutrient, unfertilized conditions.
- Type 2 requires management that maintains its moderate, natural fertility without enrichment.
- Type 3 is clearly a product of some level of past improvement, and conservation efforts might aim to reduce its nutrient levels over time to benefit more specialist species.

Ecological Positioning via Ellenberg Values



6.4. Results of pasture productivity and land cover change using remote sensing technique

6.4.1. Pasture productivity assessment using NDVI index

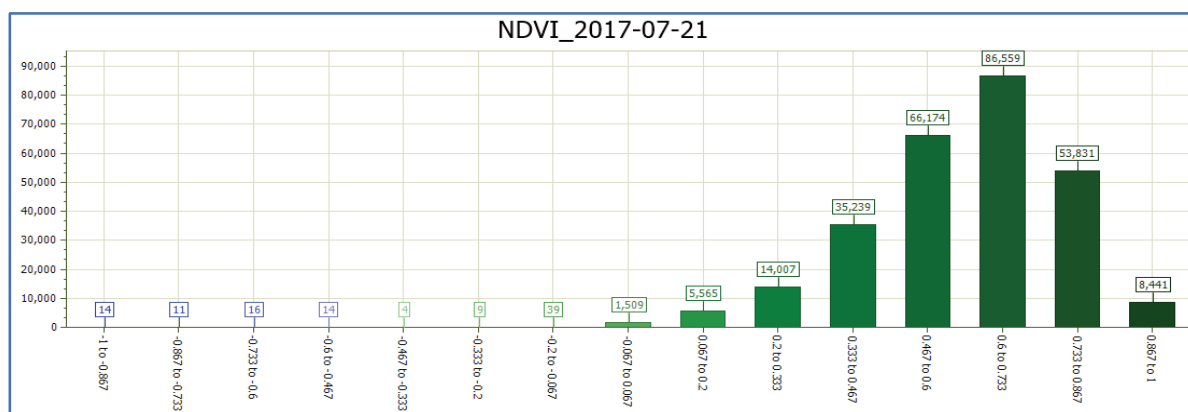
NDVI histograms represent the **frequency distribution of vegetation index values** across the study area. Each bar corresponds to the number of pixels falling within a specific NDVI range, thus illustrating the **dominant vegetation conditions** at a given date. This approach provides a **quantitative and objective overview** of how vegetation density and productivity vary in time, from low values (bare or dry areas) to high values (dense, healthy grasslands). The use of histograms was selected because it allows for:

- **Direct comparison between different dates and years**, identifying shifts in vegetation conditions.
- **Detection of subtle changes** in the proportion of high or low NDVI values that might not be visually evident in maps.
- **Statistical interpretation** of ecosystem productivity trends across the Korab Protected Area.

Through this method, temporal NDVI distributions provide a clear measure of **grassland health, degradation, or recovery**, supporting long-term monitoring by ADZM Dibër and Kukës.

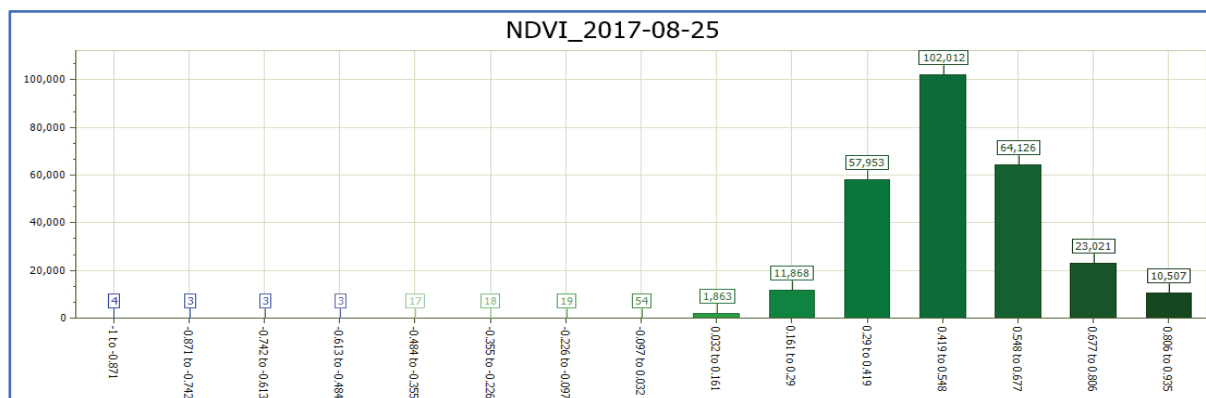
NDVI_2017-07-21 Early Summer Baseline

The distribution is **skewed toward moderate NDVI values (0.33–0.72)**, with peaks at **0.47–0.73 (~86,559 pixels)**. It represents **active vegetation**, corresponding mainly to **mountain meadows and mid-elevation pastures**. The low NDVI (<0.2) portion (~10%) corresponds to **rocky slopes and bare alpine ridges**. July 2017 reflects a **healthy grassland cover**, typical of early-summer growth under normal precipitation.



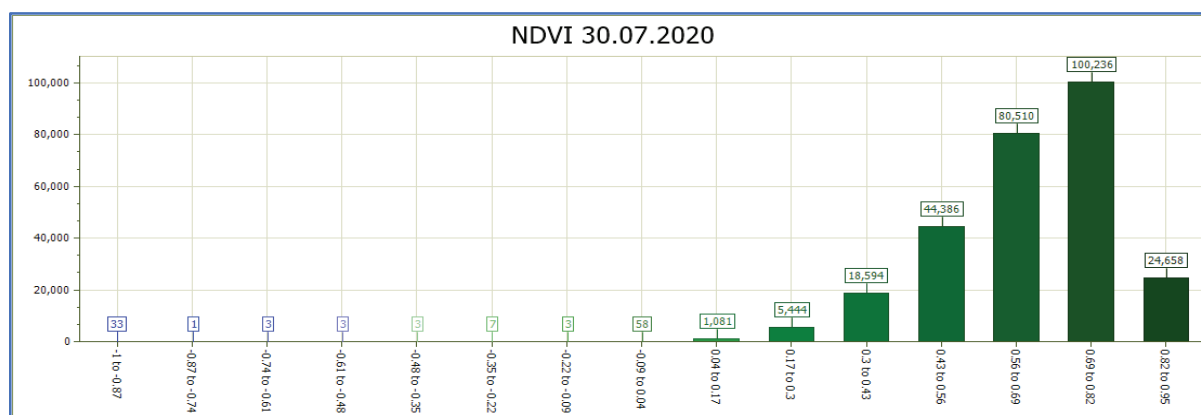
NDVI_2017-08-25 Late Summer Maximum

The histogram peak shifts rightward, reaching **0.41–0.67 (102,000 pixels)** — the **highest greenness level** of 2017. NDVI values >0.5 dominate, indicating **dense biomass and maximum chlorophyll activity**. Optimal photosynthetic performance and grass productivity; the **vegetation is at its seasonal peak**.



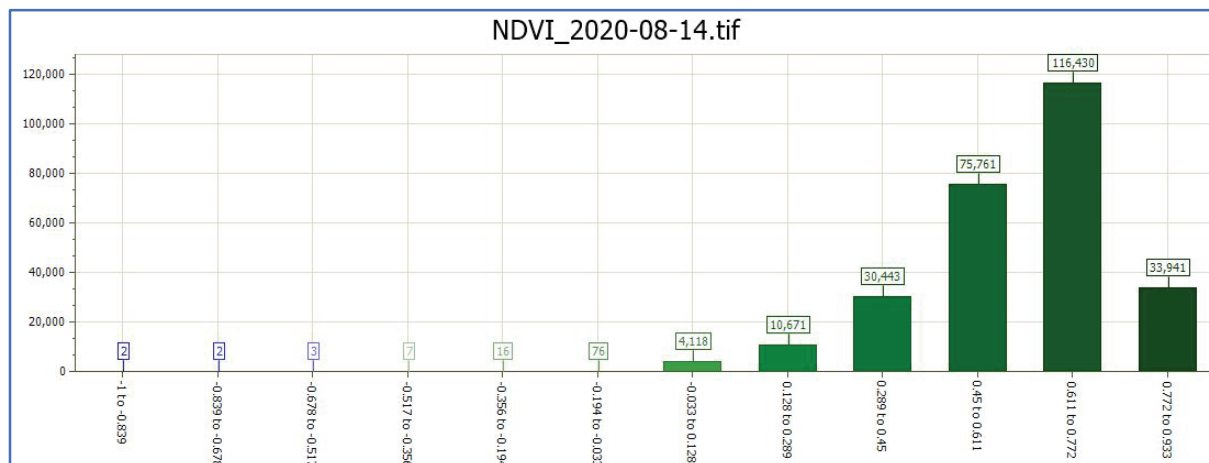
NDVI_2020-07-30 Mid-Summer after Wet Period

NDVI remains high, with a strong concentration at **0.43–0.69 (~80,000–100,000 pixels)**. Compared to 2017, there is a **slightly higher spread toward lower classes (0.2–0.4)**, showing **minor spatial heterogeneity**. Grasslands remain productive, though slight reductions may reflect **patchy moisture or grazing activity**.



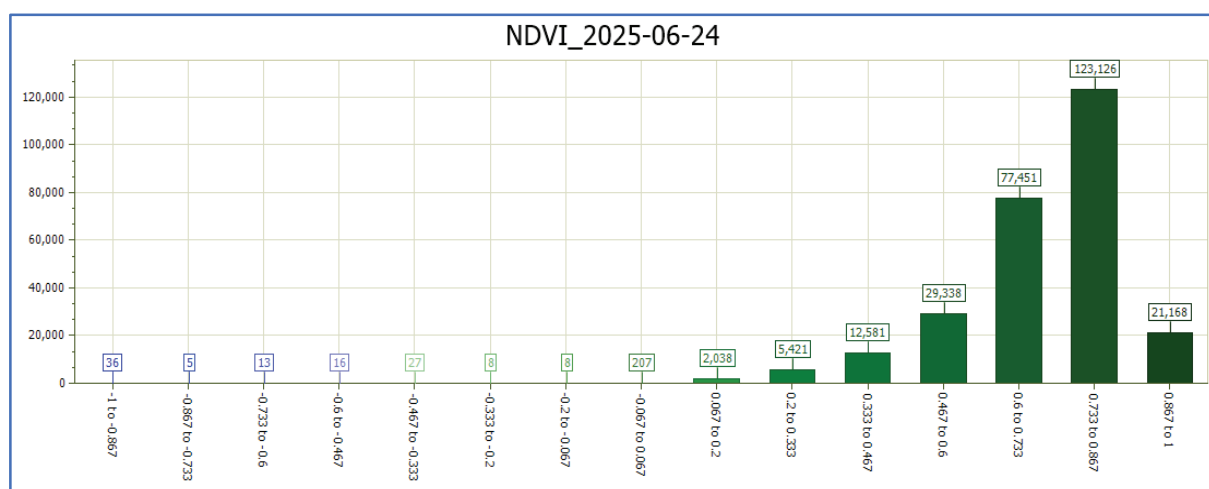
NDVI_2020-08-14 Dry-Season Conditions

The peak shifts downward to **0.41–0.71 (116,000 pixels)**, still showing dense vegetation but with an **increase of mid-NDVI values (0.3–0.5)**. The tail of low NDVI (<0.2) slightly expands, indicating **drying or partial senescence of grasslands**. Typical late-summer decline due to **reduced soil moisture**, though pastures remain generally **productive**.



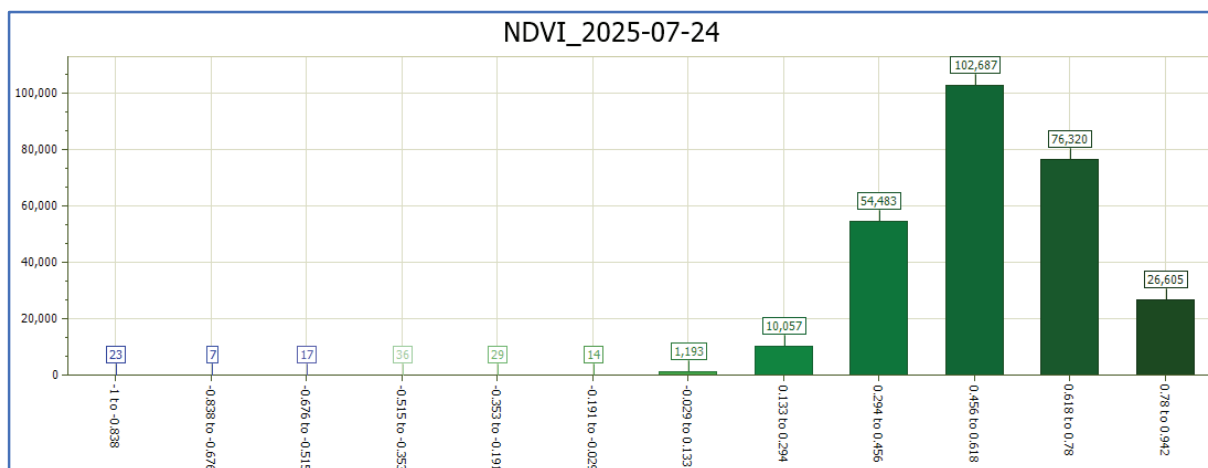
NDVI_2025-06-24 Early Summer Recovery

Early-season NDVI is already high, peaking at **0.47–0.66 (123,000 pixels)** higher than 2017's baseline. Low NDVI values (<0.2) remain minimal, suggesting **early greening and strong start of vegetation**. Indicates **rapid post-spring recovery** and favourable climatic conditions for pasture growth.



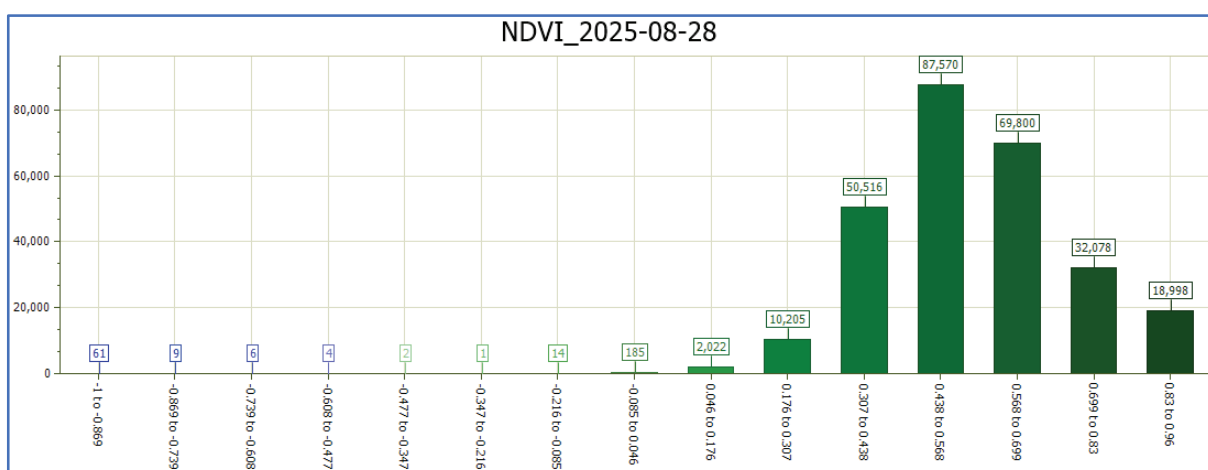
NDVI_2025-07-24 Mid-Season Peak

The main mode is **0.45–0.67** (**≈102,000 pixels**) comparable to 2017 late-summer maxima. NDVI distribution shows **slight narrowing**, meaning vegetation cover is **more homogeneous** across the park. Represents **stable and high biomass productivity**; alpine pastures maintain excellent condition.



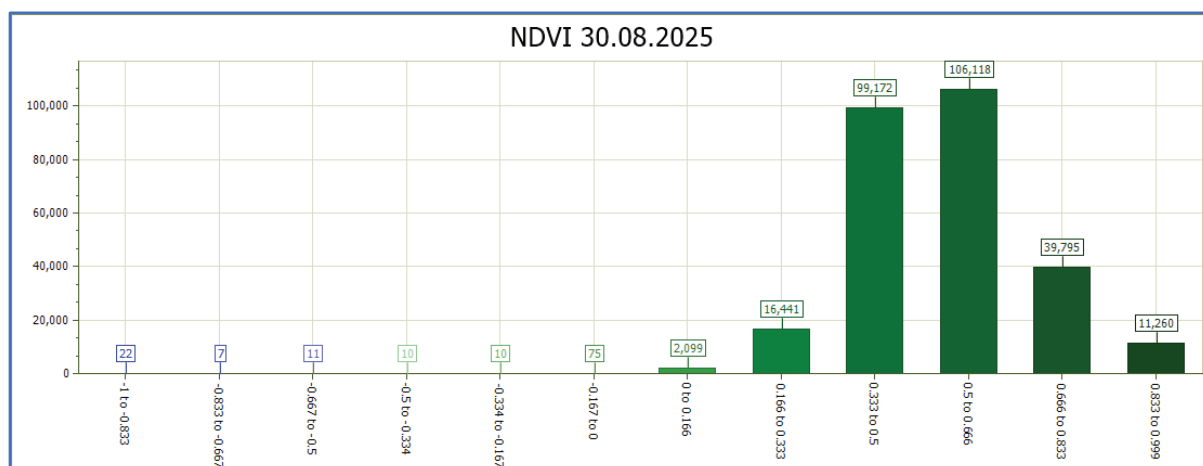
NDVI_2025-08-28 End-of-Summer Decline

The histogram contracts toward **0.37–0.65**, with main peaks at 0.37–0.65 (**≈87,000 pixels**). Decline in NDVI >0.7 classes reflect **partial senescence** or water stress typical of late August. Moderate reduction of greenness, consistent with **seasonal drought stress** and grazing activity.



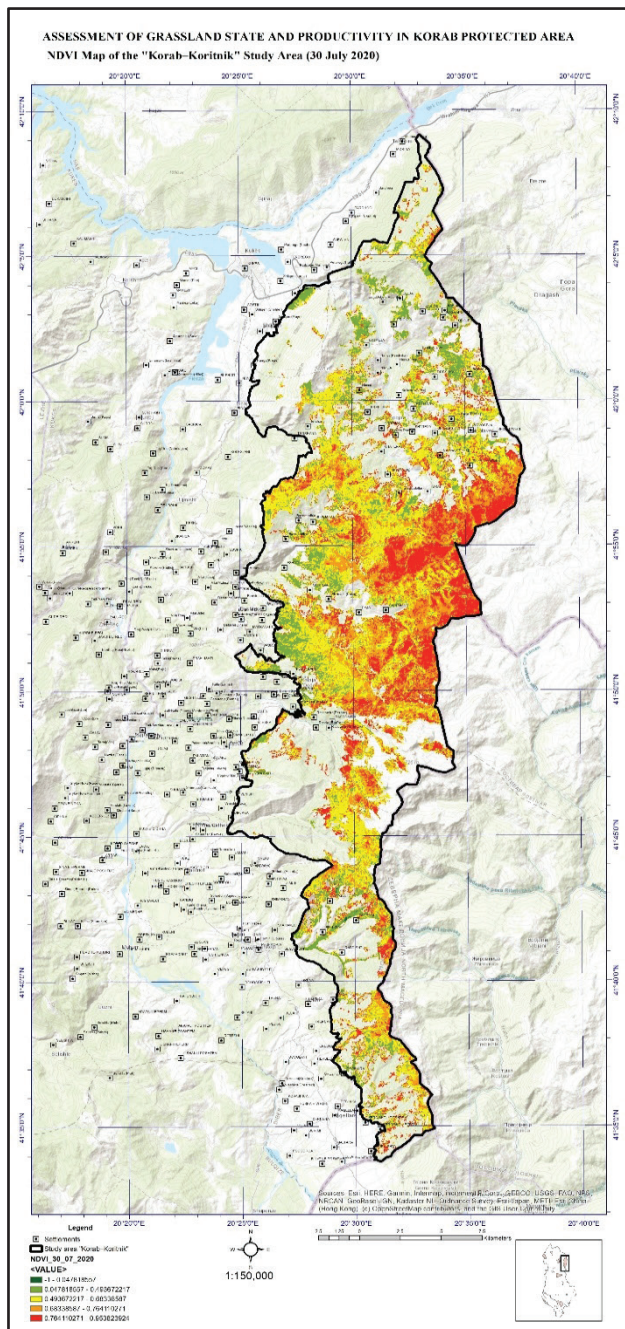
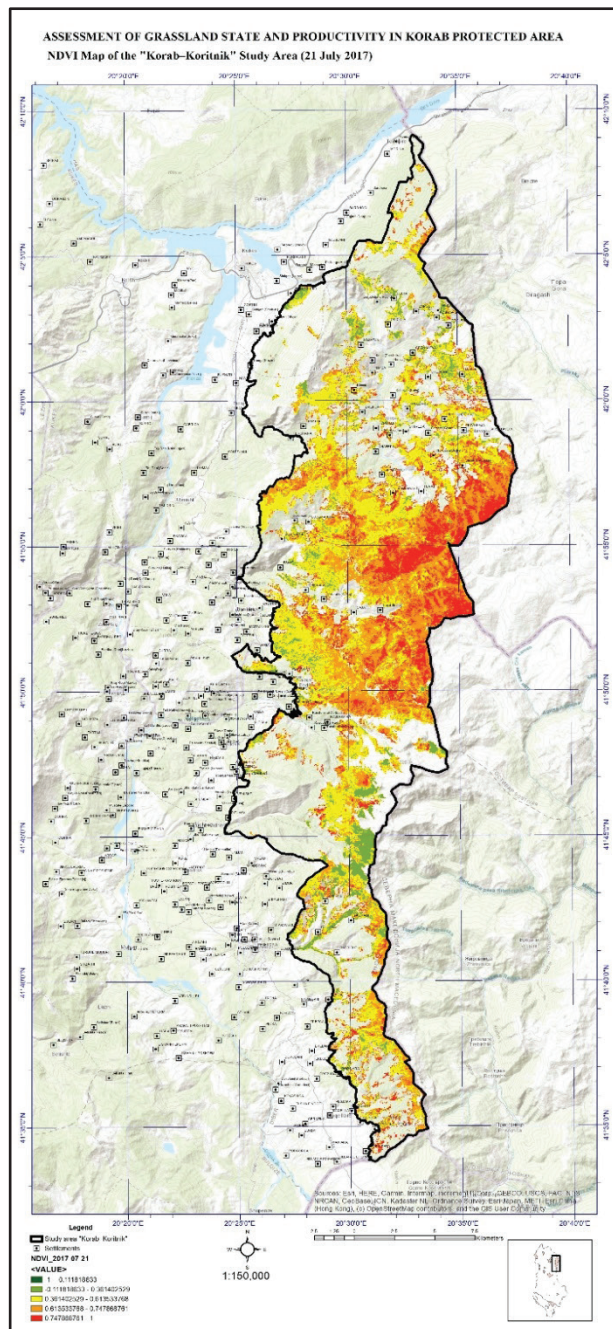
NDVI_2025-08-30 Post-Rain Regrowth

The histogram shows renewed rightward shift, peaks at **0.33–0.66 (~99,000–106,000 pixels)**. NDVI increase after 28 Aug suggests **short-term recovery following local precipitation**. Confirms the **resilience of alpine pastures** and their rapid response to improved moisture.



Over the eight-year monitoring period, NDVI values indicate **stable to slightly improved vegetation productivity** across the Korab–Koritnik grasslands. Summer 2025 shows higher NDVI averages than 2017, highlighting **ecosystem recovery** due to favourable climatic conditions. Spatial variations remain minor, confirming **good pasture management** and **limited degradation**. The NDVI response after August rainfall illustrates the resilience of alpine ecosystems, essential for grazing and biodiversity support.

For this case we designed the maps of the NDVI index throughout the Korab protected area in order to identify better the distribution of grassland productivity.



6.4.2. Interpretation and analysis of land cover change in Korab protected area

The Corine Land Cover (CLC) dataset provides an overview of how different land types have changed between 2000 and 2018. The dataset measures area in **hectares (ha)** for various categories such as forests, agricultural lands, grasslands, urban areas, and sparsely vegetated regions. Overall, the data suggests a **moderate transformation in land use**, characterized by **urban expansion, forest composition shifts, and slight declines in grassland and Mediterranean vegetation**. Between 2000 and 2018, the study area underwent **substantial land cover transformation**.

Table 9. Corine land cover data estimated using remote-sensing in Korab protected area

Corine land cover	Area(ha)_ year 2000	Area (ha)_ year 2018	Change (ha)	Interpretation
Bare rocks	26.85	278.19	251.34	Significant increase—possibly due to erosion, quarrying, or land degradation.
Broad-leaved forest	5258.87	5891.60	632.73	Forest expansion—possibly due to natural regeneration or reforestation.
Complex cultivation patterns	1048.65	1458.10	409.45	More diverse, small-scale farming.
Coniferous forest	5323.20	4219.66	-1103.54	Notable decline, suggesting deforestation, logging, or conversion to other land uses.
Construction sites		11.69	11.69	Emerging development areas
Discontinuous urban fabric	46.08	93.54	47.45	Almost doubled—clear urban expansion.
Land principally occupied by agriculture, with significant areas of natural vegetation	3902.81	4060.24	157.43	Slight expansion—indicating mixed-use landscapes.
Mixed forest	869.46	1153.16	283.69	Increase—may reflect coniferous areas transitioning to mixed forest.
Moors and heathland	2158.80	2122.54	-36.27	Relatively stable
Natural grasslands	17037.37	16385.97	-651.40	Noticeable decrease—possibly due to forest expansion or urban development
Non-irrigated arable land	8.37	6.13	-2.24	Negligible change, but slight decrease
Pastures	997.00	1217.05	220.05	Expansion of grazing areas.
Sclerophyllous vegetation	4012.35	3282.15	-730.20	Decline—likely replaced by urbanization or forest transitions.
Sparsely vegetated areas	5297.23	5745.55	448.32	Increase—potentially linked to deforestation.
Transitional woodland-shrub	7849.33	7910.82	61.48	Slight growth, possibly indicating early stages of forest regrowth.
Total	53836.37	53836.37		

Data showing that forest composition is changing—broad-leaved and mixed forests are growing, while coniferous forests are shrinking. There is a **notable compositional shift** in forest types, possibly due to **natural regeneration, abandonment of agricultural land, or reforestation**. We noted a decrease in coniferous forest area, likely due to **logging, fire, or conversion** to mixed/broad-leaved forest. In the area, transitional woodland-shrub areas remained stable, suggesting a balanced rate of succession and disturbance.

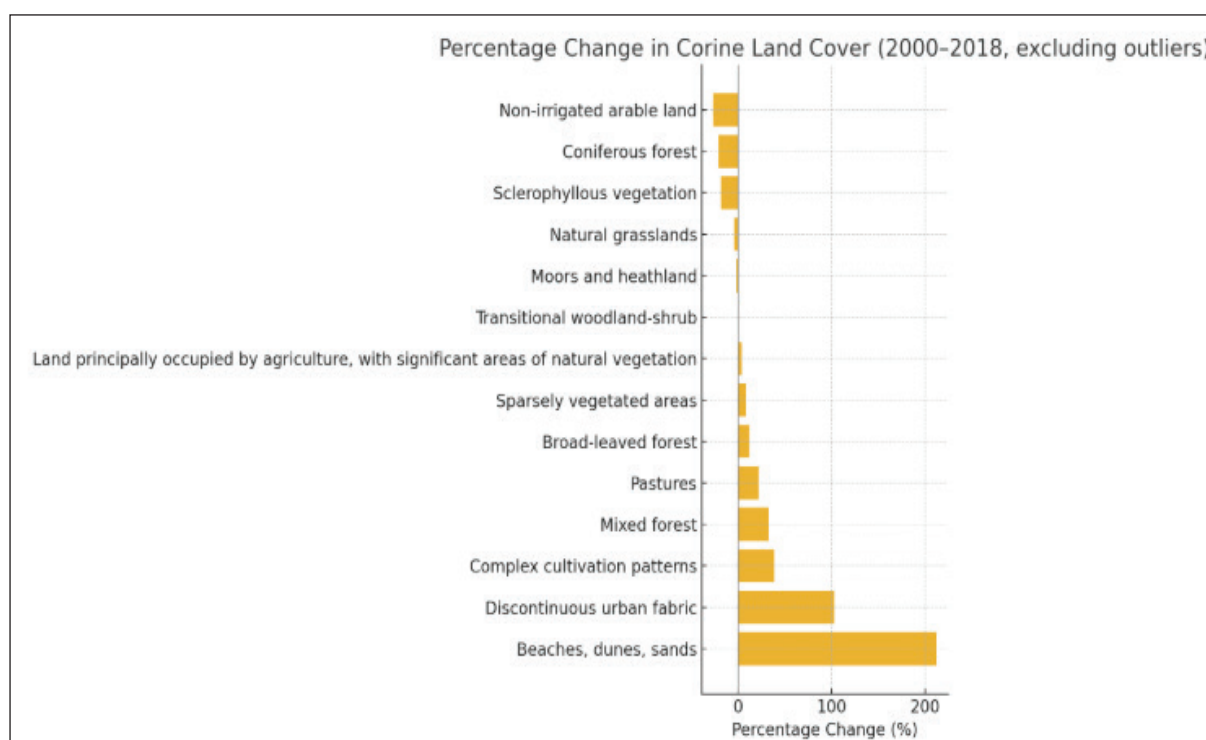


Figure 24. Land cover change(200-2018) in percentage in Korab protected area

These patterns may indicate a **transition toward more diverse and ecologically resilient forests**, enhancing biodiversity but also reflecting **changes in forest management practices**. **Grasslands and sclerophyllous (Mediterranean-type) vegetation** are declining, possibly due to **afforestation, urbanization, or land abandonment**. The **decline in sclerophyllous vegetation** may also reflect **climatic or fire-related changes**, as these ecosystems are sensitive to disturbance and drought. Agricultural land is slightly increasing, particularly in complex and mixed forms, while pastures increased, possibly linked to **livestock expansion** or **conversion of arable land**. Loss of these habitats could affect open-land biodiversity and ecosystem services such as **pollination and grazing**. Urban and construction areas are expanding, indicating development pressure. Urban growth exerts **pressure on surrounding ecosystems**, contributing to **habitat fragmentation, soil sealing, and loss of agricultural or forest land**.

Bare and sparsely vegetated areas expanded significantly, which could reflect **erosion, deforestation, wildfires, or natural geomorphic changes**. These

changes suggest **land degradation or exposure**, warranting monitoring of land against various risks.

The overall picture reflects **dynamic land-use change driven by urbanization, ecological succession, and human adaptation**, highlighting the need for **integrated land management and conservation strategies** to balance development and environmental sustainability.

6.5. Threats in Alpine and subalpine grasslands

6.5.1. Climate change

The Korab alpine ecosystems are becoming more and more fragile because of changes in the weather and environmental stress. Changes in rainfall and temperature patterns have made the phenological cycles of some species shorter, which has led to fewer successful births. Droughts and frost damage are more threats to alpine plants. The upward movement of vegetation zones also makes it harder for endemic and high-altitude plants to find homes. These effects of climate change make the problems of overharvesting and habitat loss even worse, showing how important it is to have conservation and climate-resilient management strategies that work together.

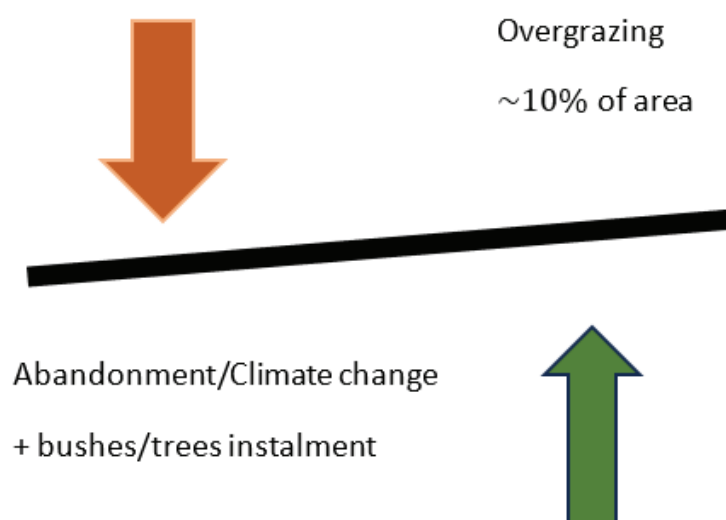


Figure 25. Balance between overgrazing and climate change impacts in Korab nature park

There is clear evidence of altitudinal forest species migration in the study area. In 2002, the upper tree line in the village of Shishtavec was at an elevation of 1,480 meters above sea level (m a.s.l.). The tree line had moved up to 1,518 m asl by 2023. This shows that vegetation belts have moved up about 38 meters over the

course of 22 years, which is a measurable vertical shift in response to changing weather patterns.



Figure 26. Shift in tree line altitudes in Shishtavec Village, during 2001-20223; ↑ + 38 m



Figure 27. Picture from Korab protected area showing the advancing of forest vegetation

6.5.2. Overgrazing

Overgrazing in the Korabi Mountain area has greatly decreased the production of aboveground biomass and sped up the erosion of soil on mountain slopes. This degradation is most noticeable in places where grazing pressure is high and constant, such as near water sources and places where shepherds regularly provide salt licks. These localized “hotspots” of grazing intensity lead to vegetation loss, soil compaction, and a greater risk of erosion. Field observations show that these effects are especially strong in places like Bjeshket e Grames, Fusha e Panairit, Carakoli, Bjeshket e Bardhocit, and Portat e Korabit. These places are very important places where people have disturbed the environment, and the high number of animals has caused measurable drops in ecosystem productivity and stability.



6.5.3. *Burning of Juniperus shrubs*

This has been seen in many places in the Korab Protected Area, especially in Gryka e Cajës and Kazan, where the number of *Epilobium angustifolium* populations has been growing. Similar patterns can be seen all over the park, which suggests a larger ecological trend. The belt of alpine grasslands is mostly made up of *Juniperus* spp. at higher elevations. These areas are very likely to degrade because they have steep slopes and soils that are not well developed, have a light texture, and have a low clay content. When *Juniperus* stands are burned or disturbed, the protective vegetation cover is lost, and the soil surface is exposed. This disturbance quickly starts the process of erosion, which makes the land less stable and makes alpine ecosystems less able to adapt.



Figure 28. Burning of Juniper within Koritnik nature park

6.5.4. *Grassland habitat damage*

Expanding pastures, uncontrolled grazing, and infrastructure development are fragmenting the fragile alpine habitats. The protected area slopes contain high-biodiversity meadows that are now deteriorating due to soil erosion, and uncontrolled tourist access. These alterations disrupt key ecological processes,

including pollination, seed dispersal, and soil stabilization, which are critical for the natural regeneration and the overall resilience of alpine ecosystems. If left unaddressed, these pressures threaten both biodiversity integrity and the ecosystem services that local communities rely upon.



Figure 29. A mountain road, transferred in very short time into main source of erosion (Bjeshka e Sarakollit)

6.5.5. Water discharge from grasslands in Korab protected area

The building of artificial channels and the rerouting of water away from grassland ecosystems, especially in the wetlands of Grama and the grasslands of Bjeshka e Hinokës, are the main causes of wet meadow degradation and drying out. These changes in the water cycle throw off the natural balance of water, which causes the loss of plant communities and ecosystem functions that depend on moisture.

Also, taking water from natural springs has had a direct effect on the hydrological regime of Liqeni i Zonjave. The lake has dried up partially or completely during the dry season because less water is coming in. This process harms aquatic habitats and puts aquatic plants and animals at great risk of extinction, which hurts local biodiversity and ecological stability.

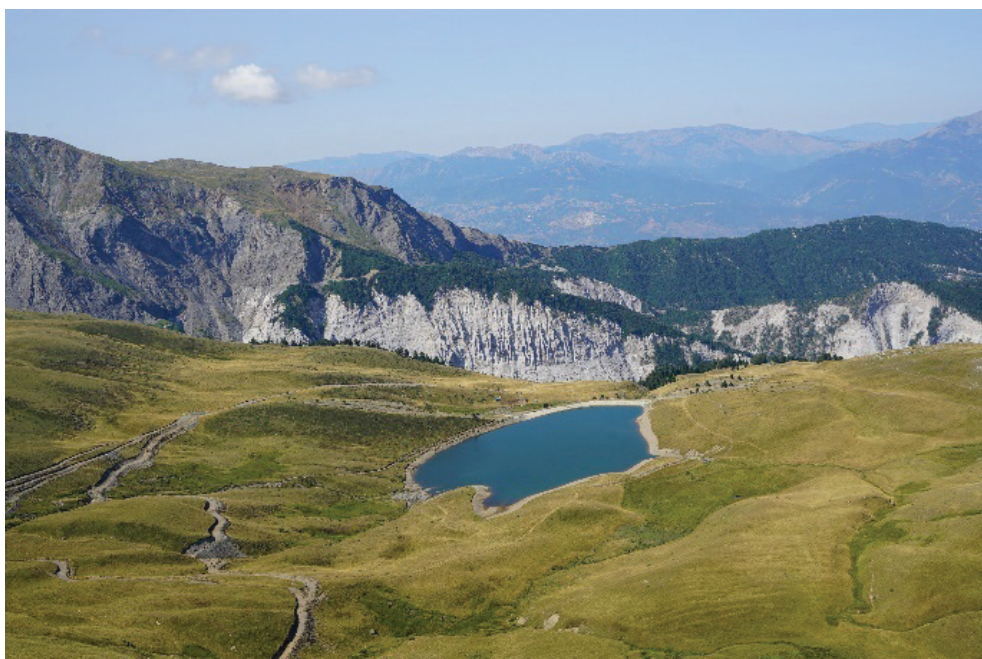


Figure 30. Grama lake, Bjeshket e Grames

6.5.6. Wildfire risk

Wildfires are a big problem for the park's ecology and management. In some places, the decline or absence of traditional grazing practices has caused a lot of fuel to build up, which makes fires more likely and more dangerous. Mali i Gjallicës and the Bjeshkët e Koritnikut are the most at-risk areas right now. The lack of good roads makes it even harder to prevent, put out, and manage fires in general. The situation in the coniferous forests of Pelpeniku Mountain is especially bad. These forests are thought to be some of the most ecologically valuable in Albania. Fires in these ecosystems are very dangerous because the steep slopes, shallow soils, and light-textured substrates make it very hard for plants to grow back naturally. So, wildfires in these kinds of habitats can change the park's natural landscape and ecosystem dynamics in ways that last a long time or even forever.

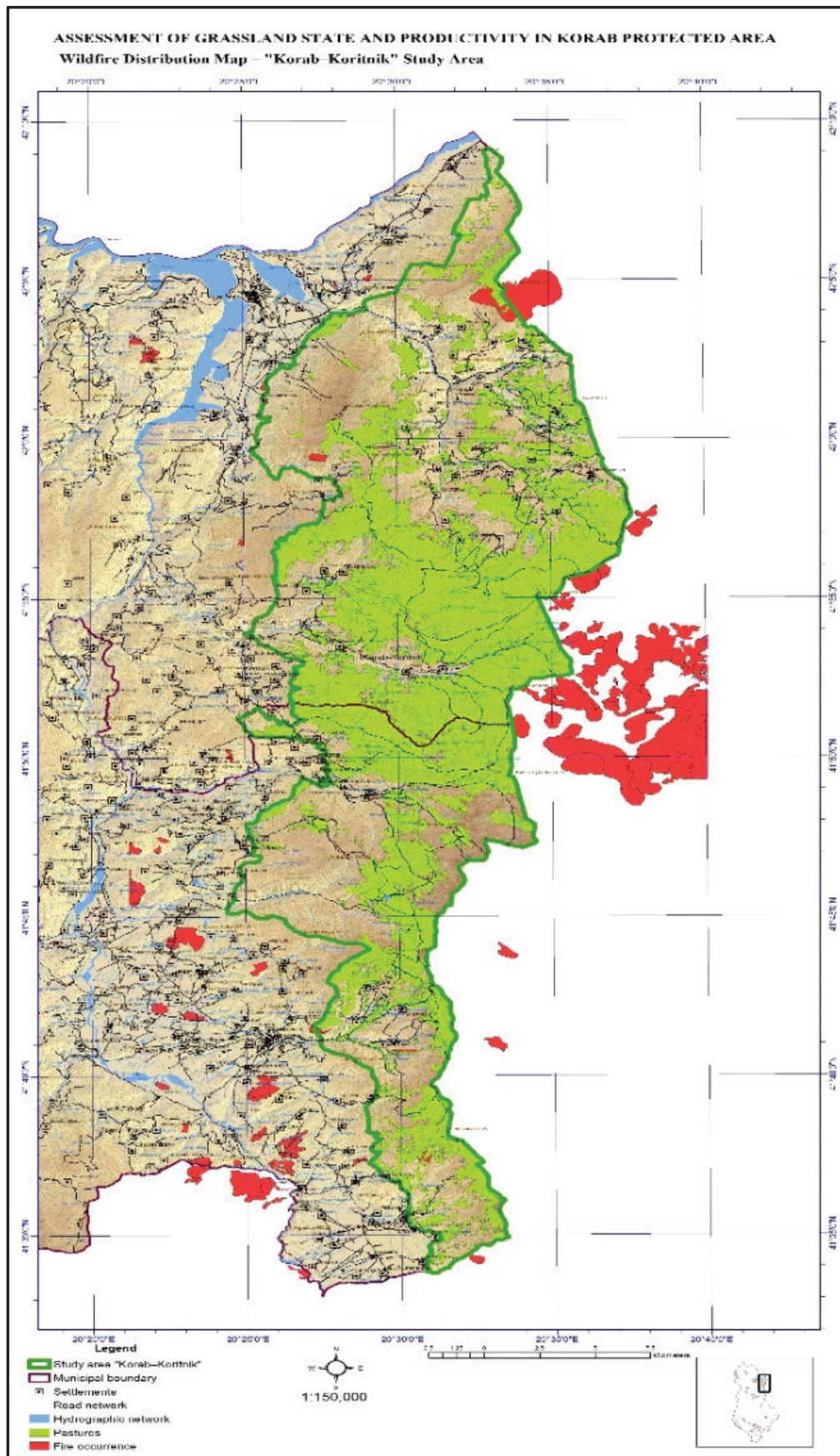


Figure 31. Mapping of wildfires in Korab protected area

6.5.7. Soil erosion

Soil erosion is one of the worst things that can happen to the grassland ecosystems in the Korab Protected Area. These habitats are especially prone to erosion because they have steep terrain, shallow, poorly developed soils, and a lot of human activity. Overgrazing is one of the main causes of soil degradation because it tramples and removes plants, which lowers ground cover and soil cohesion. This makes the surface more vulnerable to wind and water erosion. This happens most often in places where there are a lot of animals, like near water points and salt licks, where the loss of plants and the compaction of the soil speed up the erosion process.

Also, vehicles making informal paths and channels changing the flow of natural water have made the soil less stable in many grassland areas. These disturbances not only break up habitats, but they also cause more runoff and surface erosion, which slowly washes away the fertile topsoil. When vegetation cover is reduced and soils are exposed, the process of erosion becomes self-reinforcing. This leads to less biomass productivity, less water infiltration capacity, and a long-term decline in ecosystem services. In the most severe cases, the degradation of grassland soils can lead to changes in ecosystems that are less productive and less diverse, which hurts both the health of the environment and traditional pastoral livelihoods. The Brezi i Butë ("Soft Belt") is a clear example. It is a narrow strip of land, usually 2 to 3 meters wide, that was built along the state border during the time of political monism. To make it easier to find human footprints in case someone tried to escape, this area was purposefully cleared of plants. The long-term effects on the environment of this practice are still clear today. The belt was often found on steep mountain slopes, so taking away the vegetation covers made the soil very unstable. Because of this, these places have become hotspots for fast and large-scale erosion, which keeps getting worse over time. The lack of protective plant cover on fragile soils has caused the loss of topsoil, made it harder for plants to grow back naturally, and created erosion gullies, which are all things that are making slope ecosystems in the park worse.





Figure 32. Erosion signs noted within Korabi nature park

6.6. Socio-economic characteristics of the Korab protected area

6.6.1. Stakeholders overview and consultation process

This analysis focuses on understanding the social dynamics, stakeholder interests, and potential impacts of restoration activities on local communities. Stakeholders were classified into three groups.

- a) **Primary Stakeholders:** These stakeholders directly influence the utilization and state of local resources. This group includes farmers, shepherds, harvesters of forest products, and private enterprises operating within the focus area.
- b) **Secondary Stakeholders:** These are actors who have a direct or indirect impact on the management of natural resources in the focus area. Examples include agriculture land management officials in Kukes and Diber municipalities, the Regional Administration for Protected Areas in Kukes & Diber.
- c) **Interest Groups:** This group comprises individuals or organizations with significant interests FOR Korab protected area. It includes local Civil

Society Organizations (CSOs) like ALCDF, local forest user associations e.g. Shishtavec.

6.6.2. Stakeholders mapping in the Korab protected area

Stakeholder mapping is a visual process that helps you understand how each stakeholder is involved in managing natural resources and land degradation in the area of interest. For each municipality, pertinent stakeholders engaged in the focal area were identified and classified according to their interest and influence utilizing a four-quadrant influence-interest matrix. The x-axis shows how interested people are, with the highest interest on the right and the lowest on the left. This shows how land degradation affects stakeholders. The y-axis shows how much of an impact the stakeholder can have on the state of forest resources in the study area. This map shows where stakeholders are based on these two measures. The results of the stakeholder mapping process that was finished in both municipalities are below.

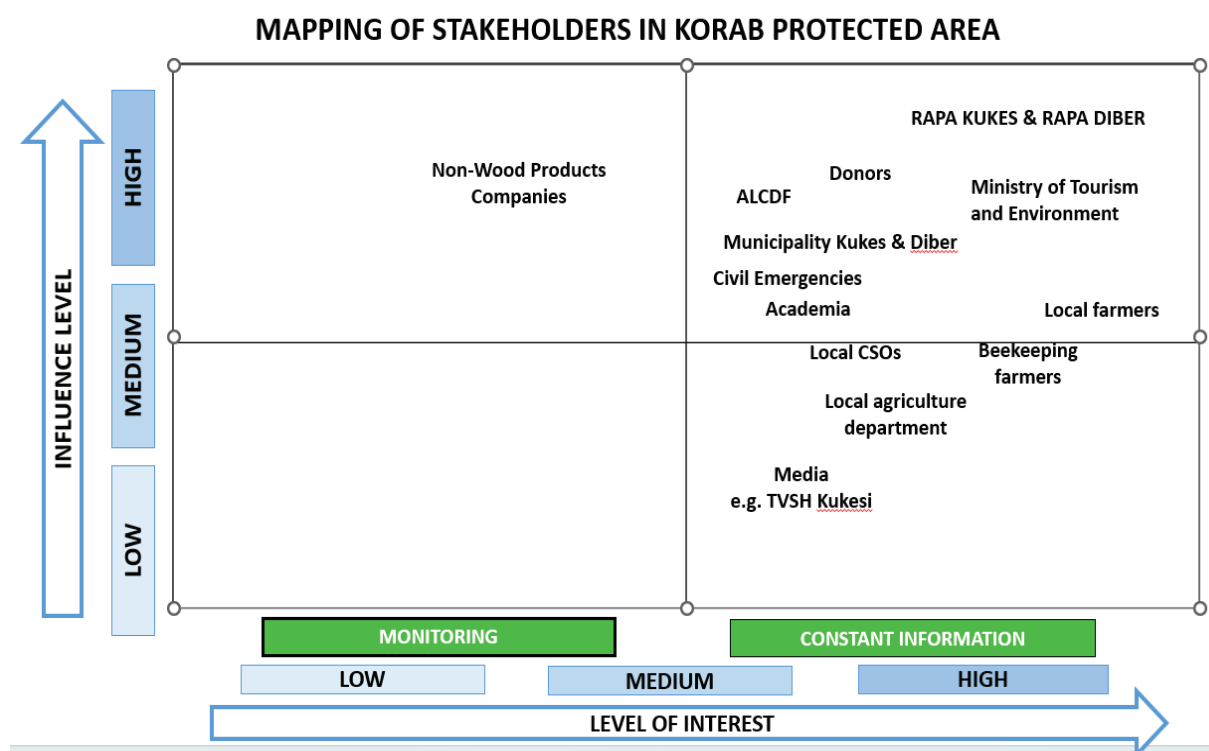


Figure 33. Mapping of stakeholders in Korabi nature park

6.6.3. Local Knowledge and Interviews with Shepherds and Stakeholders

6.6.3.1. Introduction

To better understand the views of people who are most closely connected to the landscape, we did a series of qualitative interviews as part of our assessment of the Korab Protected Area. Five shepherds and four staff members from the protected area (three from RAPA Kukes and one from RAPA Diber) were interviewed. The shepherds, who have lived in the highlands for a long time, gave us useful information about traditional pastoral practices, the problems they have with managing grazing, and their thoughts on conservation measures. Their testimonies show how the natural world is connected to people's daily lives.

At the same time, the staff members' views of the protected area gave an institutional perspective, focusing on conservation goals, management problems, and the need to balance protecting the environment with meeting the needs of the local community. The interviews are meant to show both the traditional, lived experiences of pastoralists and the formal conservation goals of the protected area by bringing together these voices.

These talks give us a more complete picture of how local communities and management authorities see the Korab Protected Area. They show us possible synergies, tensions, and chances for more inclusive and sustainable management.

6.6.3.2. Methodology used for data collection

We made a structured questionnaire with six parts so that we could systematically get information from the shepherds in the Korab Protected Area. The goal of the questionnaire was to get both quantitative and qualitative data, mixing facts with personal opinions and experiences. We used both open-ended and closed-ended questions. The closed-ended questions produced comparable and quantifiable data among respondents, whereas the open-ended questions enabled shepherds to articulate their perspectives, elaborate on challenges, and convey local insights that may not surface through structured responses alone.

The six sections of the questionnaire were organized as follows:

- 1) Demographic Information – age, household composition, and experience in shepherding.
- 2) Livestock and Grazing Practices – herd size, seasonal mobility, and grazing patterns.
- 3) Economic Aspects – sources of income, reliance on livestock products, and market access.
- 4) Perceptions of the Protected Area – awareness of conservation rules, restrictions, and opportunities.

- 5) Challenges and cooperation – issues related to pasture availability, predators, or interactions with park management.
- 6) Traditional practices and cultural heritage- this section explores the cultural dimension of pastoral life in the Korab area. The aim is to understand whether shepherding practices are linked to specific traditions, rituals, or forms of knowledge, and how these are passed down across generations. The questions also examine the extent to which younger community members remain engaged with these traditions and whether they continue to form part of everyday pastoral activities.

Further details on the questionnaire design and structure can be found in the Annex of this report.

6.6.3.3. Analysis of Livestock Farming and Pasture Management in Korab Protected Area

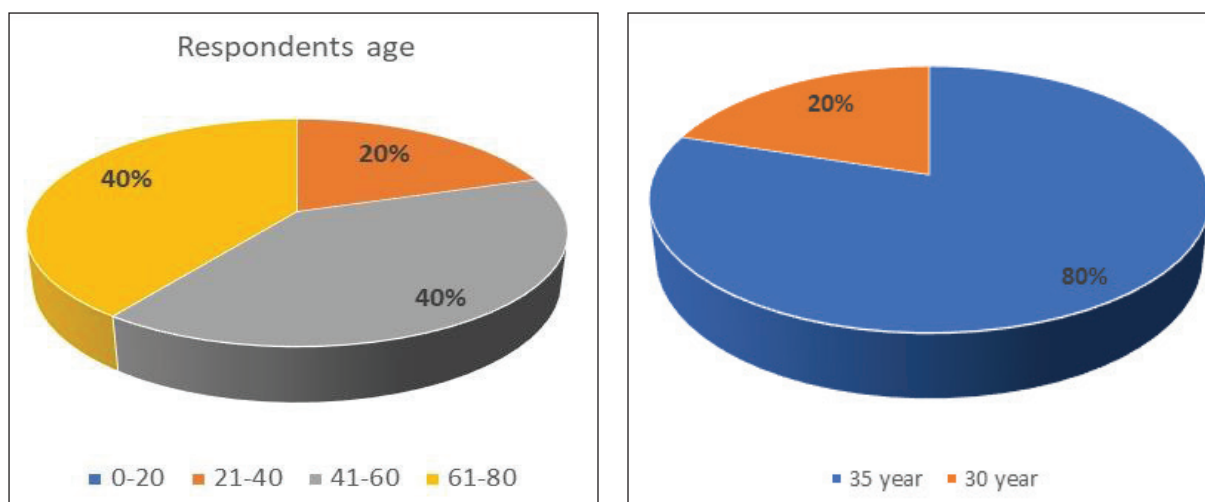
This analysis gives a full picture of the current state and problems of managing pastures and raising livestock in the Korab Protected Area. It gives a complete picture that is necessary for sustainable development, making smart choices, and improving the lives of people in the area by combining social, economic, ecological, and cultural points of view.

This analysis is significant as it offers a thorough comprehension of the present condition and obstacles of livestock farming and pasture management within the Korab protected area. This analysis integrates socioeconomic, ecological, and cultural perspectives, providing a comprehensive overview that is crucial for sustainable development, informed decision-making, and enhancing the livelihoods of local livestock farmers.

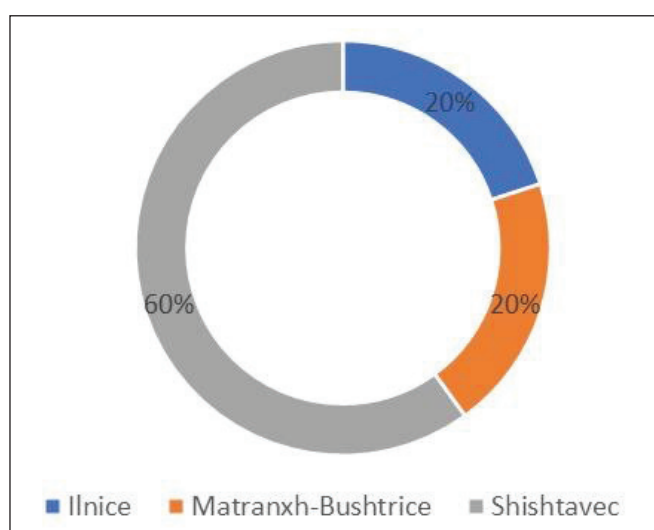
Demographics and Experience

The survey shows that the majority of shepherds are between 41 and 80 years old, which shows that the pastoral community is getting older. Participation varied among villages: Illicë and Matranxh-Bushtricë had only one respondent each, while Shishtavec had the most (3 out of 5). This suggests that the results may be more representative of the conditions in Shishtavec than in the other villages.

Four out of five people who answered said they had been shepherding for 35 years, and one person said they had been doing it for 30 years, which is still a long time. This shows that farming animals has been a way of life for a long time and will continue to be for future generations.



Participation is not the same in all villages. Ilnicë and Matranxh-Bushtricë only had one respondent each, but Shishtavec had the most responses (3 out of 5). This means that the survey sample is mostly from Shishtavec, so the results may better show the views or conditions in that village than in the other two.



Livestock Composition

There are a total of 1,000 sheep in the herds, which shows that this area is specialized. There aren't many cows (58 in total) and there aren't many goats (55 in total, owned by only two people). Denisi had the most varied herd (30 cattle and sheep), while Shaban Murati had a large flock of sheep and goats. These patterns suggest that sheep farming is the main thing that people do, while keeping goats and cows is either extra or depends on where they live. People who own cows probably do so on a small scale, for their own dairy and meat needs, not to sell to a big market.

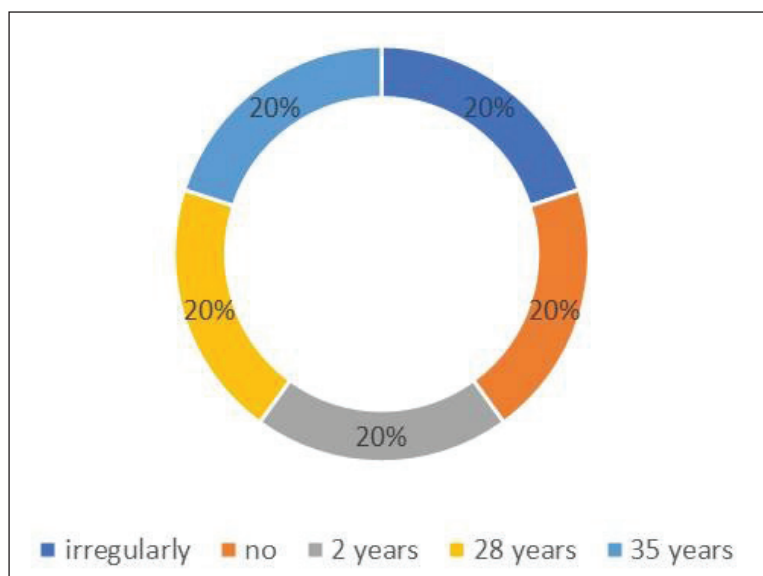
Tradition and Knowledge Transfer

All respondents (100%) reported that they inherited livestock farming from their families, underlining its intergenerational character. None started independently, which highlights the importance of family-based knowledge transfer. Likewise, all respondents reported practicing traditional methods, relying on inherited techniques and local resources rather than modern technologies or mechanization. Livestock farming thus emerges not only as an economic activity but also as cultural heritage.

All respondents (100%) reported that they practice livestock farming in a traditional way. This means that the methods, techniques, and management practices used are based on long-standing traditions, likely inherited from previous generations. It also suggests a limited adoption of modern technologies, mechanization, or innovative practices, relying instead on customary knowledge, family experience, and local resources. Livestock farming in the surveyed group is fully traditional, reinforcing the idea that it is both a cultural heritage and a sustainable livelihood practice maintained over decades.

Transhumance Practices

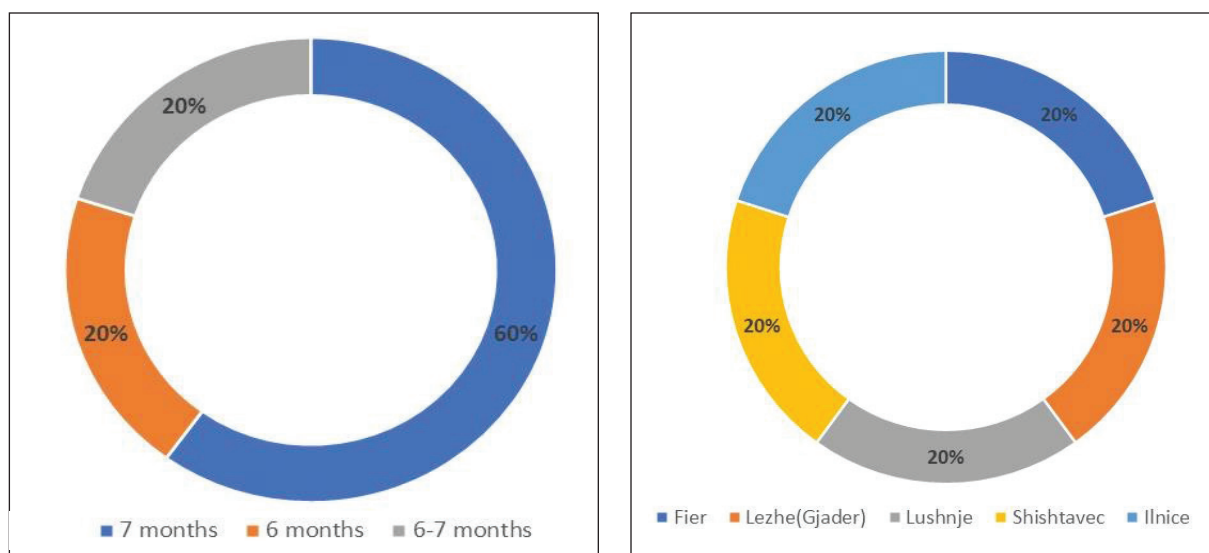
The responses are diverse, showing different experiences and levels of involvement in transhumance (seasonal livestock movement). Some respondents have extensive experience — ranging from 28 years to 35 years, reflecting a deep-rooted tradition of transhumance. One respondent has only 2 years of experience, suggesting new adoption or revival of the practice. One respondent practices transhumance inconsistently, which may point to changing socio-economic or climatic conditions that affect mobility. While other respondents do not practice transhumance at all, showing that this tradition is not universal among livestock farmers in the survey.



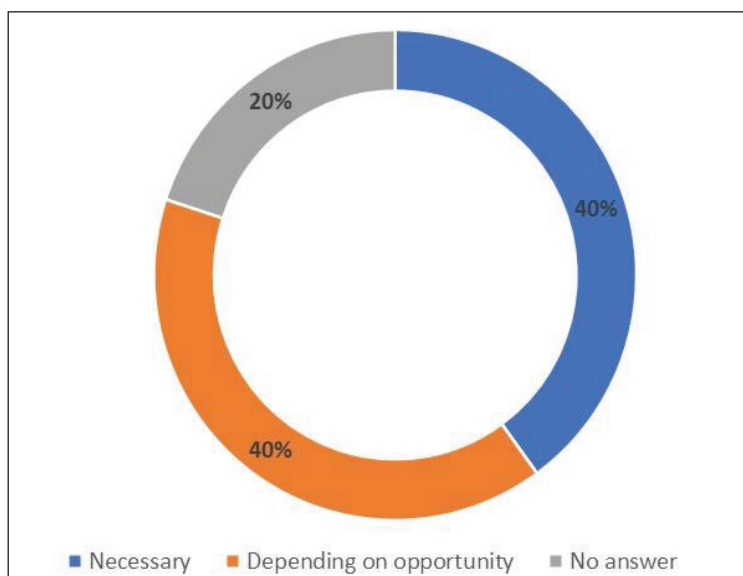
80% of respondents have some form of experience with transhumance (whether short-term, long-term, or irregular) while 20% of respondents do not practice it, which may indicate shifts towards sedentary livestock farming. The data reflects both continuity and change: while some farmers maintain a strong tradition of transhumance, others are moving away from it or adapting it to current conditions.

Wintering Practices

Most shepherds (60%) reported wintering of livestock for 7 months in winter, while others kept them for 6 months, or 6–7 months depending on the climate conditions during the year. Wintering locations were diverse: some moved animals to lowlands (Fier, Lushnje, Lezhë) for milder climates and fodder access, while others remained in the mountains (Shishtavec, Illicë) showing that not all farmers practice long-distance winter transhumance. No single strategy dominates, showing adaptability to resources and family connections.



These data indicate no dominant wintering area; rather, each farmer has a different strategy. The split in diverse areas suggests adaptability—some shepherds move to the lowlands for better conditions, while others rely on local winter housing. This highlights both the traditional mobility of herders and the diversity of strategies depending on household resources and connections. 40% consider transhumance as something to be practiced depending on opportunities—this reflects a flexible attitude, possibly shaped by economic conditions, climate, or labor availability. 40% of respondents view it as necessary (either generally or specifically due to the need for animal feed). This indicates that for some farmers, transhumance remains a vital practice to secure fodder and maintain livestock health. 20% gave no answer, which may indicate either uncertainty or indifference.



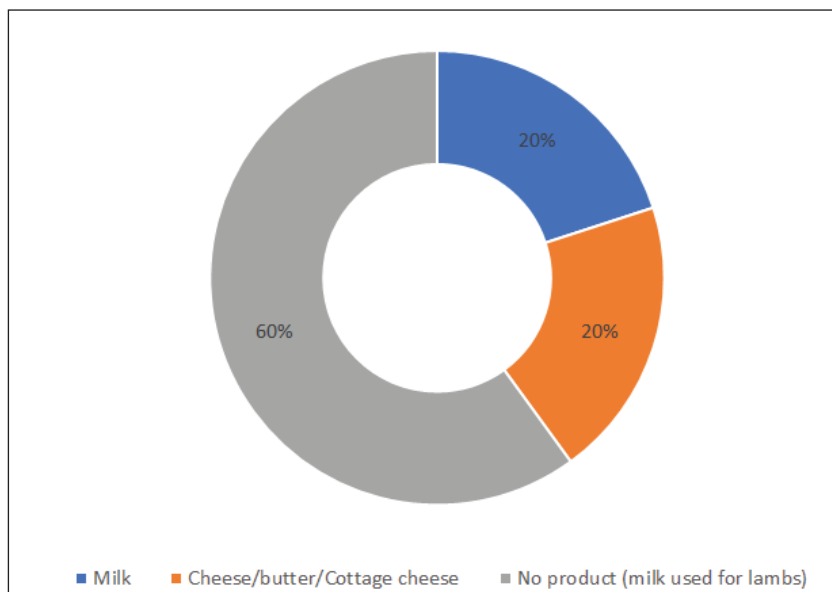
Opinions are diverse: some see transhumance as essential, others as conditional, suggesting a shift in traditional practices due to modernization, market pressures, or changing pasture availability. The emphasis on “need for food” shows that fodder scarcity is a driving factor behind the continuation of transhumance. The flexibility in responses (“depending on opportunities”) could indicate that transhumance is no longer a universal necessity, but rather a selective strategy. While still considered important or necessary by many, transhumance is increasingly being practiced conditionally, reflecting both tradition and adaptation to changing realities.

Production and Markets

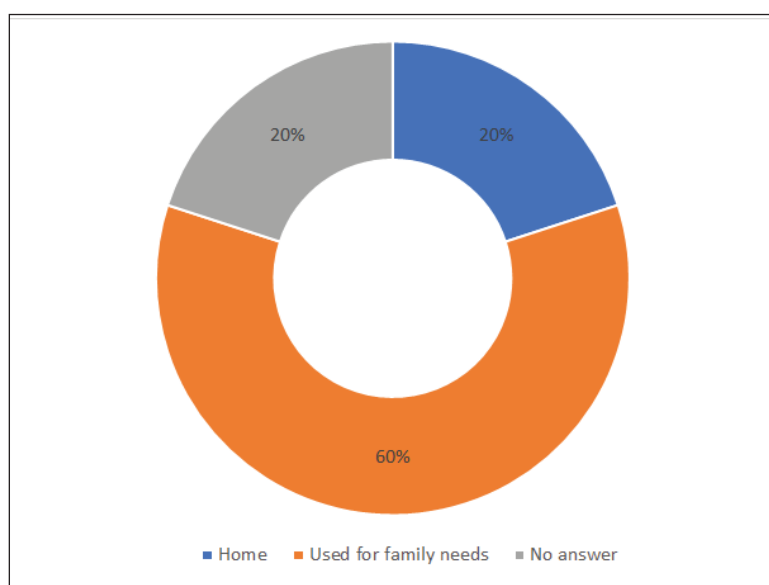
Dairy production is limited:

- 60% do not produce dairy products, as milk is mainly used for lambs,
- 20% consume raw milk,
- 20% process milk into cheese, butter, or cottage cheese.

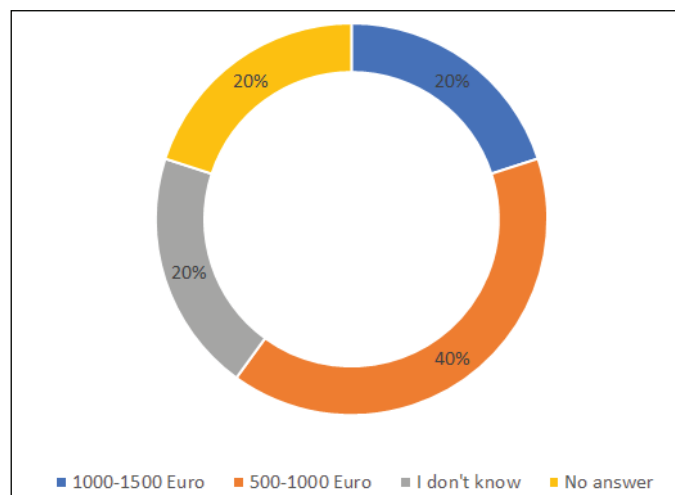
This confirms that meat, not dairy, is the main output. Livestock products are largely for family use (60%), with only 20% sold directly from home, highlighting subsistence orientation and weak market integration. This indicates that livestock holders in the area are mainly oriented towards meat production rather than dairy commercialization. The limited processing of milk reflects both a missed opportunity for value addition and an area with potential for future development through training, technology transfer, and improved market access.



The data reveal that livestock products are primarily used for family consumption (60%), while only a small portion of respondents (20%) sell directly from home. This suggests that livestock farming in the area remains largely subsistence-oriented, with limited market engagement and income generation. Strengthening market access and creating incentives for commercialization could enhance the economic benefits for local households.



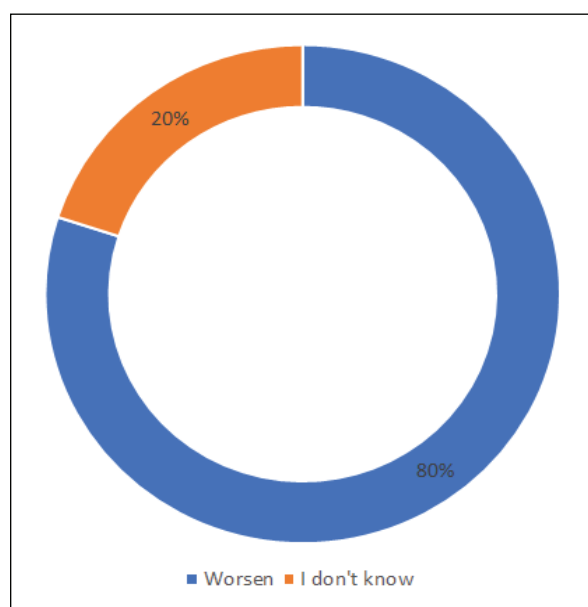
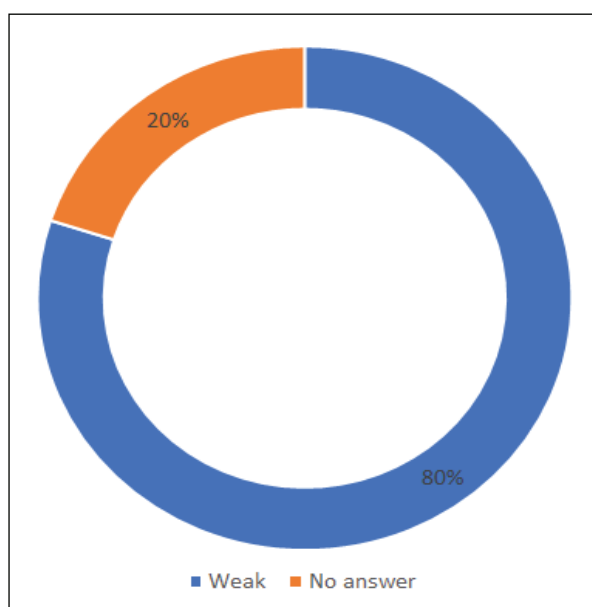
The survey indicates that most livestock holders (40%) earn between 500–1000 Euro per month, while a smaller share (20%) achieve higher earnings of 1000–1500 Euro. However, the fact that 40% of respondents either did not know or did not provide an answer highlights a lack of income monitoring and suggests that economic benefits from livestock may be underreported. Overall, livestock provides an important but modest source of household income, with potential for improvement through better market access, value addition, and financial literacy.



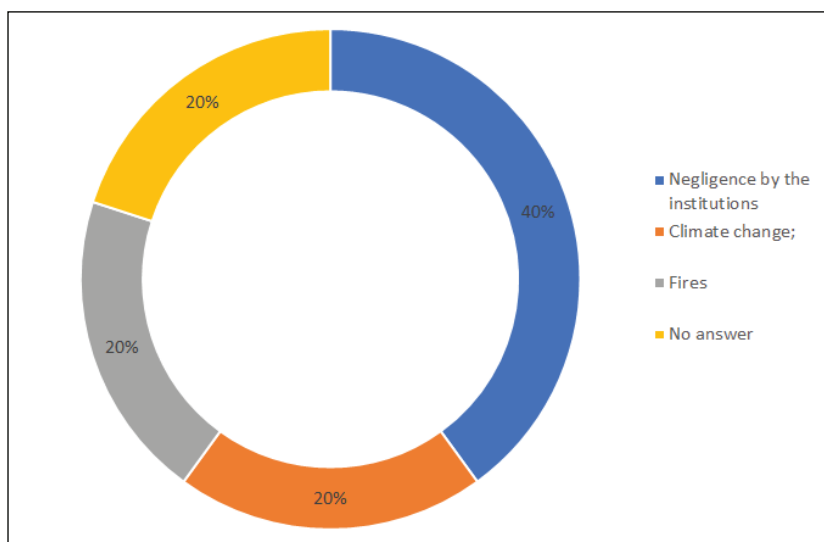
Pasture Conditions

Majority (80%) of respondents said that the condition of pastures is poor, which shows that grasslands are degrading having a low productivity. This situation undermines livestock productivity and increases household vulnerability, as farmers may depend more on external feed sources. Urgent measures for pasture restoration, sustainable grazing practices, and community-based management are needed to improve forage availability and ensure long-term viability of livestock farming.

The vast majority (80%) say that the condition of the pasture is getting worse, which strongly indicates a process of continuous degradation rather than stability or improvement. This trend, combined with the already weak state of pastures, poses a serious threat to livestock productivity and community livelihoods. It shows that immediate action is needed including improved grazing management, restoration measures, and long-term sustainable pasture use strategies.



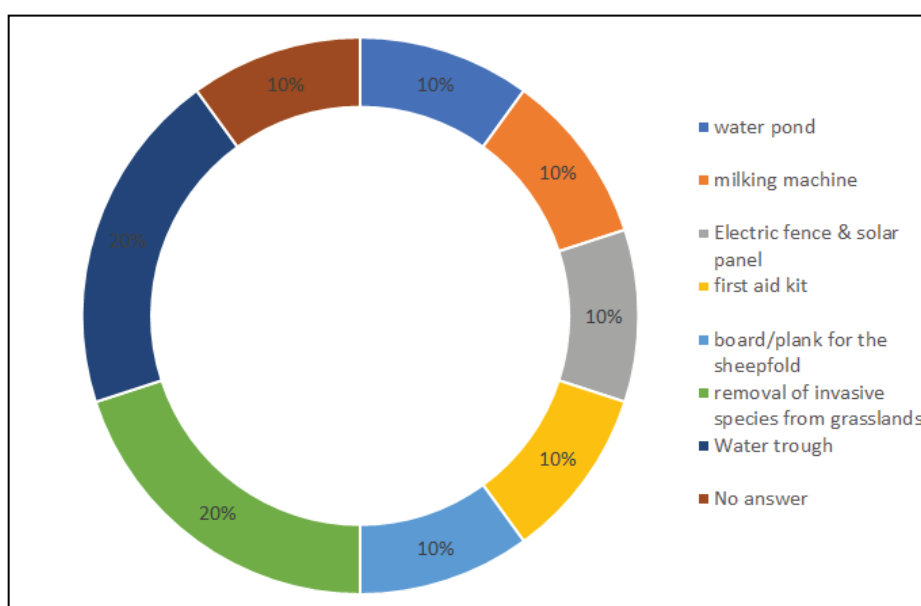
Respondents cited various factors contributing to the degraded state of pastures, with institutional negligence (40%) as the predominant reason, succeeded by climate change (20%) and fires (20%). These findings suggest that both governance shortcomings and environmental pressures are driving pasture degradation. Addressing these challenges will require stronger institutional engagement, climate adaptation measures, and fire prevention strategies to safeguard grazing resources.



Suggested interventions included:

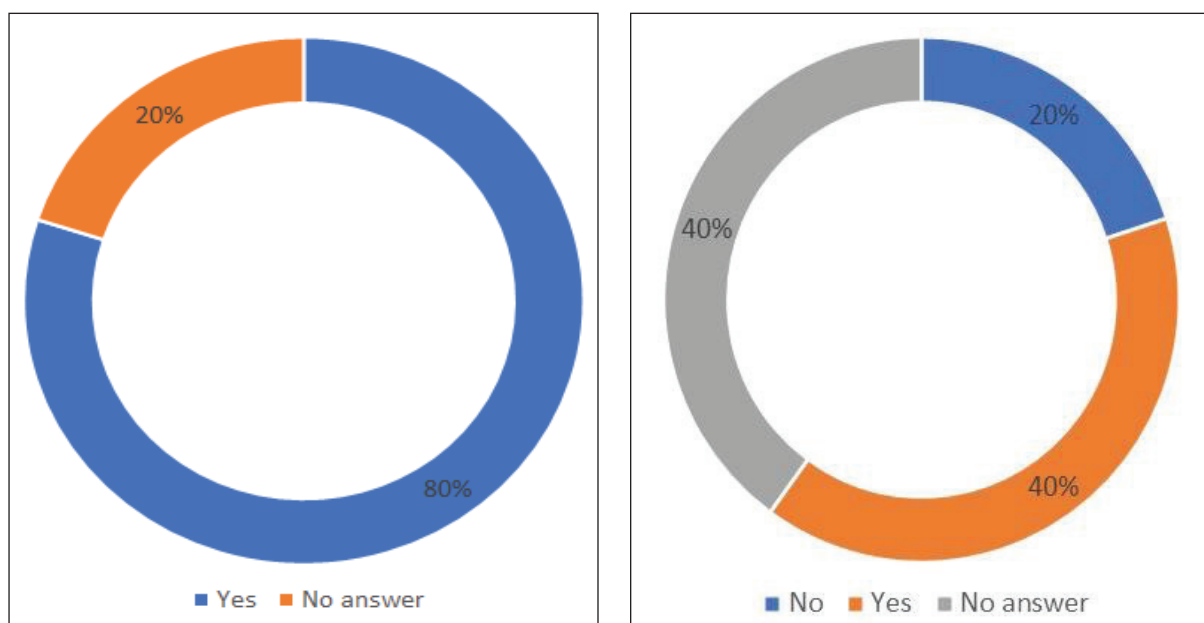
- Removal of invasive species (20%),
- Provision of water troughs (20%),
- Infrastructure improvements (ponds, sheepfold boards),
- Equipment (milking machines, solar-powered fences),
- First aid kits.

These reflect both ecological and practical needs for sustaining livestock.



Cooperation and Governance

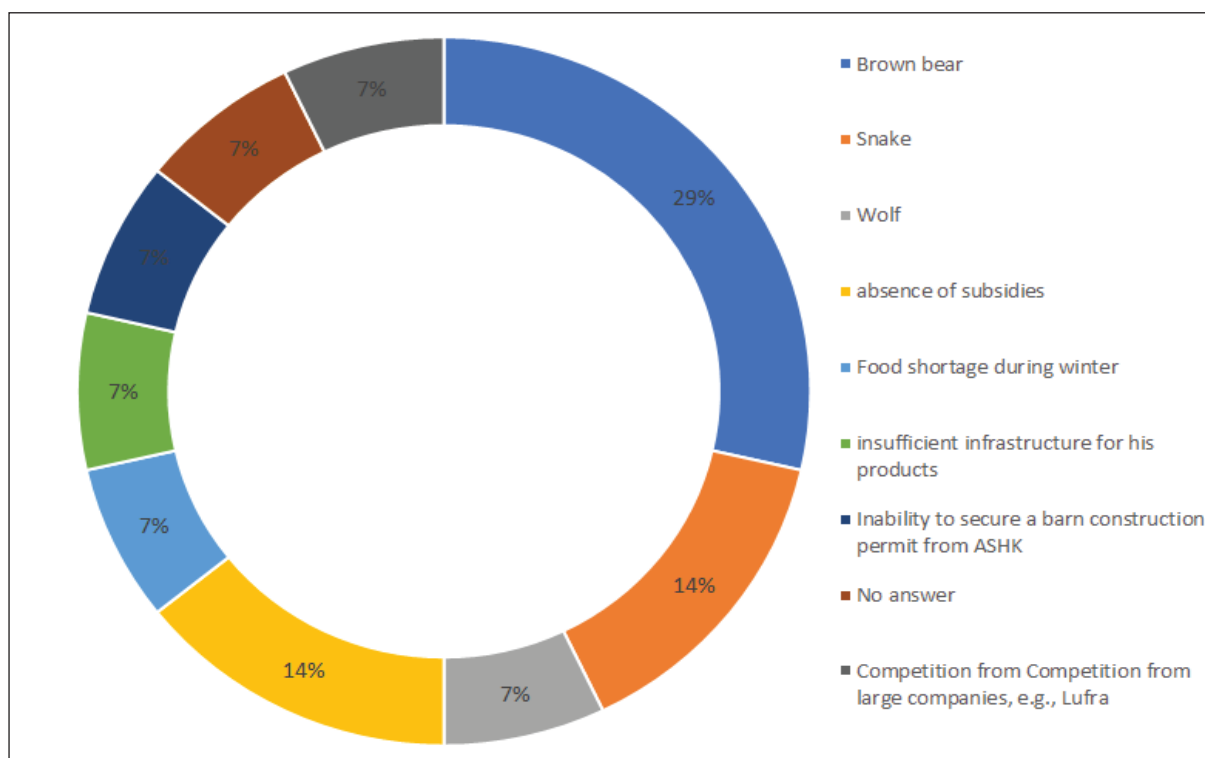
Most of the people who answered said they worked with RAPA (80%), mostly by reporting incidents, especially fires. But most of the time, cooperation is reactive, with only a few structured programs like training or joint projects. A very high proportion (80%) of respondent's report cooperating with RAPA, showing widespread collaboration. Only 20% did not answer, and no one explicitly said "No", which reinforces the overall positive trend.



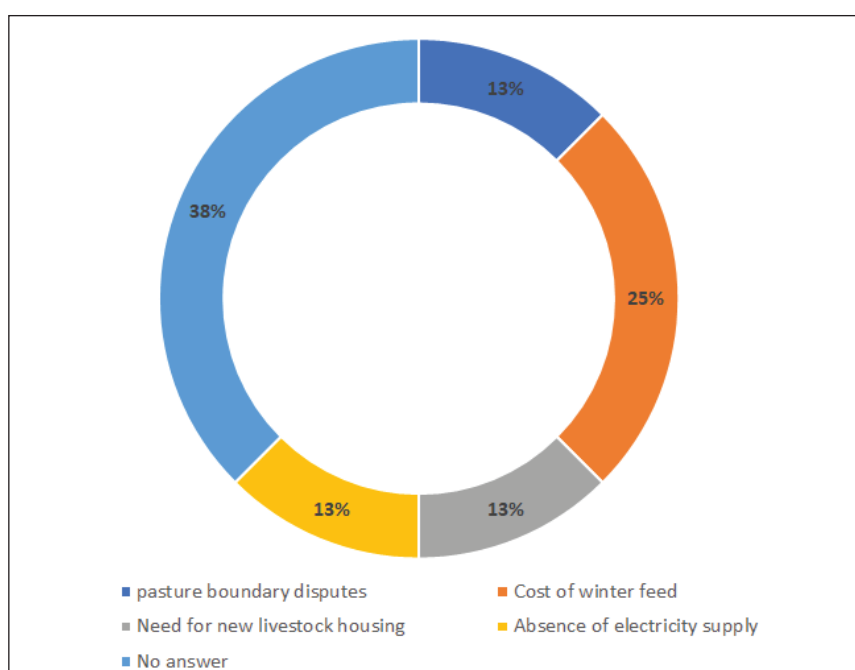
Shepherds reported being excluded from pasture-use decision-making, pointing to a governance gap. More people getting involved could make things more sustainable and reduce conflicts. Despite these gaps, satisfaction with cooperation was high: 80% rated it good or very good, with no negative responses.

Risks and Challenges

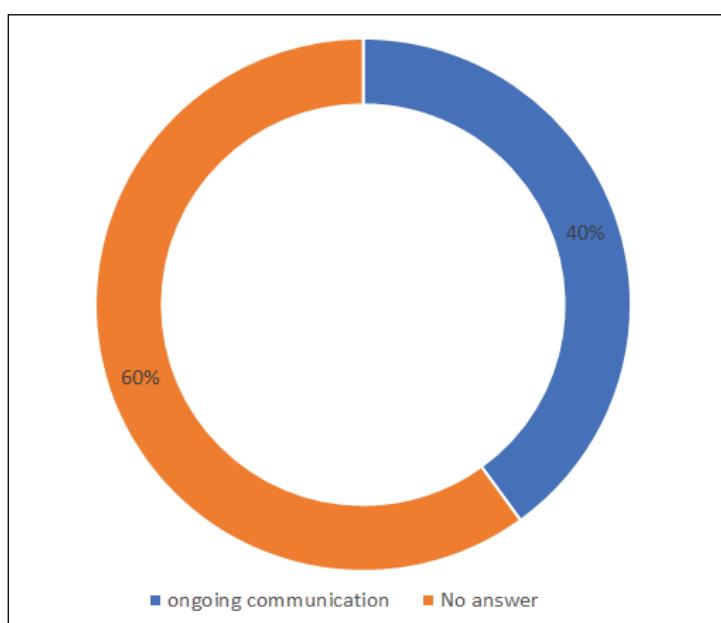
The survey results show that livestock farmers face many risks. The most serious one is conflict between people and wildlife (brown bear, snake, wolf), which was mentioned by 50% of respondents. In addition, institutional shortcomings such as lack of subsidies and difficulties in obtaining construction permits, as well as economic pressures from insufficient infrastructure, winter feed shortages, and competition with large companies, pose further challenges. These risks show that livestock farming is very vulnerable in many ways, so we need to respond in a way that includes better wildlife management, institutional support, and better access to infrastructure and markets.



A quarter of the people who answered said that the high cost of winter feed was the most important issue. Farmers had very different needs for feed, depending on the size of their herds, but the cost of feed was the same for everyone. The high cost of winter feed stands out as the most pressing problem, affecting a quarter of respondents. Disputes, lack of housing, and lack of electricity are each noted, pointing to diverse but less commonly shared challenges. In general, the problems are economic (the cost of feed), social (disputes over boundaries), and infrastructural (housing, electricity).

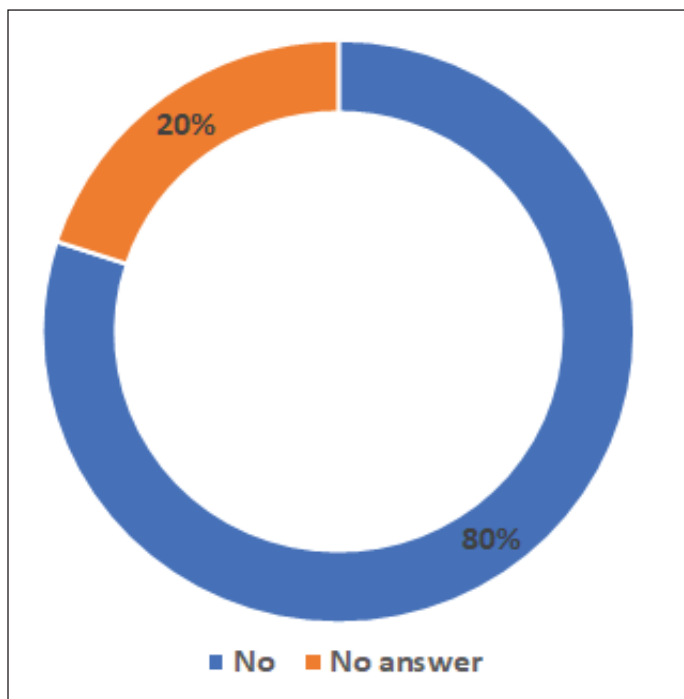


The main challenges facing respondents are economic pressures and resource/ infrastructure constraints, with winter feed costs as the dominant concern, but also underlying land-use conflicts and service gaps that affect livelihoods. The survey shows that the main suggestion for improving cooperation is ongoing communication (40%), pointing to the need for stronger dialogue and engagement between farmers and institutions. But the fact that 60% of respondents didn't give any suggestions could mean that they don't trust each other, don't know much about cooperation, or have had bad experiences with it in the past. Building confidence and ensuring regular, transparent communication could be the first step toward improving collaboration in the sector.



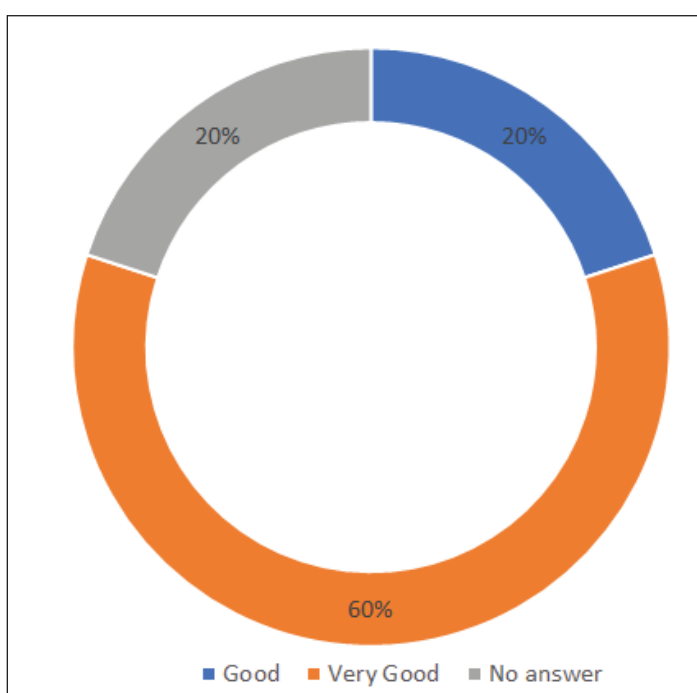
Shepherd's role in decision-making

The majority reported that shepherds are not included in pasture-use decision-making. There is no evidence of significant participation by shepherds in decisions, suggesting a top-down or externally managed approach. Shepherds are direct users and dependents of pastures, so leaving them out of decisions could lead to conflicts, a lack of ownership, or practices that aren't sustainable if they don't meet local needs.



As conclusion, shepherds are mostly left out of formal decision-making about pasture management, pointing to a governance gap where greater participation and inclusiveness could improve both cooperation and sustainability.

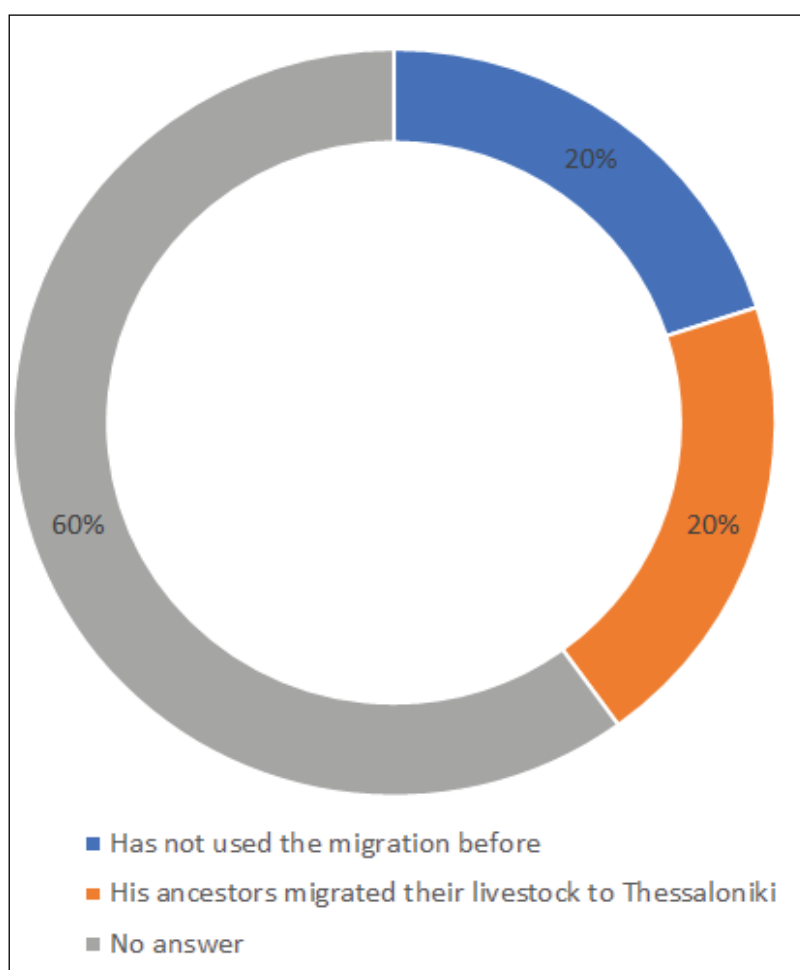
80% of respondents rate cooperation with RAPA as either *good* or *very good*, showing high satisfaction. Most of the people who answered not only think that working together is useful, but they also think it is very beneficial. No respondents rated the cooperation negatively, which suggests strong trust and good working relations.



Cooperation with RAPA is not only widespread (as earlier data showed) but also highly valued, with the majority of respondents expressing very positive experiences.

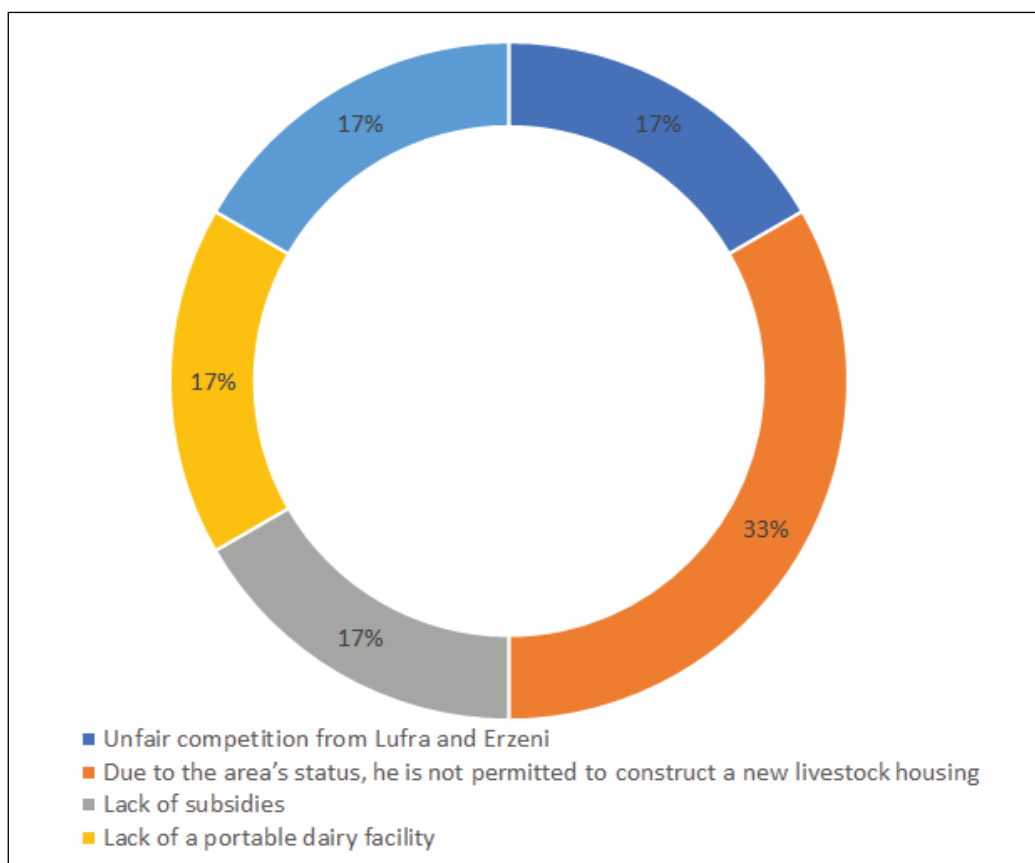
Traditions and Intergenerational Transfer

Few respondents shared information on traditions, with most referencing ancestral rather than current practices. While 60% reported passing knowledge to their children, 40% did not, which makes people worry about the future of cultural heritage in pastoralism.



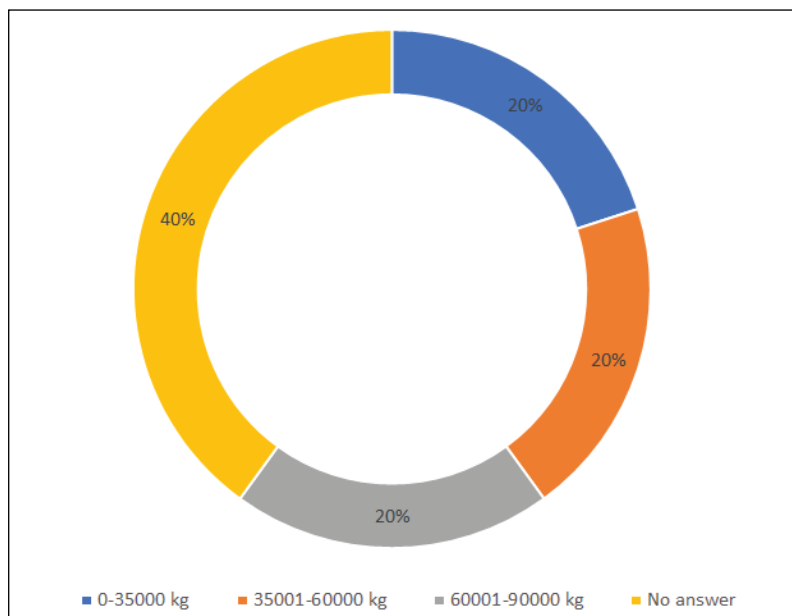
Special traditions tied to livestock activities are largely absent or no longer actively practiced, with only historical references remaining. This indicates a decline in cultural continuity within pastoral practices. According to the survey, 60% of people who answered said they had taught their children traditional livestock practices. One person said they did so reluctantly. However, 40% have not transmitted these traditions at all, highlighting a potential decline in cultural continuity. Training programs, community projects, and financial incentives are all ways to help and encourage younger generations. Farmers feel limited by land-use or conservation

rules that prevent them from improving livestock housing. Competition with large companies and lack of subsidies make small-scale livestock farming harder to sustain. Farmers were asking for portable dairy facilities and machinery, which shows that they want things to be more modern and efficient. While each issue is mentioned by a small number of respondents, together they reveal overlapping struggles in market access, support systems, and infrastructure development.



The main suggestions stress the need for policy flexibility (building more homes), financial help (subsidies), fairer markets, and more money for infrastructure and equipment to make the livestock sector stronger.

The data shows significant differences in winter feed demand, suggesting variability in herd sizes, management systems, or resource availability among respondents. Combined with earlier findings where *"cost of winter feed"* was the most cited difficulty, this data reinforces that winter feeding is both a large and unevenly distributed burden.



Winter feed needs vary widely among respondents, with some requiring relatively small amounts while others need up to 90,000 kg, reflecting different herd sizes or production scales. However, the cost of winter feed remains a critical shared challenge, regardless of quantity.

6.6.3.4. Key Insights from the analysis of Livestock Farming and Pasture Management in Korab Protected Area

Based on the above-mentioned analysis we concluded that:

- Livestock farming in Korab remains traditional, family-based, and sheep-dominated.
- Pasture degradation and feed costs are the greatest constraints.
- Cooperation with RAPA exists but needs to evolve from reactive to proactive.
- Cultural traditions are declining, with limited transfer to younger generations.
- Market engagement is weak, leaving untapped opportunities in dairy processing and commercialization.

These findings should be addressed to both local actors (farmers, communities, protected area staff) and institutional/strategic actors (municipalities, ministries, NGOs, donors, and private sector). Local actors can play an important role in their implementation directly in practice, while institutional stakeholders can translate them into policies, funding, and structural support.

6.7. Measures proposed in Korab grasslands

The Korab Protected Area situated in the northeastern part of Albania has a wide variety of ecosystems, such as alpine meadows, coniferous forests, and freshwater habitats. But these ecosystems are coming under more and more stress from both human and natural factors. Overgrazing, soil erosion, hydrological alterations, infrastructure development, and the legacy of historical land-use practices have contributed to the degradation of grasslands, threatening both ecological integrity and local livelihoods. Climate change makes these problems even worse by changing the timing of plant growth, making it easier for species to move, and raising the risk of wildfires. To keep the ecosystem functions, biodiversity, and cultural values of the Korab Protected Area, it is important to know what causes grassland degradation and to take specific steps to restore and manage the area.

1-Sustainable Grazing Management

- **Rotational grazing:** Split up grasslands into smaller paddocks and move animals around to keep them from overgrazing and give plants time to recover.
- **Stocking rate adjustments:** Align livestock numbers with the carrying capacity of each grassland to avoid vegetation degradation.
- **Seasonal grazing restrictions:** Keep animals out of sensitive areas during the wettest or most active growth times to protect soils and plant communities.

2- Erosion Control and Soil Restoration using nature-based solutions

- **Replanting of degraded slopes:** To stabilize soils and increase the organic matter, plant native grasses, legumes, and shrubs.
- **Terracing and check dams:** Building check dams on steep slopes with local stone or wood to slow down runoff and stop soil loss.

No	Measures	Local name	Quantity
1	Concrete stone check dam	Perroi i Thelsh	2
		Perroi i Pelit	3
		Perroi i Pogjacet	2

- **Buffer strips:** Maintain or restore vegetation along watercourses to reduce sediment transport and protect wet meadows.

3-Water Management and Wetland Protection

- **Restore natural hydrology:** Block or change man-made channels that drain wetlands and restore the natural water flow.
- **Protect water sources and ponds:** Prevent water abstraction from lakes and springs to maintain aquatic habitats and grassland moisture.

4-Improvement of grassland infrastructure meeting the livestock demand for water

This measure aims to provide alternative water points to reduce pressure on natural water bodies for livestock. We have identified together with shepherds and protected area staff several locations that are presented in the table below:

No	Measures	Local name	Quantity
1	Concrete water troughs for livestock at Bjeshka e Shkinakut	Ligata e Lepurit	1
		Kroi I ftohte (Gjibri)	1
		Gurre e zeze	3
		Kroi i Mbretit	1
2	Concrete water troughs for livestock at Bjeshka e Cajes	Kepi i Canit	1
		Kroi i Djemve	1
		Likeni i Letnit	1
3	Repairing of water ponds	Grame	1
		Illice	1
		Maqellare	1
4	Concrete water troughs	Grame	1
5	Construction of wooden troughs for placing salt	across the PA	

5-Wildfire Risk Reduction

- **Controlled grazing in high-fuel areas:** Reduce vegetation accumulation in areas prone to wildfires.
- **Firebreaks and access roads:** Make firebreaks to improve the access for firefighters, especially in coniferous forests.

6-Rule of law to protect habitat in Korab protected area

- **Limit vehicle access** in sensitive grassland areas to reduce habitat fragmentation and soil compaction.
- Prevent wildfires in the Korab protected area mainly burning of Juniper from shepherds.

7-Restoration of degraded grassland habitats

Effective restoration strategies aim to reestablish plant communities, stabilize soils, and enhance ecosystem resilience while maintaining the traditional pastoral use of these landscapes.

- **Introduction of native grasses and legumes:** Planting species that are suited to the local climate and soil (e.g former-Brezi i bute) will help the area recover faster and increase biodiversity.

Informs policy and management decisions:

- By identifying weak and worsening pastures, institutional gaps, and economic limitations, authorities and NGOs can **design targeted interventions** for pasture restoration, sustainable grazing, and support for small-scale farmers.

Supports livelihood improvement:

- Knowing production patterns, income levels, and market engagement helps **identify opportunities for value addition**, market integration, and diversification, which can improve household income and resilience.

Highlights ecological and environmental risks:

- Understanding threats like wildlife conflicts, invasive species, fires, and climate impacts enables the development of **sustainable land and wildlife management strategies**.

Preserves cultural and traditional knowledge:

- Insights into how livestock traditions are transmitted—or not—help communities and institutions **promote intergenerational knowledge transfer**, which is crucial for maintaining local heritage and sustainable practices.

Identifies gaps in cooperation and support systems:

- Responses on communication and institutional negligence point to the **need for stronger cooperation, training, and trust-building** between farmers and institutions.

Guides practical interventions:

- Farmers' suggestions (water troughs, invasive species removal, fencing, milking machines) provide **direct input for intervention planning**, ensuring solutions are relevant and feasible.

Informs risk management strategies:

- Recognizing the multidimensional risks—natural, institutional, and economic—helps in **developing comprehensive risk mitigation plans**, increasing the resilience of livestock systems.

Annex

No	Local name	Forage dry weight (gr/m ²)	Pasture yield in (kg/ha)	Average daily grass ration in kg per animal	Duration of the grazing season (time) in days	Carrying capacity (heads/ha)
1	Guri Mëngjezes	367.95	3,679.5	1.6	195	12
2	Guri Mëngjezes	219.75	2,197.5	1.6	195	7
3	Guri Mëngjezes	538.55	5,385.5	1.6	195	17
4	Kroi Hasan Begut	154.52	1,545.2	1.6	195	5
5	Kroi i Bardhë	114.21	1,142.1	1.6	195	4
6	Llakator	106.26	1,062.6	1.6	195	3
7	Gurrë e Zezë/Çaje	154.38	1,543.8	1.6	195	5
8	Gurrë e Zezë/Çaje	245.40	2,454.0	1.6	195	8
9	Kufiri Kukës/Dibër	313.50	3,135.0	1.6	195	10
10	Bjeshka e Carakollit	302.20	3,022.0	1.6	195	10
11	Gramë	102.17	1,021.7	1.6	195	3
12	Illicë	508.78	5,087.8	1.6	195	16
13	Illicë	502.61	5,026.1	1.6	195	16
14	Illicë	44.72	447.2	1.6	195	1

Database of interviews with local shepherds

Nr.	Emri blegtorit	Moshë	Gjinia	Vendlindja	Nr. viteve si blegtor	Numri krerëve të bagëtive			A e keni të trashëguar këtë aktivitet nga familja	A e ushtroni në mënyrë tradicionale
						dele	dhi	lope		
1	Gjelen Hoxha	69	M	Shishtavec	35	120		13	po	po
2	Shaban Murati	51	M	Shishtavec	35	230	25	3	po	po
3	Xhevdet Murati									
4	Denisi	22	M	Matranxh - Bushtricë	35	300	20-25	30	po	po
5	Ulvi Fida	61	M	Illicë	35	200	30	2	po	po

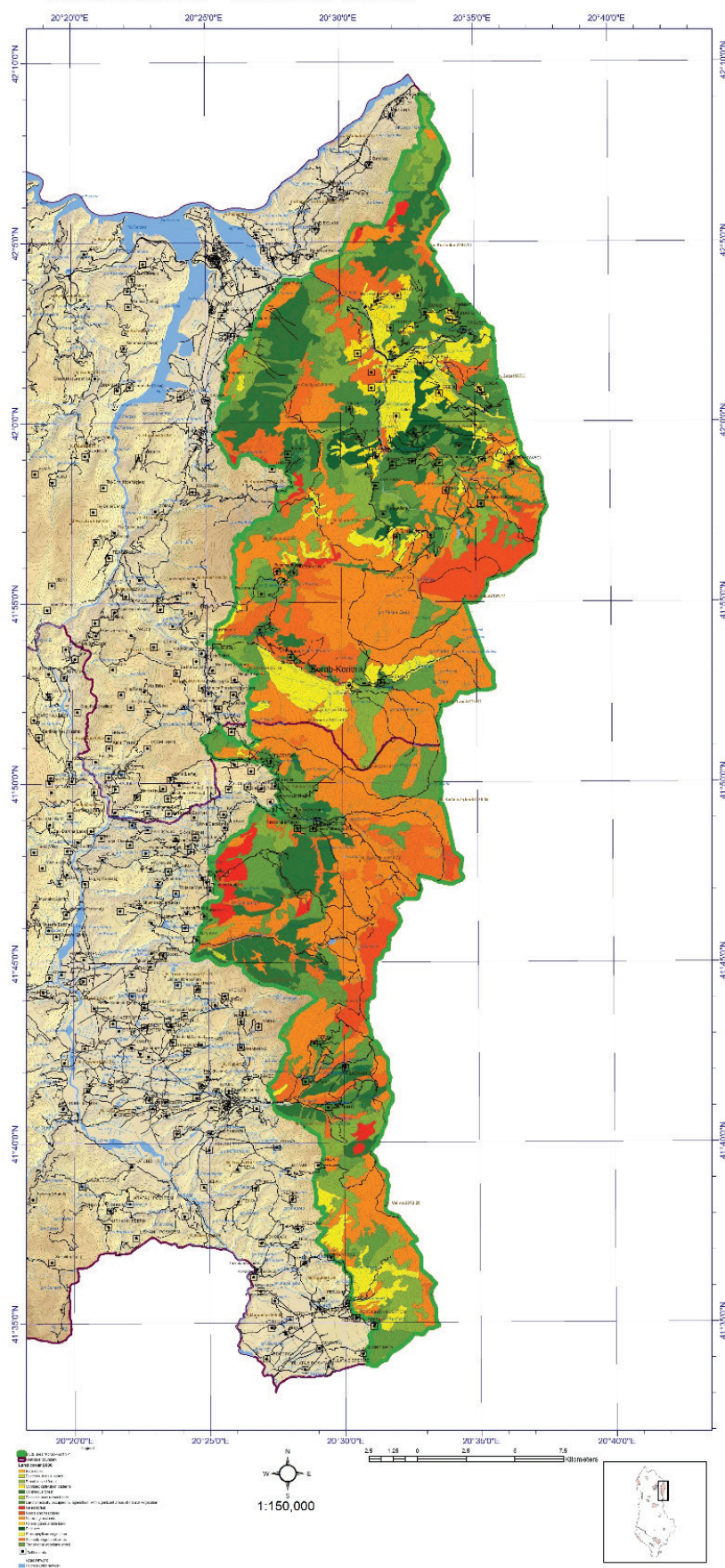
No	Emri blegtorit	A e praktikoni trans-humancën	Sa kohe dimeroni me bagetite?	Zonat kryesore per dimerim te bagetive	Si mendoni per trans-humancën	Produktet qe prodhoni	Ku I tregtoni produktet	Te ardhurat tuaja mujore nga blegtoria	Gjendja e kullotave	Gjendja e kullotave ne vitet e fundit	Arsyet per gjendjen e kullotave	Nderhyrjet e propozuara
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2	Shaban Murati	deri 2018	6 muaj	Lushnje	domosdoshme (per shkak te nevojës per ushqim)	qumeshtin ia le ta pijne qengjat	perdor per nevojat e familjes se tij	1000-1500 Euro	e dobet	perkeqesuar (drojthi;	mos-kujdesja nga institucionet dhe rralle zjarret(1 rast)	Heqja e shtares/drojtithit & korite uji/vendosja e vrojtuesve te zjarreve
3	Xhevdet Murati	cdo vit	7 muaj	Fier								
4	Denisi	jo rregullisht	6-7 muaj	Lezhe(Gjader)	domosdoshme	e pjine qengjat Deri ne Korrik e shet ne baxho por me pas ia le qengjave	perdor per nevojat e familjes se tij	nuk e di	e dobet	perkeqesuar (drojthi;	klimate;moskujde sja nga institucionet	
5	Ulvi Fido	jo			sipas mundesise		perdor per nevojat e familjes se tij	500-1000	e dobet	perkeqesuar (drojthi;	ndryshimet klimatike;moskujde sja nga institucionet	1 lere uji;makine mjelese;gardh elektrik & panel diellor;kuti endihmes se shpejte;derrase per stanin

No	Emri blegtorit	A bashkepunoni me blegtoret ne zonat kufitare?	Rreziqet me keke aktivitet	A bashkep unoni me AdZM	Si realizohet ky bashkep unim?	A jeni i perfshire ne vendimarrje per perdorimin e kullotave?	Bashkep unimi me AdZM	Veshtiresite kryesore	Sygerime per permirsimin e bashkep unimit
1	Gjelen Hoxha	po	gjiareprinjte/ariu	Po	Trajnim per te rinjte para 10 vitesh	jo	shume I mire		
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3	Xhevdet Murati								
4	Denisi		ariu (11 ueje te henga para	po	njoftojne AdZM ne rastet e zjarreve	jo	shume I mire		
5	Ulvi Fido	jo	ariu dhe gjarpri	po	njoftojne AdZM ne rastet e zjarreve	jo	mire	problemet me banoret per kufijte e kullotave;blerja e ushqimit gjate dimrit (450000 ALL);nevoja per nje stalle te re me kushte optimale;mungesa e drites	komunikim I vazhdueshem

No	Emri blegtorit	A ka tradita te vecanta qe ju ndiqni ne kete aktivitet?	Si e percillni kete tradite tek te rinjte?	Sygjerime & mendime	Ushqimi per bagetite ne dimer	Cmimi qumeshtit ne treg	Shenime
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2	Shaban Murati	Parardhesit e tij kane shtegtuar bagetite ne Selanik	e kam transmetuar tek djali por me zor	shteti te jape me shume subvencione;te lejohen per te ndertuar stalla dhe ASHK te jape leje ndertimi;ka nevoje per baxho te levizshme;mekanizma dhe traktor	blen ushqim per 6 muaj	shet mishin: qingji-15000 ALL/krere; Keci-10000ALL/krere	shet rreth 150 krere/vit dhe fiton rreth 1875000 ALL/vit
3	Xhevdet Murati						
4	Denisi						Ka investuar rreth 500000 ALL per sigurimin e ujit per bagetite (100 ml x 350 ALL/ml tubi+haku punes per hapje kanali)
5	Ulvi Fido	Nuk ka perdorur shtegtimin me pare	Djali 29 vjecar merret me kete aktivitet	Per shkak te statusit te zones nuk i lejohet te bej nje stalle te re.	blen ushqim per 7 muaj	Qumeshtin deri ne Korrik e con ne baxho dhe e shet me cmimin 130 ALL/liter;Shet qengjat me cmimi 500-600 ALL/kg dhe ne 1 vit shet rreth 300 qengja.Mbledh boronica gjate sezonit.	Vjen ne Kullote ne 10 Qershor dhe iken ne 10 Tetor.Ojesen tjetër zbrit poshte ne fshatin e tij dhe per dimer blen ushqim.Ka nje stalle me siperfaqe 150 m2 dhe vathen per ti mbajtur jashte.Ka patur rastin qe eshte sulmuar nga ariu dhe gjarpri.Sipas tij deri para 10 vjetesh

ASSESSMENT OF GRASSLAND STATE AND PRODUCTIVITY IN KORAB PROTECTED AREA

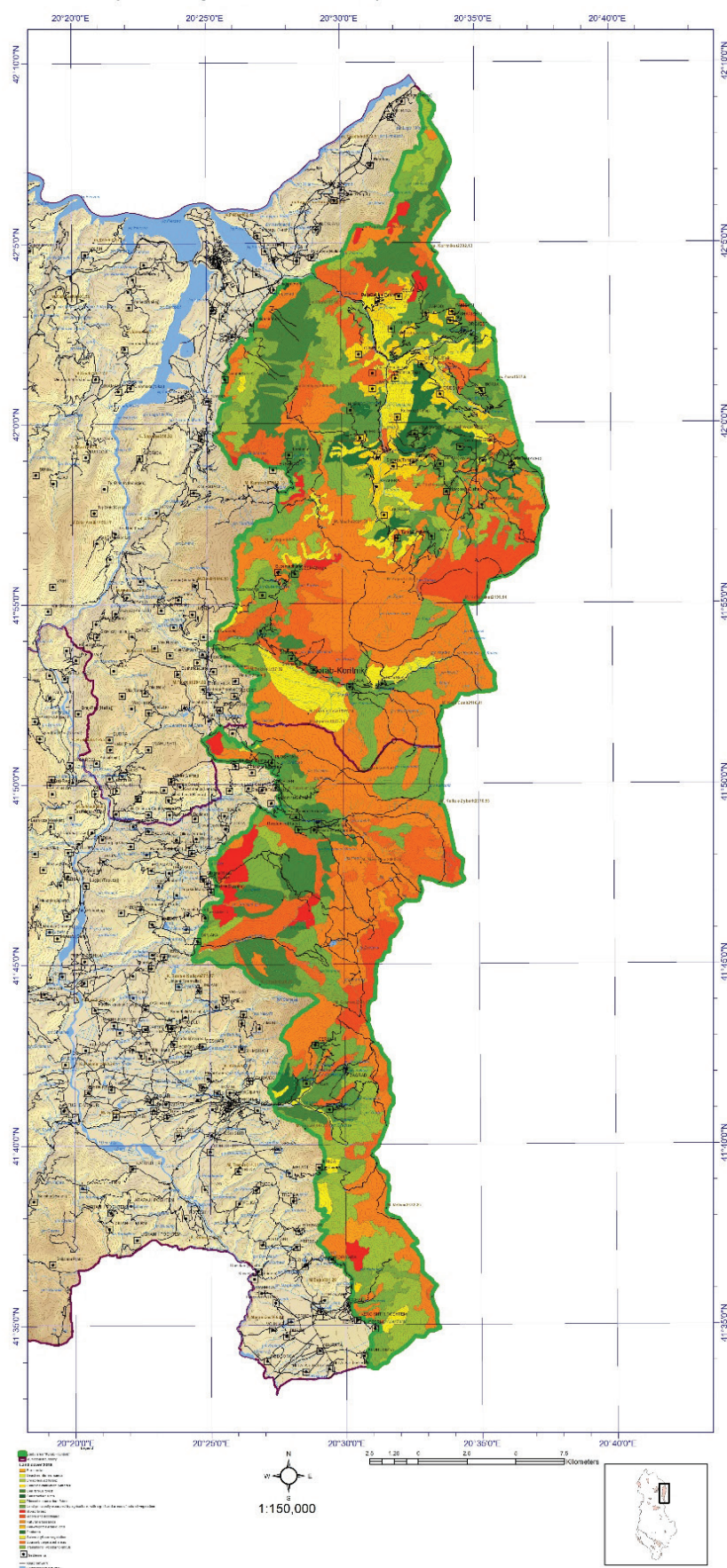
Landcover year 2000 Map – "Korab-Koritnik" Study Area



Land cover map-
year 2000

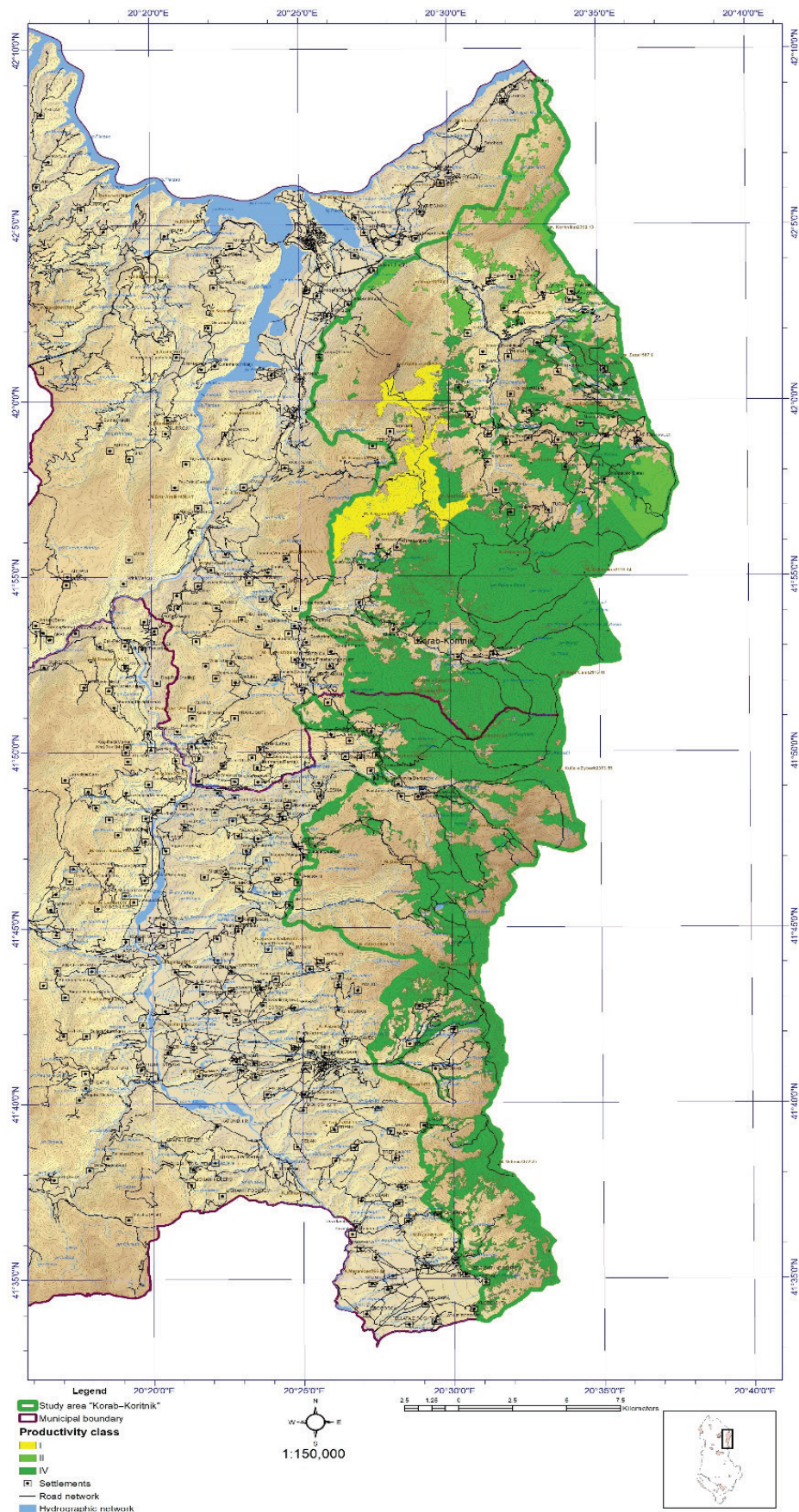
ASSESSMENT OF GRASSLAND STATE AND PRODUCTIVITY IN KORAB PROTECTED AREA

Landcover year 2018 Map – "Korab-Koritnik" Study Area

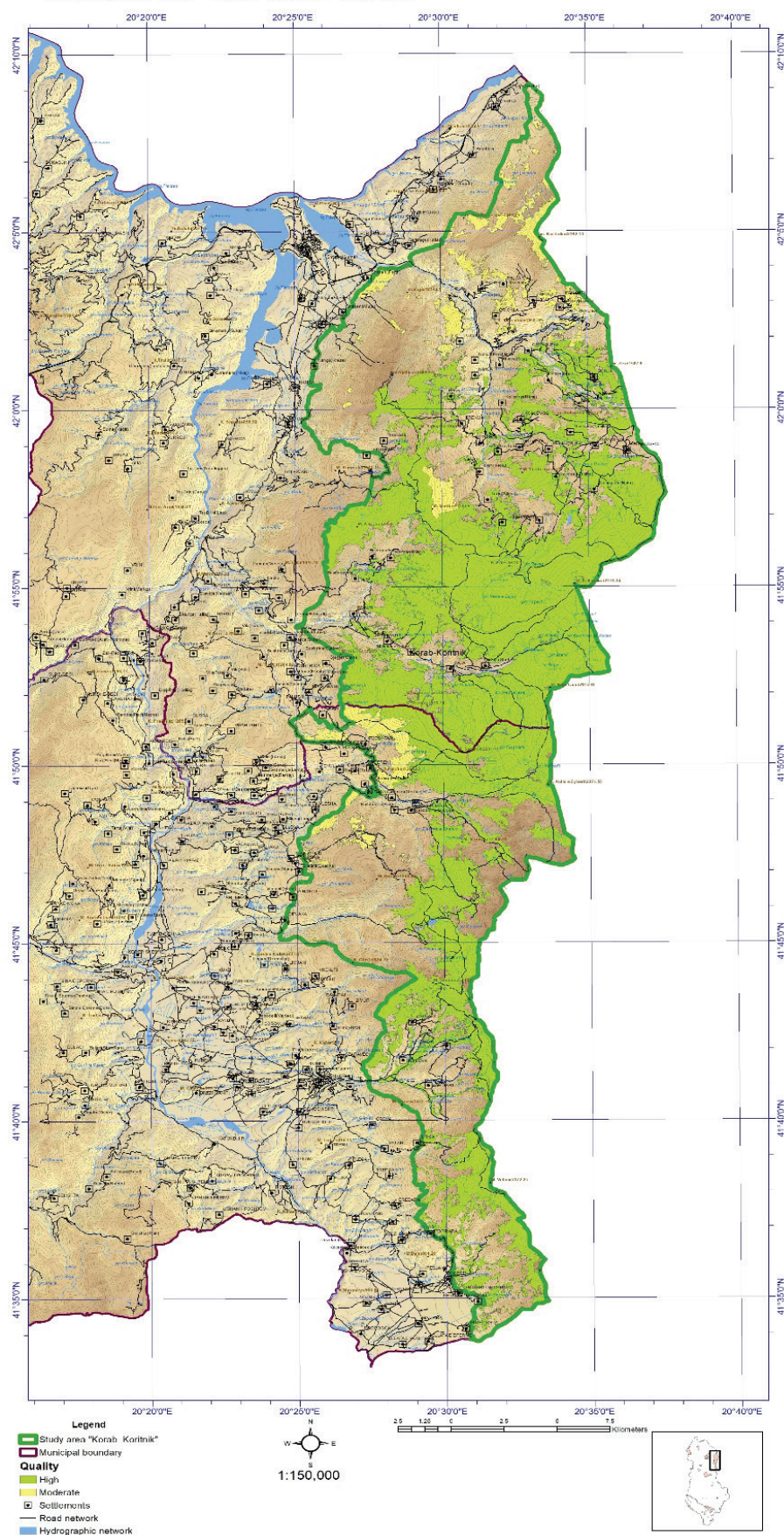


*Land cover map-
year 2018*

ASSESSMENT OF GRASSLAND STATE AND PRODUCTIVITY IN KORAB PROTECTED AREA
Pasture productivity class Map – "Korab-Koritnik" Study Area



ASSESSMENT OF GRASSLAND STATE AND PRODUCTIVITY IN KORAB PROTECTED AREA
Pasture quality Map – "Korab-Koritnik" Study Area



Map of pasture
quality in Korab
protected area

CIP Katalogimi në botim BK Tiranë

Toromani, Elvin

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