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Main Geographical Factors of Settlement Patterns and Natural Resource Use in Mountain Region: The Kvemo (Lower) Svaneti (Lentekhi Municipality) Case

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Abstract

The environmental exploitation of a region requires the study of its natural conditions and resources, as well as its geography and the related historical processes. In turn, the study of environmental conditions sheds light on material and non-material culture and traditions, as well as the patterns of natural resource use and settlement preferences. This research aims to evaluate natural resources in Kvemo (Lower) Svaneti (Lentekhi Municipality), identify the types of the natural-territorial complexes (landscapes), create a geo-informational database for the region, and establish the structure of the land resources and land use. The key outcome of this research is figuring out the landscape resources in the region, which was done by creating a geo-informative system for Kvemo Svaneti (Lentekhi Municipality) landscapes using GIS technology, based on materials from the 2023 expedition, aerial and satellite images, and topographic maps. A large-scale landscape map (1:50,000) of Kvemo Svaneti (Lentekhi Municipality) was created using GIS technology. The process identified 15 units of lower-level landscapes. According to the research findings, geographical conditions and the character of natural resource use in the region significantly influence landscape transformations, settlement preferences and farming. 43% of the territory is situated over 1000 m above sea level. Overall, Kvemo Svaneti is one of the sparsely populated regions, with 83% of its population living in small villages, each with up to 200 dwellers. The number of abandoned villages has increased (Lamanashuri, Ghobi, Tsana, and Koruldashi villages). In some villages (Bavari, Benieri, Buleshi, Zeskho, Mananuri, Kheria, etc.), the number of permanent dwellers ranges from 2 to 11. TLivestock farming is the primary form of agriculture in these areas, with pastures and haylands accounting for 92.4% of the total agricultural land. Traditional practices contribute to the development of animal farming. The upper hypsometric threshold of crop farming is 900 m.

Keywords: Natural resources, landscape map, Kvemo (Lower) Svaneti region (Lentekhi Municipality), settlement patterns

Introduction

The geographical peculiarities of mountain regions significantly influence the structure and location of settlements and the development of socioeconomic processes in mountainous landscapes. The northern highlands of Georgia, including Kvemo (Lower) Svaneti (Lentekhi Municipality), are among the highest elevations in the country. The dominant type of agriculture is traditional animal husbandry, with occasional farmlands in intermountain depressions and fluvial terraces. The region also has a developed forestry and recreational tourism industry. The informativeness of large-scale landscape maps is critical for analysing natural resources, agricultural activities, and their relationships with nature. Based on Kvemo (Lower) Svaneti (Lentekhi Municipality), large-scale landscape research created by authors shows that 15 landscape types are located in the Lentekhi Municipality area, with mountainous landscapes being the majority. The landscapes of Lentekhi Municipality's large-scale map (1:100,000) reflect the variety of individual components and their agricultural usage. As the result of landscape research, the Lentekhi Landscape geodatabase was created with ArcMap 10.8. The research revealed that both natural (geodynamic processes) and anthropogenic factors (overgrazing, deforestation) played a crucial role in the dynamics of landscapes. Kvemo (Lower) Svaneti (Lentekhi Municipality) is one of the sparsely populated regions of Georgia.

Most of the villages are situated in a linear pattern on the terraces along the Tskhenistskali, Kheledula, and Laskadula river gorges. Small villages with up to 200 people represent most (83%) of the settlement

areas, with Kheledi being the largest with 258 people. The number of abandoned and desolate villages has increased in the highlands and the high slopes of gorges (e.g., villages Lamanashuri, Ghobi, Tsana, and Koruldashi).

The number of settlements in Lentekhi Municipality according to height above sea level has been calculated.

We display the natural features of the landscape at different heights and assess their importance for farming, climate, and tourism.

Methods and Materials

The research has been conducted using stationary, semi-stationary, and field methodology (expeditionary, comparative, and statistical methods). The research draws on scientific literature about Kvemo Svaneti and cartographic maps, including "Landscape Map of Georgia" (Saneblidze et al., 1970) and "Transcaucasus Medium-Sized Landscape Map" (Ukleba et al., 1983), as well as topographic maps (scale: 1:50 000, 1:100 000) and statistical data. An important component of the resources is the field expedition conducted in 2023. We created an electronic landscape map (ArcGIS Pro) for the Lentekhi Municipality based on the expedition findings and several thematic maps. Both natural and socioeconomic factors influence the landscapes of Kvemo Svaneti. The region's peculiar landscape structure and the characteristic use of natural resources are determined by its natural conditions and specific geographical location.

Kvemo Svaneti is in the northwestern part of Georgia, on the northern slopes of the Svaneti Range (along the Caucasus ridge) and the southern slopes of the Greater Caucasus Ridge, in the Tskhenistskali River basin, its hypsometric levels ranging from 450 m (the Tskhenistskali gorge) to 4547 m (the Ailama hill on the Greater Caucasus). It is bordered by Chkhorotsku and Martvili Municipalities in the west, Mestia Municipality and the Kabardino-Balkarian Republic (the Russian Federation) in the north, Ambolauri Municipality in the east, and Tsageri Municipality in the south (Salukvadze et al., 2021; Salukvadze & Chaladze, 2024). There is one administrative unit in Kvemo Svaneti, Lentekhi Municipality (area 1344 sq. km), represented by 1 township, 8 rural districts (communities), and 60 villages. The population amounts to 4386 people (the level of population density is quite low, 3.3 per sq. km). 29.3% of the population of Lentekhi Municipality lives in urban areas and 70.7% in villages (Lentekhi Municipality priority…, 2024).

Results

The territory of Kvemo Svaneti is mainly confined to the middle and lower basins of the Tskhenistskali River, which are drained by Tskhenistskali and its tributaries: Kheledula, Laskadura, Zseskho, Gobishuri, Leusheri, Khopuri, and others. In the north, the region is locked by the Svaneti and the Greater Caucasus ranges; in the west and southwest, it is bordered by the Egrisi range, while in the east and southeast, it is bound by the Lechkhumi range. These ranges, and their extensions, occupy the main part of the Kvemo Svaneti territory. Kvemo Svaneti is a mountainous region with high- and medium-altitude mountain reliefs, and 43% of its territory is over 1000 m above sea level.

The region has a complex geological structure, which plays a major role in the diversity of its landscapes. The lower part—riverbanks and terraces— is built of Quaternary alluvial deposits. The southern slopes of the Egrisi and Lechkhumi ranges are largely built of Bajocian porphyrites and tufa deposits. The relief is comparatively steep and rocky. The axial parts of the Egrisi, Lechkhumi, and Svaneti ranges are mostly built of Jurassic rocks, occasionally combined with flysch sequences and non-karstic limestone. These rock layers are linked to strong mountain streams found in the Lechkhumi and Svaneti ranges, while the southern sides of the Greater Caucasus are mostly made up of older Paleozoic granitoids and crystalline rocks (Tatashidze et al., 2000).

Kvemo Svaneti has deposits of arsenic (not mined), quartz, barite, copper (the Zeskho ore), marble (Choluri village), lead-zinc (Rtskhmeluri village ore), and coarse sand-gravel (Kheledi-Khacheshi ore) (Khazaradze & Salukvadze, 2022). The Lentekhi region is rich in chemically diverse mineral waters. Mineral springs can be found all over the Kvemo Svaneti territory, and their number exceeds 20 (Lentekhi Municipality Vision and..., 2024).

Lentekhi Municipality has abundant water resources (drinking water springs and rivers). Tskhenistskali is the main river of the municipality. Its tributaries are Kheledula, Laskadula, Koruldashi, Ghobishuri, Zeskho, Khopuri, and other big or small rivers, together totalling 40. The region has remarkable hydropower potential and rich drinking water supplies.

Hydropower is the region's most important natural resource. Tskhenistskali stands out for its high discharge rate and a long high-water period, which significantly increases the estimated economic efficiency of hydropower arrangements on the river. A large (64%) part of the area is covered by forests, which is an important asset in Svaneti's natural capital (Kharaishvili, G., 1988; Lentekhi Municipality priority, 2024).

The climate is elevation-dependent because of the mountain relief, ranging from humid subtropical to

continental. The lower area is characterised by humidity, cold winters, and long, cool summers. Long, warm summers are characteristic of a brief section of the Tskhenistskali gorge. The average annual temperature in mountain forests (up to 1900–2000 m) ranges between 3.2 and 9.4: 3.20 in Korulda (1943 m above sea level) and 9.40 in Lentekhi (760 m above sea level). Hence, the average temperature is 6.9-1.80 in January and 12.9-200 in July. The lowest and highest recorded temperatures are -330, -260, and -320-390, respectively. Annual precipitation ranges between 1250 and 1400 mm; above the forest zone, there is a humid mountain climate with cold winters and short, cool summers. The snow cover duration is 80 days in Lentekhi and 170 days in Koruldashi (Meladze & Meladze, 2012).

The region has a broad hypsometric spectrum, which accounts for its diverse climate. We can distinguish the following types of climate (Mumladze & Lomidze, 2018).

· Humid climate with cold winters and long cool summers;
· Humid climate with long cold winters and short summers;
· Humid high mountain climate with no real summer;
· Humid mountain climate with abundant snow and glaciers.

According to agro-climatic zoning, the following sub-zones of the moderate belt are distinguished in Kvemo Svaneti: moderately warm, humid; moderately cold, with high humidity; and moderately humid, with moderate-to-high humidity. In agro-climatic terms, Kvemo Svaneti belongs to the moderately humid district of western Georgia's western Caucasus sub-region (Gagua, 2018).

In the lower zone, intensive vegetation starts from April 4-10-19 and continues to the end of October and beginning of November (Table 1). In years with early-fall and late-spring frosts, the vegetation period can be one month shorter (Meladze & Meladze, 2012; Elizbarashvili et al., 2004; Elizbarashvili & Elizbarashvili, 2021).

Table 1. Agro-climate characteristics of the Kvemo Svaneti Region (Lentekhi municipality)

Object	M. above sea level (m)	The sum of active temperatures ($10^{0>}$)	Absolute minimum temperature (average) (C^0)	Moisture rate	Annual sum of atmospheric Precipitation (mm)	Duration of frost-free days
Lentekhi	**760**	**3030**	**-26**	**8.6**	**1250**	**189**
Koruldashi	**1940**	**1070**	**-33**	**6.2**	**1390**	**130**

In the lower part of the region, there are narrow strips of alluvial soil along riverbanks, first grey-brown and further typical grey-brown forest soils, while at a higher hypsometric level, under the canopy of dark conifers, there are podsolic ashen grey soils. Mountain forest-meadow soils are frequent in the high mountain zones, between 2000 and 2250 m above sea level. At a higher elevation, they are replaced by mountain-meadow soils and even higher—by primitive soils.

The region stands out for its diverse flora and is characterised by a structure typical of the Colchian Floral Province. The Kvemo Svaneti's natural flora is mainly represented by oak, hornbeam (Carpinus caucasicus), beech, and pine. The region's flora includes fir, spruce, chestnut, alder, and birch. Colchic flora, represented by Colchic holly and ruscus (butcher's broom), can be found in the region's westernmost part. Alder forests are common on the riversides up to the upper zone, as well as in highly humid landslide geosystems. Former agricultural sites often contributed to the spread of fir trees. Beech forests are mostly found at mid-altitude, being occasionally replaced by dark conifers. Dark conifers are widely spread in the Murgouli, Koruldashi, and Devashi gorges; the largest stock is in the Kheledula River gorge. Dark conifers are often mixed with birch trees. High mountain forest areas are common from 1700 m to 2000 m, reaching 2350 m. They are represented by Litvinov birches, high mountain sycamores, and, occasionally, beech forests. Here, mixed forests mostly include birches, rowans, and goat willows. Tall herbs, such as rhododendrons and occasionally junipers, vacciniums, and other shrubs, represent the higher sub-Alpine zone. This zone reaches 2650-2700 m and is gradually replaced by the Alpine zone, which in turn is followed by subnivean and nivean zones.

The forests have climate-curative, soil-protecting, and water-conservation functions and therefore belong to landscapes with high ecological value (Salukvadze et al., 2022).

The dark conifer forest landscapes at mid-elevation are scarcely populated and are distinguished by their natural resource potential. They also have significant touristic and recreational potential: the Buashi climatic-balneological resort and the Ailama mountaineering camp are set up in this landscape zone.

Settlement types vary in the conditions of the extensive elevation range of the populated area (1430 m) and highly heterogeneous reliefs. Most of the villages are situated in a linear pattern on the terraces along the main river gorges of Tskhenistskali, Kheledula, and Laskadula. High mountain villages at the top of the vertical scale of settled areas are not large. The number of abandoned and desolate villages

has increased in the highlands and the high slopes of gorges (e.g., villages Lamanashuri, Ghobi, Tsana, and Koruldashi). In some of them (Bavari, Benieri, Buleshi, Zeskho, Mananuri, Kheria, etc.), the number of permanent dwellers ranges from 2 to 11. The Tskhenistskali middle basin gorge has an elevation range of 540 to 640 metres. Rtskhmeluri, Gvimbrala, Kvedreshi, and Tsiplkakia are the villages with the lowest altitude (540 m), while Makhashi has the highest altitude (1560 m). Overall, Kvemo Savneti is one of the sparsely populated regions, as most of the settlements (83%) are small villages (up to 200 dwellers). The largest village (258 people) is Kheledi.

According to the altitudinal scale, 17 villages, which make up 28.3% of the total Kvemo Svaneti villages, are situated between 540 and 1000 m above sea level, 33 villages (55%) are found between 1040 and 1500 m, and 10 villages (16.7%) are between 1560 and 1970 m (Fig. 1).

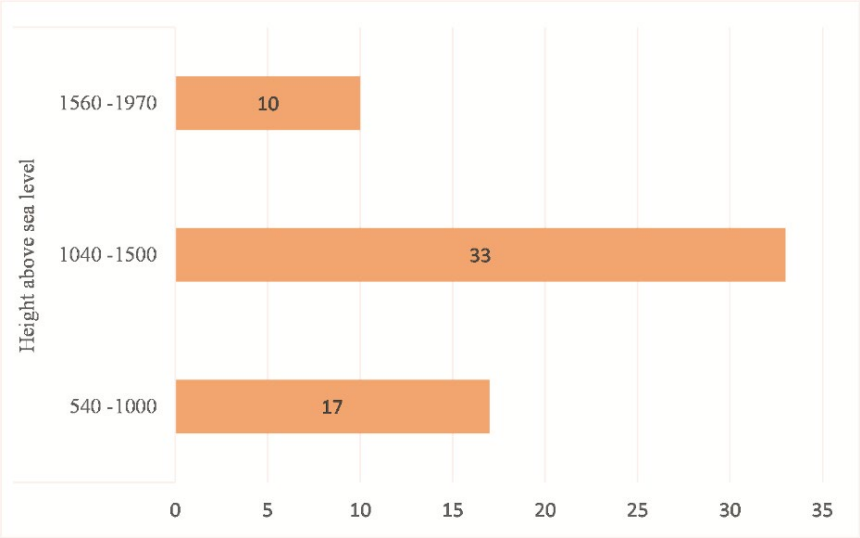

Figure 1. Number of settlements in Lentekhi Municipality according to height above sea level

Scarcity of cultivated lands and large settlement areas, underdeveloped transportation networks and industry (arsenic is no longer mined in Tsana village), and underutilised recreational resources result in a low level of agriculture and unfavourable conditions, which is associated with a low level of settlements. It should be noted that migrations in the last two decades have had a significant adverse effect on the region's settlement—specifically, migration from the highlands to small towns, then to the cities or abroad (to Spain, Germany, Italy, Greece, and Russia), which was also confirmed by responses to the socioeconomic questionnaire specially designed for the field expedition.

Apart from severe natural conditions, the settlement curve in the highlands is also influenced by natural disasters—avalanches, landslides, lahars, floods, etc. Natural disasters lead to a decrease in population in Svaneti. Between 1988 and 1991, avalanches and landslides left dozens of families without roofs, forcing them to resettle primarily in the western regions of Georgia. As a result, the level of the Highland population sharply declined.

The following trend has been revealed in the migration of the rural population: young people most often abandon villages with scarce usable lands, limited agricultural opportunities, low income, and poor standards of living (as compared to modern standards). According to the 2002 General Population Census, the population in Lentekhi Municipality totalled 6984, while according to the most recent census (2014), the figure decreased to 4386, which marks a 37.1% decline.

There can be individual as well as group resettlements, the latter being associated with natural disasters. For example, due to avalanches, several families in Kakhura village, Liskadura gorge, migrated to a different part of the same village as well as to the neighbouring village Melura.

Land resources are distributed across different zones. The following altitudinal zones can be distinguished above sea level: 500-1000 m—with natural croplands, developed livestock farming, and vegetable, potato, and grain harvesting; 1000-1500 m—with pastures and arable/hay farming; 1500-2000 m—with hay farming; above 2000 m—with lands unfit for agriculture.

The region's relatively severe climate and complex relief account for the shortage of arable lands, which in turn limits opportunities for intensive and comprehensive development of agriculture. The locals mostly grow maize and potatoes and have gardens. The most common fruit trees are apples, pears, and plums. Grapes are less common and are mainly grown in the lower zone, 800 m above sea level.

According to the 2022 data, the total land resources equal 105.758 ha, of which 1.560 ha (1.1%) are arable land, perennial plants make up only 140 ha (0.2%), haylands ha (4.1%), and pastures ha (11.7%). A large area is covered with forests, bushes, and shrubbery (83.215 ha), which is more than a half (61.9%) of the total area. Other types of land cover a total of 28.642 ha (see Fig. 2):

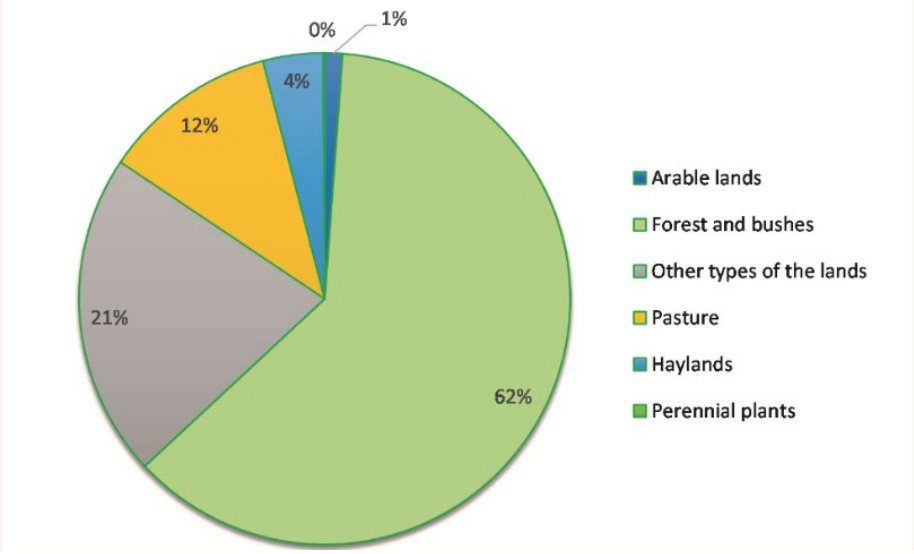

Figure 2. The Structure of Lentekhi Municipality land resources in % (2022)

The main agricultural and settlement zone is situated 1000-2000 m above sea level, which is approximately 1/3 of the total area of the region.

Due to severe soil erosion resulting from unsustainable use of land resources, unregulated use of pastures, and other socioeconomic reasons, a significant area of land has been wasted or become less fit for intensive cultivation.

Different species of perennial plants are spread over the following areas (Fig. 3): grapes—32 ha; acinaceous fruit trees—87 ha; and juglandaceae—21 ha. Of grape species, white Jvarisa grapes commonly grow in the lower zone (villages Kheledi and the Kheledula gorge), and Kachichi is spread in the higher zone (the Tskhenistskali gorge). Gardening is underdeveloped in the municipality due to overgrown trees and low prices on fruit. Gardening is more common for highland villages of the region. If we invest in building a processing plant, the branch will flourish. Fruits grown in this region are fully organic and, by taste, are not inferior to fruits grown in other regions.

52% (11,691 ha) of agricultural lands are state-owned, while 48% (10,821 ha) are private property.

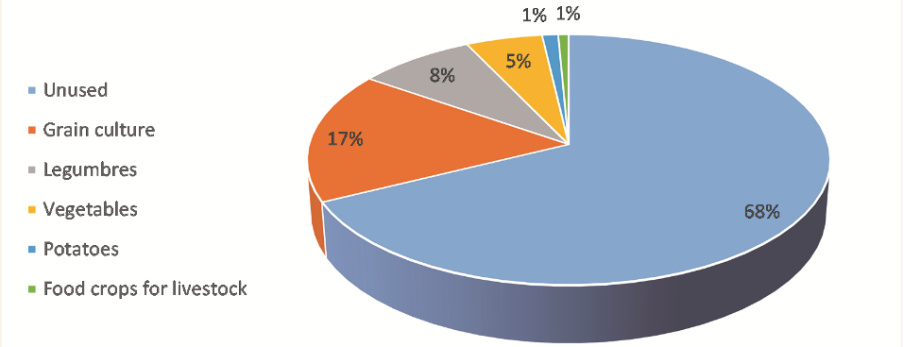

Figure 3. The structure of agricultural plots in Lentekhi municipality

Severe winters and the geography of the region do not allow the development of multi-branch and multifunctional agriculture (Fig. 4). Market access is a problem for local farmers. On the other hand, the natural environment and agricultural lands are preconditions for developing livestock farming, potato farming, and apiculture. Lower-zone villages of Lentekhi Municipality (Rtskhmelura, Gvimbrala, Nanari, and Khopuri) have a market gardening potential as well. The most marketable crop in the region is the potato. It is quite popular and highly demanded on the market. Potatoes are mainly transported to the Kutaisi market or sold to local traders.

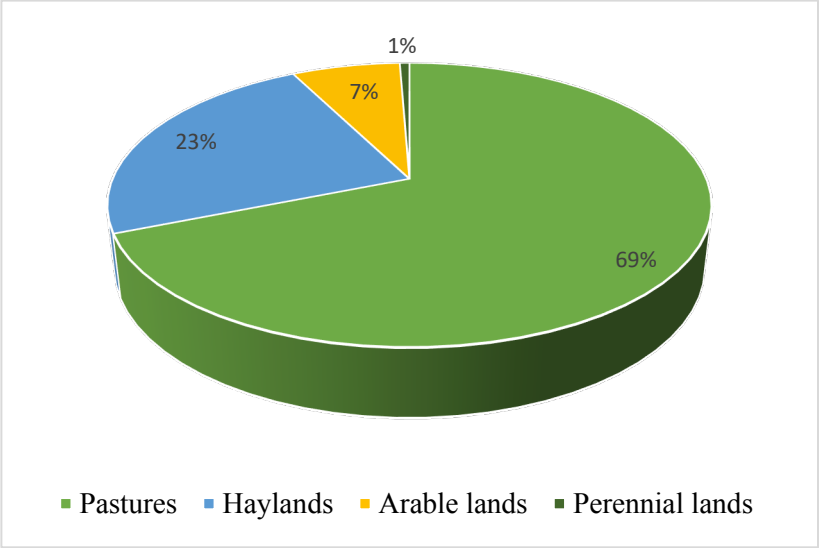

Figure 4. Structure of agricultural crops in Lentekhi municipality

The following changes occurred in agricultural land areas between 1972 and 2022 (Fig. 5):

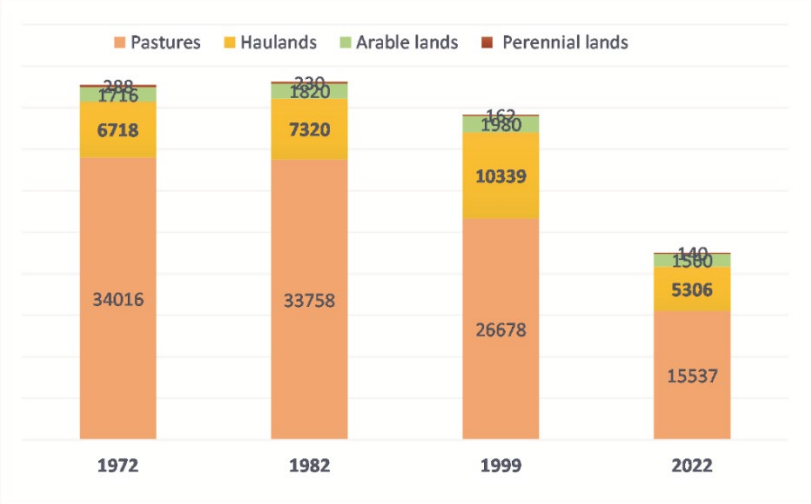

Figure 5. Land Use Changes in Lentekhi Municipality (1972-2022)

The total area of pastures insignificantly declined during the period; however, the 2022 figure is 2.3 times lower as compared to 1972. Hayland areas gradually grew at the expense of pastures; however, the 2022 figure is twice as low as in 1999. The area of arable land insignificantly (by 264 ha) grew between 1972 and 1999 but decreased by 420 ha relative to 1999. Perennial plantations had a declining trend during the period, with a 140 ha decrease recorded in 2022.

Because of natural, socioeconomic, and historical factors, as well as by virtue of the traditional practices, animal farming has always been a leading branch of agriculture in the region. It is a traditional branch in Lentekhi Municipality and has always been the main source of income for local farmers. The following table shows livestock counts in the municipality (Table 2).

Table 2. Livestock counts in Lentekhi Municipality as of 2018.

Cattle	5191
Swine	500
Goats and sheep	50

Cattle breeding plays a leading role in the region. The locals own 5191 cattle heads, including 2500 cows. Other home-farmed cattle in the municipality include 500 heads of swine and 50 goats and sheep. The total number of poultry is 10,000 (Lentekhi Municipality Vision &..., 2024).

Cattle numbers have sharply decreased in the last few decades due to low production capacity, home-made manufacturing of dairy products, and challenges related to market access. Given the region's remarkable potential for cattle breeding—hayfields, pastures, basic traditions, and experience—the existing cattle count would significantly increase if all available resources were used. The increase in

turn would result in higher volumes of meat and dairy products, which are always in high demand. Furthermore, locals use cattle, specifically oxen, as draught animals. Thus, animal farming has much greater potential for development. Only in the summer do farmers move their cattle to highland pastures. In other seasons, the locals use nearby pastures or fodder (in winter).

Beekeeping has been a traditional practice in Svaneti. The high quality of honey was determined by the abundance and diversity of trees and sub-Alpine and Alpine plants in Lentekhi Municipality, which speaks of the high potential of the branch in the region. Currently, there are 230 beekeepers in the municipality, with a total of 1800 hives.

A significant part of the forest area in Lentekhi Municipality survives pristine. Forests in the region are distinguished by biodiversity and multifunctionality. Apart from their role in industry, forests protect soil and regulate climate and water. They also are the source of firewood and timber for the population.

For now, industry remains rather underdeveloped in the region, being mainly represented by wood processing (6 small and 1 medium-sized mill). Another prominent branch of industry is food processing— mostly the processing of fruit and agricultural products.

The region's geography, scenery, climate, fresh air, abundance of fir and deciduous forests, cultural monuments, mineral waters, and other natural resources create unique conditions for tourism (auto-tourism, hiking, hunting, ecotourism, etc.). Of special note are the climatic-balneological resorts Muashi and Zeskho, which have the potential to become ski resorts. As a result, Zeskho will be able to receive visitors all year round and, importantly, contribute to the socioeconomic growth of the region. Koruldashi village, likewise, has all necessary conditions for the development of a ski resort.

The municipality also has balneological potential, as it is rich in spring waters that are favourable for rheumatic diseases and arthritis. There used to be recreational facilities in the region, which no longer exist.

The current structure and performance of the landscapes are directly associated with geological factors, as well as the type and scale of human activities.

In the region, landform-shaping factors include the prominent hypsometric curve, the diverse lithological structure, and orographical units. Exogenic processes—mechanical and chemical weathering and accumulation, landslides, mudflows, etc.—play a major role, as they account for the meso- and micro-relief diversity. In mountainous regions, their intensity primarily depends on factors such as absolute height, relief exposition, and declension.

We carried out comprehensive studies of landscapes in the territory of the region. We estimate each distinguished landscape type based on its natural conditions and potential resource usage. In the territory of Lentekhi Municipality, we distinguished 15 types of landscapes (Fig. 6): The Lentekhi Municipality Landscapes:

1. Medium mountains, erosive-denudative, built with Bayosian porphyrites, clays, and sandstones. In some places (in the lower part), beech and hornbeam-beech forests coexist with beech-chestnut forests, characterised by deciduous undergrowth and elements of evergreen undergrowth on brown forest soils. It includes the extreme eastern part of the Egrisi ridge and the slopes of the extreme western end of the Lechkhumi ridge. It is located near the villages of Naghomari, Kverdeshi, and Rtkhmeluri.
2. Medium mountains, built of Liassic shales and sandstones, with beech, chestnut-beech, and beech-hornbeam forest, in some places with dark evergreen forest elements and scattered evergreen undergrowth, on brown forest soils. The landscape extends to the Tskhenistskali River to the left and the Khledula River to the right, south of Lentekhi.
3. Medium mountains with erosive-accumulative relief, built of Leasian shales and sandstones with Quaternary fluvioglacial deposits, with beech-chestnut-hornbeam and oak forests and their derivatives, with deciduous undergrowth and shrubs, partly with agricultural fields and populated areas. The landscape extends to the river. The landscape encompasses both the right side of Tskhenistskali and the river itself. The landscape can be found on the left slope of Kheledula, as well as in the extreme lower part of Laskadura, specifically in the areas of Lentekhi, Kakhura, Tsanashi, Lesema, and Babili.
4. Middle mountains, erosive-accumulative relief, built of Liassic shales and sandstones and Quaternary alluvium, clays, and conglomerates; oak and oak-hornbeam; and on the northern slopes with hornbeam-beech, beech-chestnut, and beech forest; evergreen undergrowth; agricultural fields; and pastures on alluvial and brown forest soils. Extends to the river The Kheledula valley stretches from Tsanashi to Tskhumaldi.
5. Middle mountains, built up of Quaternary layers, Liassic clay shales and sandstones, and middle mountains, with oak and oak-hornbeam forests and their derivatives, strongly transformed as a result of human activity. It spreads in the eastern part of the Kvemo Svaneti depression, from the river Cholshura to the river Kheshkuri. On the right slope of Tskhenistskali, in the areas of the villages Tekali and Sakdari.

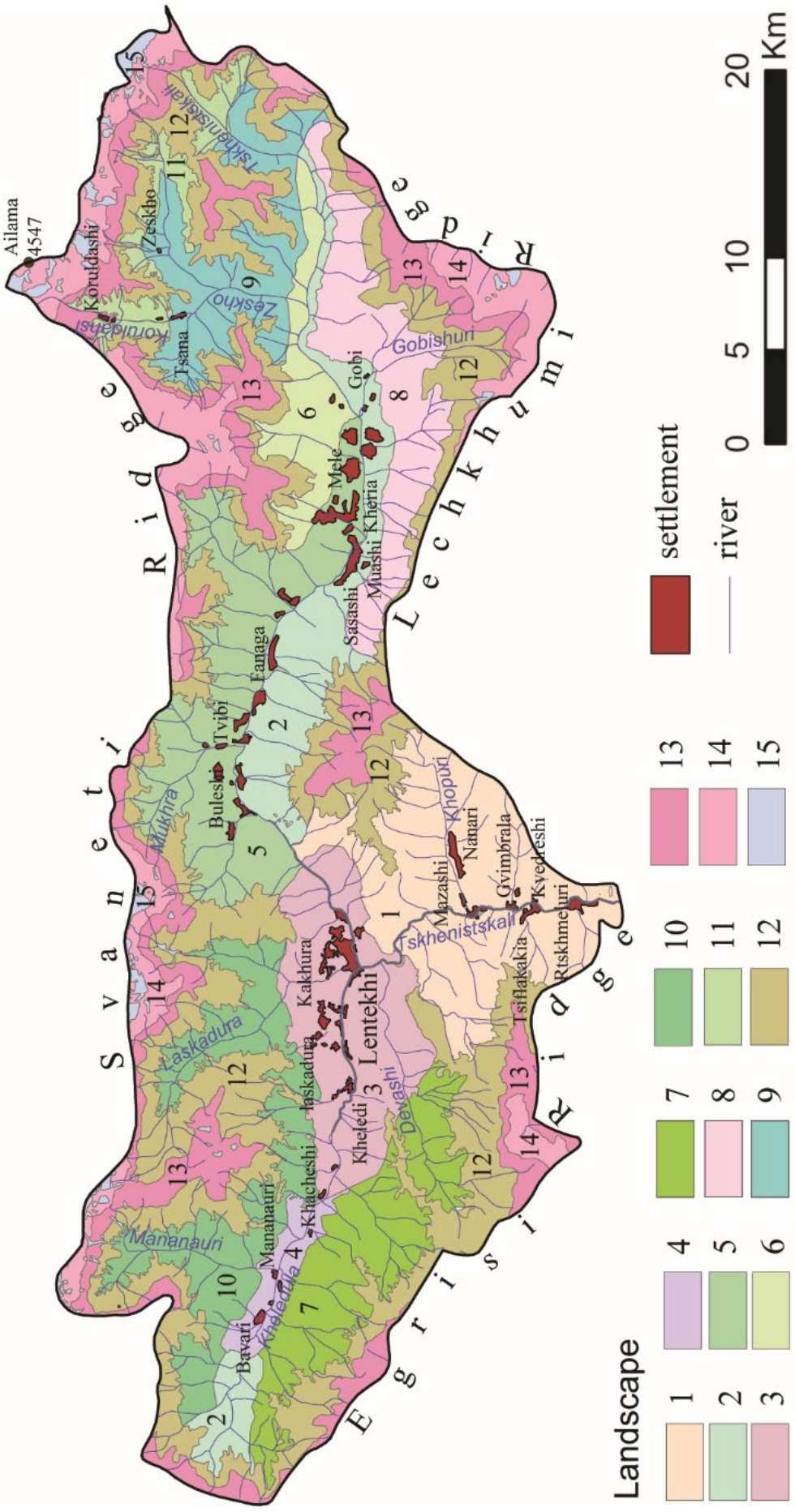

Figure 6. Lentekhi Municipality Landscapes

6. Middle mountains, with an excess of terraces, beech, birch, and alder forests—in some places with oak— on brown forest soils. It extends to the river on the right slope of the Tskhenistskali River, to the east of the mouth of the Koruldashi River.
7. Middle mountains, with beech-coniferous and coniferous forest. The landscape is characterised by deciduous and occasionally evergreen undergrowth, brown forest, and dark grey podzolic soils. The landscape extends to the Devashi River valley, on the eastern slopes of the Egrisi ridge and the southern exposure of the Shvi ridge, and the river in the valleys of the right tributaries of Kheledula.
8. Middle mountains, built with Triassic shales and Liassic layers, and beech-fir forest extend the landscape to the river Tshenistskali, from Lentekhi to the Murgouli river, on the slopes of the northern exposure of the Lechkhumi ridge. This is the northern exposure of the Lechkhumi ridge.
9. Middle mountains, Built with Jurassic layers, steep and rocky slopes with coniferous and birch-coniferous forests, deciduous undergrowth, brown forest and dark grey podzolic soil. The landscape extends to the river in Koruldashi and Zeskho valleys, above sea level (1400-2100 m).
10. High mountains, built of Liassic shales and sandstones, with birch and beech-birch forest, with dense vegetation on mountain forest-meadow soils. The landscape extends to the slopes of the southern exposure of the Svaneti Ridge in its western part, along the rivers in the valleys of Khledula, Skiliri, and Lascadura.
11. High mountains, built with crystalline rocks and Jurassic layers, with birch forest and mountain-forest-meadow soils. It extends to the extreme eastern part of the Svaneti range and the southern slopes of the main Caucasus range, in the upper parts of the rivers Koruldashi, Zeskho, and Tskhenistskali.
12. High mountains, Built of Jurassic sandstones, shales and crystalline rocks, with subalpine meadows, with fragments of crooked birch and with subalpine shrubs, on the mountain-meadow soils. It extends to the southern exposure of the Svaneti ridge and the slopes of the main Caucasus ridge (Ailama peak), above sea level at 2650 m, also on the ridges of Egrisi and Lechkhumi.
13. High mountain alpine meadows, in some places with the participation of rhododendrons, are shrubs. It is spread in a continuous strip on the south of the Greater Caucasus range, the Lechkhumi ridge, as well as on the south of the Svaneti ridge and on the slopes of the northern exposure of the Egris ridge, from approximately 2650 m to 3000 m above sea level.
14. High mountain subnival landscapes are spread on the crests of the Greater Caucasus range, Lechkhumi, Svaneti, and Egris ranges, at 2950-3500 m above sea level.
15. Glacial-nival landscapes northeast of Lentekhi on the Greater Caucasus, with glaciers and eternal snow.

Discussions

The goal of the research is to assess natural resources, identify separate natural-territorial complexes (landscapes) as landscape types, and create a geo-informational database. For that purpose we had scientific fieldwork in Lentekhi Municipality (in 2023). We observed the natural and anthropogenic factors in the landscapes, which had undergone changes due to human activities. The materials obtained in the field immensely helped us to reveal the natural and anthropogenic landscapes of the region and define their boundaries. We distinguished landscapes and created a geo-information system of the landscapes of Lentekhi, Lentekhi Municipality.

Conclusion

Thus, geographical factors, including relief, climate, and soil, significantly influence the structure of natural resource use and the settlement patterns in the Kvemo Svaneti region.

43% of the total territory, drained by deep-set rivers, is over 1000 m above sea level. The terraces along the Tskhenistskali, Kheledula, and Laskadula river gorges host most of the villages in a linear pattern. Most (83%) of the settlement areas are represented by small (up to 200 people) villages, the largest one being Kheledi (258 people). 28.3% of Kvemo Svaneti villages are situated from 540 m to 1000 m above sea level, 55% are between 1040 and 1500 m, and 16.7% are between 1560 and 1970 m.

By their natural conditions, Kvemo Svaneti landscapes are especially fit for livestock farming, crop farming, and recreational tourism.

The biggest part (92.4%) of agricultural lands is pastures and haylands. Only 7.1% of agricultural lands are arable, with perennial crops accounting for only 0.2%. Arable lands are found up to 800 m above sea level. Annual sunshine duration is more than 2200 hours. The region is rich in mineral waters and forest areas (64%), which determine its touristic and recreational potential.

As a result of the physicogeographical study of Kvemo Svaneti (Lentekhi Municipality), a large-scale (1:100,000) map of Lentekhi Municipality was created, with 15 landscape sub-types. The types of landscapes identified reveal the natural diversity and potential of the region. The majority (76.7%) of

the region consists of mountainous landscapes. Of the landscape types identified, some are fit for agricultural activities, some for forest resource management, and some for recreational purposes.

Competing interests

The authors declare that they have no competing interests.

Authors' contribution

E.S. led the writing of the article, distinguished the separate landscapes of the Kvemo Svaneti Region as landscape types, and compiled a large-scale landscape map and a diagram: Number of settlements in Lentekhi Municipality, according to height above sea level: The structure of Lentekhi Municipality land resources in % (2022); the structure of agricultural plots in Lentekhi municipality; Structure of agricultural crops in Lentekhi municipality: Land Use Changes in Lentekhi Municipality (1972–2022). T. C. compiled a geoinformational database of Kvemo Svaneti (Lentekhi Municipality) landscapes in GIS and provided an electronic version of the landscape map of Kvemo Svaneti (Lentekhi Municipality).

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