Main Development Directions of Agricultural Areas in the Eastern Zangezur Region

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Abstract. The territories of the East Zangezur region, including the Kalbajar, Lachin, Gubadli, Zangilan and Jebrail districts, with their rich natural resources, biodiversity, breathtaking nature, favorable climate and agro-climatic conditions, complex geological structure and diverse landforms have attracted the attention of travelers and researchers since ancient times, which led to the study of this area. The region, predominantly mountainous, is of great importance for the development of agricultural industries and achieving high productivity. Favorable climatic and relief conditions, along with fertile soils, play an invaluable role in the development of both crop production and livestock farming. Since Soviet times, the territory has been used for agricultural purposes, fully meeting the country's needs for milk, meat and grain products. This article highlights the main factors in the development of agricultural industries within the region and examines their spatial distribution, zoning and a map-scheme.

Keywords: The Eastern Zangezur region, agriculture, mountainous area, climate, soil, map-scheme, GIS.

1 Introductıon

The Eastern Zangezur region, located on the south-eastern slope of the Lesser Caucasus Mountains, has witnessed numerous historical events. This area was one of the first in Azerbaijan to emerge from the sea as a result of the Caspian regression and orogenic processes. Since ancient times, parts of this area, with its touristic significance, including the Karabakh Volcanic Plateau, have been described and studied, with more extensive research undertaken later on. The region's favourable economic-geographical location, rich natural resources and fertile soils have necessitated the study of its landscapes. The first information about the region's climate can be found in the works of Russian climatologists A.I.Voyeykov and I.V.Figurowsky. Among Azerbaijani scientists, significant contributions were made by A.A.Medetzadeh, A.J.Ayyubov, A.M.Shikhlinsky, P.S.Mirzayev and others. A.A.Medetzadeh studied the climatic characteristics of the Lesser Caucasus region and prepared synoptic maps. A.J.Ayyubov, in his work "Agroclimatic Zoning of the Azerbaijan SSR," provided detailed information about the climatic features of the region, its agroclimatic

resources and their distribution areas. Research on the natural water bodies, as well as the soil and vegetation cover of the region's landscapes, began quite late. B.A. Budagov's name should be particularly noted in these studies. He also established a laboratory for aerospace methods at the Institute of Geography of the National Academy of Sciences of Azerbaijan named after Hasan Aliyev, with the aim of utilizing aerospace materials more extensively. A.P. Mammadov, in his dissertation titled "The Content and Distribution Patterns of Heavy Metals (Hg, Pb, Cu) in the Landscapes of the Tartar River Basin", drew attention to the issue of soil contamination with heavy metals around the Tartar River basin. As we know, heavy metals, when discharged into soils and water bodies, not only cause the degradation of landscapes, but also affect human health to some extent. E.Sh. Mammadbayov defended his candidate dissertation on "The Anthropogenic Dynamics of Landscapes on the Southeastern Slope of the Lesser Caucasus". His scientific interests include natural and anthropogenic landscape studies, the application of aerospace methods in geographic research and toponymy. In his research, he identified the impact forms of anthropogenic factors as a key role in the dynamics of contemporary landscapes on the south-eastern slope of the Lesser Caucasus and examined the dynamics of these landscapes at various historical stages, determining the stability levels of corresponding natural complexes. Additionally, he developed large-scale landscape maps using aerospace materials [5]. In A.H. Valiyev's article "Assessment of the Potential of Agricultural Lands in Previously Occupied Territories," the land in the region was analyzed for agricultural development and management and the potential of these lands was assessed using a bonitrof scale. In his other article, "Soil-Climate Factors in the Development of Agriculture in Liberated Territories," he provided information about the composition, suitability for use and quality characteristics of the soils in these formerly occupied areas, as well as the climatic features of the region. He also addressed issues related to the agroclimatic resources of the area and noted the potential of climatic resources by landscape, providing several interesting insights [15, 16]. A. Musayev, in his article "Prospective Investment Opportunities for Tourism in the Karabakh and Eastern Zangezur Economic Regions", provided extensive information on the development of the tourism sector in the region. He also conducted a comprehensive analysis of statistical data from the State Statistical Committee of the Republic of Azerbaijan in this article [10]. Sh. Aliyeva, in her article "Development Directions of the Economy of Eastern Zangezur," included various sectors of the region’s economy such as agriculture, husbandry, crop production, beekeeping, tobacco cultivation, the agrarian sector and the agrarian-industrial complex, tourism sector, especially the tourism-recreation complex, non-oil and gas sectors, primarily the mining industry, information and communication technologies, “smart” technologies, the transport-logistics sector and others. She conducted extensive research and analysis in this article published in the journal Geostrategy, arriving at these conclusions [3]. Additionally, during this period, the booklet "The Economic Regions of Karabakh and The Eastern Zangezur of Azerbaijan", published by the Center for Analysis of Economic Reforms and Communication of the Republic of Azerbaijan, provided important information on the economic and social indicators of each of these regions [1, 2, 8].

2 Materıals and Methods

The article focuses on the development directions of agricultural areas in the mountainous Eastern Zangezur region, which is the research area and the principles of their spatial distribution. Special attention is given to the mountainous relief conditions, climate, solar radiation and other components. The Eastern Zangezur region was established in 2021 based on a Decree signed by the President of the Republic of Azerbaijan, Ilham Aliyev. Covering an area of 7,471 km², the region includes the territories of Kalbajar, Lachin, Gubadli, Zangilan and Jabrayil, located along the borders with Armenia and Iran [16].

In preparing the article, historical, comparative, analytical, synthetic, mathematical-statistical and GIS methods were employed. Initially, various literature and archival materials related to the area were obtained and climate, soil and agricultural maps from different periods were comparatively analyzed. After the analyses, the natural conditions of the region were assessed using GIS technologies and a zoning map-scheme was developed based on the analysis of statistical data from the State Statistical Committee. It should be particularly noted that the article pays special attention to the region's mountainous conditions and the role of this mountainous relief in the placement of agricultural areas.

3 Results and discussion

Agriculture is a widely practiced economic sector across the world, providing people with food products. The development of this sector is directly linked to landscape components. For the placement and advancement of agriculture, key conditions include fertile soils, rivers and canals for irrigation, agricultural machinery and favourable climatic conditions. When all these conditions are met, it is possible to develop this economic sector and obtain healthy food. As is known, in developing countries, agriculture holds a primary position and in recent times, rapid population growth in such countries has negatively impacted food security [13]. Research has concluded that approximately 30-50% of all produced food is estimated to be wasted in the food supply chain [14]. This creates inequality in ensuring that people around the world are fully supplied with agricultural products.

In the area of our research, in Eastern Zangezur, there are all the necessary conditions for the development of the agricultural sector. Fertile soils, favorable climate, relief and abundance of rivers in the region provide ample opportunities for the creation and development of agriculture and livestock farming. The location of the region on the southern and southeastern slopes of the Lesser Caucasus Mountains, with mountain ranges over 3,000 meters high, contributes to the diversity of its climate (Figure 1).

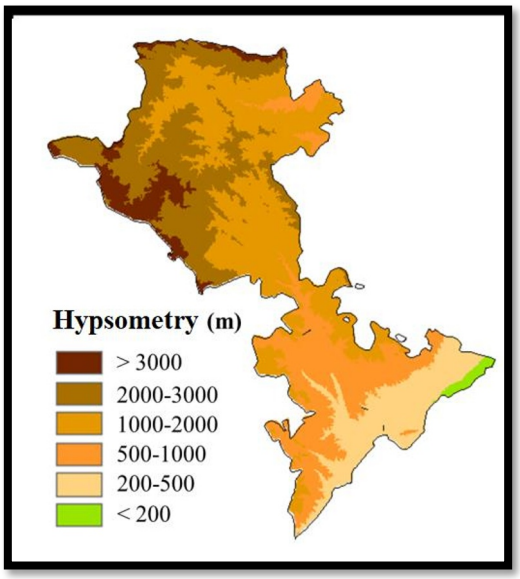

Fig.1. Relief condition of the Eastern Zangezur region.

As can be seen in Figure 1, the fact that the area consists of high mountain ranges partially or completely blocks the incoming air masses, preventing them from directly entering the region. For instance, the cold continental-Arctic and maritime-Arctic air masses coming to our country's territory from the northern slopes are obstructed by the Murovdagh range, which stretches across the northern part of the region. As a result, these air masses change direction and enter the region from the north-east and north-west, where their characteristics begin to moderate. Moreover, the large mountains located in the western part of the region hinder the direct entry of southern cyclones, which are humid in winter and dry in summer, coming from the Black Sea and the Mediterranean. Thus, these air masses also enter the region in a significantly altered form. Additionally, the mountainous terrain creates extensive grassland areas conducive to the development of livestock farming, making the cultivation of annual and perennial fodder crops essential [11].

In the Eastern Zangezur region, which has favourable agro-climatic conditions, the annual amount of solar radiation continues to increase toward the high mountainous areas. It is observed that this value increases from the Jabrayil region in the south-east toward the north and north-west. Analysis of satellite imagery shows that the annual amount of solar radiation in the Eastern Zangezur region mainly varies between 120-140 kcal/cm² (Figure 2).

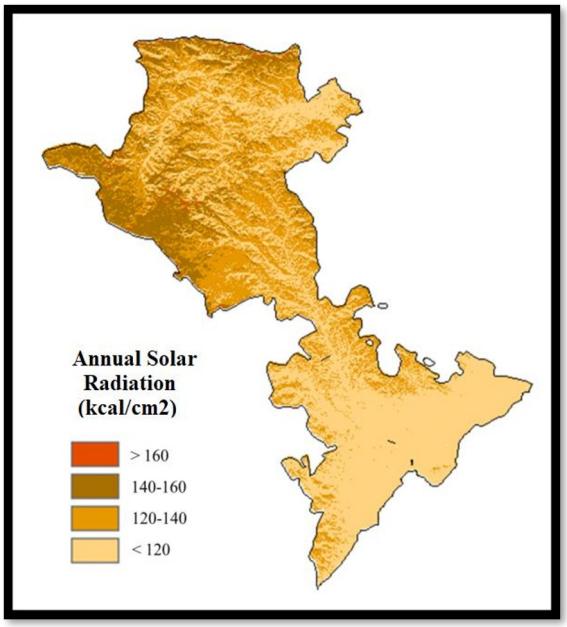

Fig. 2. The amount of annual solar radiation in the Eastern Zangezur region.

As can be seen from Figure 2, while the amount of solar radiation within the study area reaches up to 120 kcal/cm² in the southern part, this value increases to 160 kcal/cm² in the northern and northwestern highland areas. Although the figure is difficult to discern, it also shows that in small areas in the western part, this value exceeds 160 kcal/cm². Thus, from the analysis, it can be concluded that in the plains, foothills, and low- and mid-mountain zones of the East Zangezur region, where the placement of agricultural fields is advisable, the amount of radiation fluctuates within 140-145 kcal/cm². This creates sufficient conditions for the development of various types of agricultural crops, especially grain crops, dry subtropical fruit growing, vegetable growing, and cotton growing.

In addition to the aforementioned factors, the influence of soil-forming factors, the diversity of natural conditions and the development of ancient farming culture have led to the formation of a complex soil cover in the Eastern Zangezur region (Figure 3) [7]. In the Kalbajar region, mainly turf mountain-meadow soils and brown mountain-forest soils are widespread. The Lachin region, with 72 thousand hectares of summer pasture, mountain-meadow, brown mountain-forest and carbonate-rich chernozem soils. In the Gubadli region, brown mountain-forest soils are predominant. In the Jabrayil region, the soils of the Araz river plain are highly fertile dark chestnut soils. Large villages of Jabrayil - such as Greate Marjanli, Soltanli and others - are located on these productive soils of the Araz river plain.

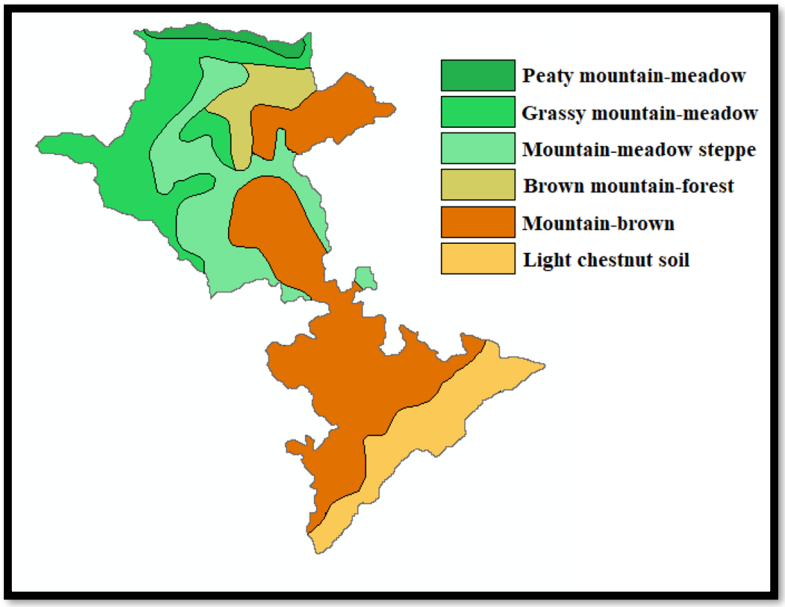

Fig. 3. The soil types of the Eastern Zangezur region.

Thus, based on the above, it is evident that the agricultural sector in the region plays a significant role in the development of husbandry and crop production. Husbandry, in particular, stands out among the agricultural sectors for meeting human needs for food and other products. This sector has been one of the earliest forms of cultural development among humans since ancient times. Considering that the Eastern Zangezur region has always been an agricultural area, it is not an exaggeration to say that the region offers very favourable conditions for the development of husbandry. The presence of summer and winter pastures, the widespread distribution of high and low-altitude mountain-meadows, the cold climate conditions of the highlands and so on, provide a foundation for the development of cattle farming, sheep breeding and beekeeping, allowing for high productivity. It is worth noting that during the Soviet period, agriculture in the regions that were part of the Karabakh and the Eastern Zangezur economic regions of Azerbaijan reached a high level of development and the population's demand for dairy, meat and grain was fully met. Even today, the development of these sectors will make significant contributions to the population’s dietary needs.

Livestock farming, which provides the population with meat and dairy products, belongs to the category of large-scale cattle breeding. To develop this industry, it is necessary to ensure proper care for animals, monitor their health, maintain pastures and grazing lands, drive animals to these pastures for grazing, etc. By strictly observing these rules, it is possible

to establish and develop livestock farming and obtain high yields of dairy and meat products. According to the State Statistics Committee, 6.1 thousand tons of meat were produced in Eastern Zangezur in 2022, of which 3.4 thousand tons were produced in Kelbajar, 1.3 thousand tons in Lachin, 118 tons in Gubadlin, 97 tons in Zangelan and 1.3 thousand tons in Jabrayil. As can be seen, the leaders in this indicator are the Kelbajar and Lachin districts, which have vast pastures, as well as the Jabrayil plains, which include winter pastures. The total volume of milk produced in the district amounted to 50.7 thousand tons, among which Kelbajar (20.2 thousand tons), Lachin (19.9 thousand tons) and Jabrayil (8.9 thousand tons) stand out. Milk production volumes in Gubadly and Zangelan amounted to 1.3 thousand tons and 486 tons, respectively. It should be noted that the composition of meat and dairy products also includes sheep and poultry products. According to statistics, in 2022, 91.4 thousand heads of cattle were registered in the district, including 2.7 thousand heads of buffalo. Of the total 94,100 cattle, 37.9% were from Kelbajar (of 35,700 cattle, 35,100 were cows and 0,600 were buffalo), 42.8% from Lachin (of 40,300 cattle, 38,200 were cows and 2,100 were buffalo), 2% from Gubadly (of 1,900 cattle, all were cows), 5.6% from Zangelan (of 5,300 cattle, all were cows), and 11.6% from Jebrail (of 10,900 cattle, almost all were cows). Although these figures are lower than in Soviet times, they are projected to increase over time.Sheep farming, which provides people with meat, dairy and wool products, is part of the small livestock sector. For this sector to develop, the presence of summer pastures is essential, as this allows for an increase in the productivity of animals. Various breeds of sheep farming have spread and developed in different countries and regions. The location of the Eastern Zangezur economic region of Azerbaijan in the high-mountainous areas of the Lesser Caucasus Mountains, which are rich in subalpine and alpine meadows with extensive grazing lands, creates ideal conditions for the high-level development of sheep farming. It is no coincidence that during the Soviet era, the volume of sheep farming in the regions, especially in Gubadli, Zangilan and Lachin, was at a high level. In fact, in the Kalbajar-Lachin areas, the number of small livestock was 2.5-5 times greater than the number of large livestock. After liberation from occupation, special attention was also paid to the development of sheep farming in these areas. In 2022, a total of 413.1 thousand sheep were recorded in the region, with 165.5 thousand in Kalbajar, 133 thousand in Lachin, 11 thousand in Gubadli, 13.5 thousand in Zangilan and 90.1 thousand in Jabrayil. The total volume of wool obtained was 758 tons, with 285 tons from Kalbajar, 275 tons from Lachin, 9 tons from Gubadli, 17 tons from Zangilan and 172 tons from Jabrayil. As the statistics show, sheep farming, like other livestock sectors, has been widely developed in Kalbajar and Lachin, which possess large grazing and mowing areas within subalpine and alpine meadow landscapes.

Poultry farming, widely practiced in countries around the world, belongs to the husbandry sector that provides people with meat, eggs and feathers. Favourable climatic conditions are one of the key requirements for the development of this sector. It is important to note that unlike other animal types, poultry farming requires special attention to factors such as the dryness of the area where the birds are kept, climate norms, feeding and farm equipment. This is because chickens possess a thermoregulatory mechanism in their biological structure, which helps them maintain their body temperature in cold conditions. However, in such cases, they increase their energy consumption, which raises their food requirements. For this reason, all these factors must be carefully considered. Just like in other regions of Azerbaijan, there are wide opportunities for the development of poultry farming in the Eastern Zangezur region. According to the 2022 report of the State Statistics Committee, a total of 291.9 thousand birds were recorded in the region, with the majority - 121.1 thousand - coming from Jabrayil. Lachin followed with 79 thousand, Kalbajar with 74.7 thousand, Gubadli with 10.6 thousand and Zangilan with 6.5 thousand birds. Of the 291.9 thousand birds in the region, the total number of eggs produced amounted to 16.5 million, with 6 million from Jabrayil, 4.9 million from Kalbajar, 4.7 million from Lachin, 0.5 million from Gubadli and 0.4 million

from Zangilan. It is predicted that these figures will increase in the coming years. According to the forecast of the Center for Agrarian Research, the volume of egg production in the Eastern Zangezur region is expected to reach 50.7 million eggs in the future, with the majority coming from Jabrayil [6].

Beekeeping predominantly thrives in the cold climate conditions of high mountain regions, providing people with honey products. In addition to honey, bees play a crucial role in pollinating trees, thereby contributing significantly to plant development. For this reason, various technologies are prioritized in different countries to protect bee colonies. Furthermore, beeswax and propolis are used as special medicinal substances. The presence of flowering plants is also essential for bees to produce high-quality honey. Therefore, beehives must be placed in specific locations. Our research area, the Eastern Zangezur Economic Region, holds exceptional significance for the development of beekeeping. It is no coincidence that the highest quality honey is attributed to the Kalbajar and Lachin regions. The mountainous areas of Kalbajar and Lachin create favourable conditions for producing clean and high-quality honey. After these regions were liberated from occupation, efforts to redevelop beekeeping in the area commenced. Over 40 thousand bee colonies have been placed in the region, a number that has since increased to over 70,000. According to the 2022 statistics of the State Statistical Committee, 70.2 thousand bee colonies have been settled in the region, with 88.7% of them recorded solely in the Kalbajar and Lachin regions. Specifically, 39.4 thousand colonies were registered in Kalbajar, 22.9 thousand in Lachin, 5.1 thousand in Gubadli, 1.2 thousand in Zangilan and 1.6 thousand in Jabrayil. All of this will facilitate the supply of clean and high-quality honey products to the population of Azerbaijan. Additionally, it should be noted that in 2022, a total of 656.1 thousand bee colonies were counted across Azerbaijan, with 10.7% of them concentrated in the Eastern Zangezur region. It is worth mentioning that among Azerbaijan's 14 economic regions, the Eastern Zangezur region ranks fourth in terms of the number of bee colonies, following the Sheki-Zagatala (139.6 thousand), Nakhchivan (100.5 thousand) and Lankaran-Astara (71.5 thousand) regions. This demonstrates that all four areas encompass mountainous zones. Other livestock farming activities, such as camel breeding, pig farming and others, are less prevalent in the region, which is closely linked to the area's climate, terrain and other factors. In total, 83 donkeys (55 in Lachin, 19 in Zangilan and 9 in Jabrayil), 98 pigs (only in Kalbajar region), 65 camels (only in Jabrayil region) and 2 mules (only in Lachin region) were recorded in the region. Among these, goat and horse breeding are relatively more widespread, with 27.3 thousand goats (11.8 thousand in Kalbajar, 9.6 thousand in Lachin, 957 in Gubadli, 1.3 thousand in Zangilan and 3.6 thousand in Jabrayil) and 2.8 thousand horses (1.2 thousand in Kalbajar, 1.5 thousand in Lachin, 3 in Gubadli, 22 in Zangilan and 176 in Jabrayil) registered in the East Zangezur region [4].

Thus, the relief of the region, highly productive and large-scale mountain-meadow landscapes, pastures, brown mountain-forest soils, mountain-chernozem soils and agroclimatic resources have created conditions for the development of agriculture. Agriculture, which occupies a significant place among the countries of the world, plays a vital role in providing the population with flour, fruits, vegetables, greens, vitamins, pickles and other products. For the development of this industry, the sum of active temperatures should exceed 1200 ° C per year, and solar radiation should be more than 100 kcal / cm^2. In addition, a significant factor is the gentle relief of the terrain and the suitability of soils for cultivation. Agriculture is divided into such categories as grain growing, fruit growing, vegetable growing, tobacco growing, tea growing, cotton growing and rice growing, each of which is characterized by resistance to light, heat, humidity and drought. East Zangezur district plays an invaluable role in growing annual, biennial and perennial forage crops, which are necessary for feeding livestock and obtaining high yields. Jabrayil, Lachin and Zangilan districts are especially suitable for growing forage crops. In 2022 alone, forage crops were

sown on 2.6 thousand hectares in East Zangezur district, and almost all of this area is located in the above-mentioned districts. Kelbajar accounted for 90 hectares, and Gubadli - 11 hectares. In other districts, 1.5 thousand hectares of forage crops were sown in Jabrayil district, 0.7 thousand hectares in Lachin and 0.3 thousand hectares in Zangilan. Future plans include expanding these sown areas. In addition, it is important to note that in 2022, 372.7 thousand hectares of forage crops were sown in Azerbaijan, with the largest share in the Mil-Mugan economic region (84.9 thousand hectares), and the smallest in the Absheron-Khizni economic region (0.8 thousand hectares). Without taking into account the Baku agglomeration, the East Zangezur region ranks 11th out of the remaining 13 economic regions in terms of sown areas of forage crops. The liberated Karabakh economic region with a sown area of 80.4 thousand hectares ranks second in the republic.

In addition to the above, the Eastern Zangezur region is also of great importance for the development of agricultural industries such as grain farming, viticulture, fruit farming and vegetable farming. While the mid- and high-mountain areas are favourable for pastoral farming, forage crop cultivation and beekeeping, the plain and foothill southern areas provide suitable conditions for the development of other agricultural industries.

Grain farming is one of the most widespread types of crop farming worldwide, providing people with flour, bread and other products. This type of farming has been a core activity of humans since ancient times. The total area of grain crops worldwide is approximately 219.2 million hectares, with a production output of 808.4 million tons. Grain farming is divided into two groups: spring and winter crops, including wheat, barley, rye etc. These crops require temperatures ranging from 1-20°C for germination, 10-20°C for growth and development and 15-25°C for harvest, varying by species. For winter crops, 12-15°C is sufficient for development, while for spring crops, 16-23°C is optimal. The total active temperature required for wheat ranges from 1000-2000°C annually and beyond. In contrast, barley, which is less frost-tolerant, requires a sum of active temperatures ranging from 1000-1500°C for early-ripening varieties and 1800-2000°C for late-ripening varieties. For oats, these figures range between 1000-1500°C and 1500-1800°C, with an average requirement of 1350-1650°C. In general, 1000-1200 m^3 of water is required per hectare of grain. Despite efforts to develop grain farming in Azerbaijan, 40-45% of demand is still met through imports. The Eastern Zangezur region, with its favourable soil and climatic conditions, including brown mountain-forest, mountain-chernozem and dark chestnut soils, provides ample opportunities for developing grain farming. This agricultural sector can be developed in the Gubadli, Jabrayil and Zangilan regions of the economic region, as well as partly in Lachin. According to the State Statistical Committee, in 2022, wheat was sown on 27,451 hectares, barley on 12,629 hectares and oats on 326 hectares in the East Zangezur region. It should be noted that this represents a significant increase compared to the previous year, 2021. Oats were cultivated only in the Zangilan (325 ha) and Jabrayil (1 ha) areas, while other crops were grown across the entire region. A total of 27.95 tons of grain was harvested from wheat, barley and oats farms, with 18.9 thousand tons of wheat, 9 thousand tons of barley and 0.05 thousand tons of oats. Additional data is provided in the table below (Table 1) [9].

As seen from Table 1, the majority of wheat and barley cultivation and harvests are concentrated in the Gubadli and Jabrayil regions, highlighting the favourable conditions for the development of grain farming in these areas. Despite the cultivation of these crops in Kalbajar region, the conditions for the development of grain farming in this area are virtually nonexistent. Therefore, the focus of grain cultivation should be directed towards the regions of Gubadli, Zangilan and Jabrayil, where favourable conditions prevail. Additionally, it can be noted that the yield in the Eastern Zangezur region was 7.9 centners per hectare for wheat, 9.7 centners per hectare for barley and 10.1 centners per hectare for oats.

TABLE 1. Distribution of wheat, barley and oats in the Eastern Zangezur region (2022).

Kind	Regions / Characteristics	Kalbajar	Lachin	Gubadli	Zangilan	Jabrayil
Wheat	Crop field (ha)	21	1757	9776	6967	8930
	Harvest (t)	73	1020	6168	2977	8681
	Productivity (sent/ha)	34,2	5,8	6,7	7,6	9,7
Barley	Crop field (ha)	69	639	4631	3150	4140
	Harvest (t)	241	877	2685	630	4554
	Productivity (sent/ha)	35	13,7	6,8	10	11,3
Oats	Crop field (ha)	-	-	-	325	1
	Harvest (t)	-	-	-	50	1
	Productivity (sent/ha)	-	-	-	10	16,7

Source: *The State Statistical Committee of the Republic of Azerbaijan*

Grapes, considered a valuable crop, have been cultivated worldwide since ancient times. The leaves of this crop are used in culinary dishes such as dolma, while the fruit is utilized in various industries for producing wine, juice, jam, raisins, molasses, vinegar and more. Grape cultivation is labour-intensive and requires specific conditions: at least 180 sunny days, no fewer than 150 frostless days, 1,300 hours of annual sunshine, annual solar energy ranging from 1,020.8 to 1,345.6 kWh/m² and annual solar radiation between 120-180 kcal/cm². For the successful development of this sector, the sum of active temperatures should average between 2,800-3,100°C, with fast-maturing varieties requiring 2,500-3,000°C and late-maturing varieties requiring 2,850-3,225°C. In addition to proper heat and light for grape ripening and development, the presence of juice in the fruit is also critical. Each hectare of grape vineyards requires 800-1,200 m³ of water. Given the availability of all these agro-climatic resources in the southern and south-eastern parts of the Eastern Zangezur region, particularly in Gubadli, Zangilan and Jabrayil regions, it is clear that the development of viticulture in these areas is feasible. The expansion of the viticulture sector in these regions can lead to high yields, a tradition that dates back to the Soviet era when viticulture was one of the most widespread agricultural sectors in the region. Currently, the planting of grape crops has already begun in the Eastern Zangezur region. According to the 2022 report by the State Statistics Committee, 92.3 hectares of vineyards were planted, of which 72.2 hectares were in Gubadli and 20.1 hectares in Jabrayil regions. A total of 222.4 tons of grapes were harvested from the planted 72.2 hectares, with Jabrayil region solely contributing to this figure. The grape yield in Jabrayil region was 91.9 centners per hectare. In Gubadli region, no yield was obtained due to the newly established vineyards. Although grape planting began in Jabrayil region in 2015, it only started in Gubadli region in 2022. However, it is predicted that over time, Gubadli region will also yield abundant harvests. The Center for Agricultural Reform Analysis under the Ministry of Agriculture forecasts that in the coming years, a total of 27.3 thousand tons of produce will be produced across 1,200 hectares in Jabrayil, 400 hectares in Gubadli and 1,000 hectares in Zangilan regions [12].

Vegetable farming, which provides people with essential foodstuffs and pickled products, is cultivated in many parts of the world. This includes crops such as tomatoes, cucumbers, cabbage, carrots, radishes, etc. The development of this sector requires, depending on the crop, 1,200-2,500 kWh/m² of solar energy, 100-180 kcal/cm² of solar radiation, a sum of active temperatures between 1,200-3,500°C, soil temperatures between 10-30°C and air temperatures between 15-30°C. For example, tomatoes require a soil temperature of 10-30°C and air temperature of 20-26°C, while cucumbers require an air temperature of 20-30°C and a soil temperature of 15-35°C. There are favourable conditions for vegetable cultivation in the Eastern Zangezur region, particularly in the southern regions of Gubadli, Zangilan and Jabrayil, where high yields are possible. Although small-scale vegetable cultivation has

begun in the Eastern Zangezur region after its liberation, it has so far only taken place in Zangilan and Jabrayil regions. According to the 2022 report by the State Statistics Committee, a total of 1 hectare each of cabbage, cucumbers, tomatoes, 0.2 hectares of onions, 0.3 hectares of garlic and 2 hectares of other vegetables were cultivated in Zangilan region. In Jabrayil region, 1 hectare each of cabbage, beets and onions, 550 hectares of peas, 5 hectares of cucumbers, 32 hectares of tomatoes, 2 hectares of garlic and 6 hectares of other vegetables were planted. A total of over 1,344 tons of vegetables were harvested from over 600 hectares of land in the Eastern Zangezur region, 97.5% of which came from Jabrayil region. The largest yield in Jabrayil region was tomatoes (563 tons) and the smallest was beets (9 tons), while in Zangilan, cucumbers and cabbage accounted for the highest yields (8 tons each) and garlic the lowest (0.3 tons). The overall productivity of the Eastern Zangezur region was 5 centners per hectare for peas, 141 centners per hectare for cabbage, 126 centners per hectare for cucumbers, 171 centners per hectare for tomatoes, 176 centners per hectare for beets, 149 centners per hectare for onions, 83 centners per hectare for garlic and 160 centners per hectare for other vegetables. The highest productivity in Jabrayil region was for cabbage (200 centners per hectare) and the lowest was for peas (5 centners per hectare). In Zangilan, the highest productivity was also for cabbage (77 centners per hectare) and the lowest was for garlic (10 centners per hectare). Additionally, sugar beet, with a total planting area of 181 hectares, a harvest of 610 tons and a productivity of 179 centners per hectare, was planted in Gubadli, Zangilan and Jabrayil regions. The respective planting areas were 128 hectares, 44 hectares and 9 hectares, with harvests of 77 tons, 31 tons and 502 tons. The productivity of sugar beet in Gubadli was 40 centners per hectare, in Zangilan it was 46 centners per hectare and in Jabrayil it was 571 centners per hectare. It is worth noting that sugar beet, a crop typical of temperate climates, requires a temperature of 20-23°C for development and a sum of active temperatures between 2,200-3,000°C for fruit formation. It is projected that in the coming years, the area of vegetable cultivation in the economic region will increase to 1,400 hectares, with a harvest of 11.9 thousand tons.

Fruit growing is a widespread type of agriculture all over the world, providing people with dried fruits, juices, fresh fruits, jams, compotes, vitamins and other products. Although fruit farming is mainly widespread in Europe, the area devoted to this agricultural sector is also significant on other continents. Examples of fruits grown in this sector are apples, pears, oranges, strawberries, mulberries, figs, bananas and many more. Depending on the type of fruit, this sector requires a total active temperature of 2000 to 3000 °C or higher, with dry subtropical fruits requiring even higher temperatures. In addition, air and soil temperatures in the range of 20–30 °C and even up to 35 °C are required. For the development of fruit growing, the annual amount of solar energy required is 1500-2500 kW h/m², while solar radiation should be from 120 to 200 kcal/cm². Naturally, all these requirements vary depending on the type of fruit. For example, in a moderate climate, solar radiation is about 120 kcal/cm², and in a subtropical climate - about 160-180 kcal/cm². Fruit growing is also widely developed in Azerbaijan, which has rich and favorable natural conditions. Along with the cultivation of walnuts (Sheki-Zagatala economic region), pome fruits (Guba-Khachmaz economic region) and stone fruits (Nakhchivan economic region), berry growing is also carried out (Baku, Sabirabad regions). In the Eastern Zangezur region, which has agroclimatic resources, it is also possible to grow various types of fruits. The climate in this zone allows even dry subtropical fruits to be grown. According to the State Statistical Committee report, 298 hectares of fruit and berry plantations were planted in 2022, most of which are located in the Jebrail region (250 hectares). In the Dzhabrail district, the main fruit and berry plantations are: 0.7 hectares of bergenia, 2.3 hectares of cranberries, 3.1 hectares of alder, 22 hectares of plums, 20.1 hectares of cherries, 11.4 hectares of sweet cherries, 0.2 hectares of olives, 8 hectares of figs, 1.7 hectares of spirea, 18.8 hectares of pomegranates, 5.1 hectares of hazelnuts, 2.1 hectares of walnuts, 20.2 hectares of apricots, 15.7 hectares of

peaches, 22.4 hectares of quince, 19.7 hectares of pears, 24.8 hectares of apple trees, 7.3 hectares of other fruits, 22.6 hectares of other berries, 0.3 hectares of melons and 1 hectare of watermelon. The total area of fruit and berry plantations in the district was 250 hectares. In Gubadli district, 38.6 hectares of fruit and berry plantations were planted, of which 2 hectares are plum, 30 hectares are diospyros, 3.6 hectares are pomegranate and 1 hectare are hazelnut. Meanwhile, in Zangilan district, during this period, a total of 9.4 hectares of fruit and berry plantations were planted, of which 0.2 hectares are tangerine, 2.2 hectares are plum, 2.1 hectares are sweet cherry, 1.9 hectares are sweet cherry, 0.4 hectares are pomegranate, 0.3 hectares are hazelnut and 0.3 hectares are walnut.

Thus, it follows from the above that the study area plays an important role in the development of crop and livestock production, as well as in meeting the agricultural needs of the country's population. After the completion of construction and restoration work, complete resettlement of the population within the region and further development of agricultural sectors, this region is expected to make a significant contribution to the agricultural sector of Azerbaijan. This development will also help fully meet the needs of the population for milk, meat and grain products.

The analyses and information provided indicate that the region has significant agro-climatic and relief conditions suitable for the development of agricultural sectors. Considering all these factors, the following zoning can be proposed for the Eastern Zangezur region (Figure 4).

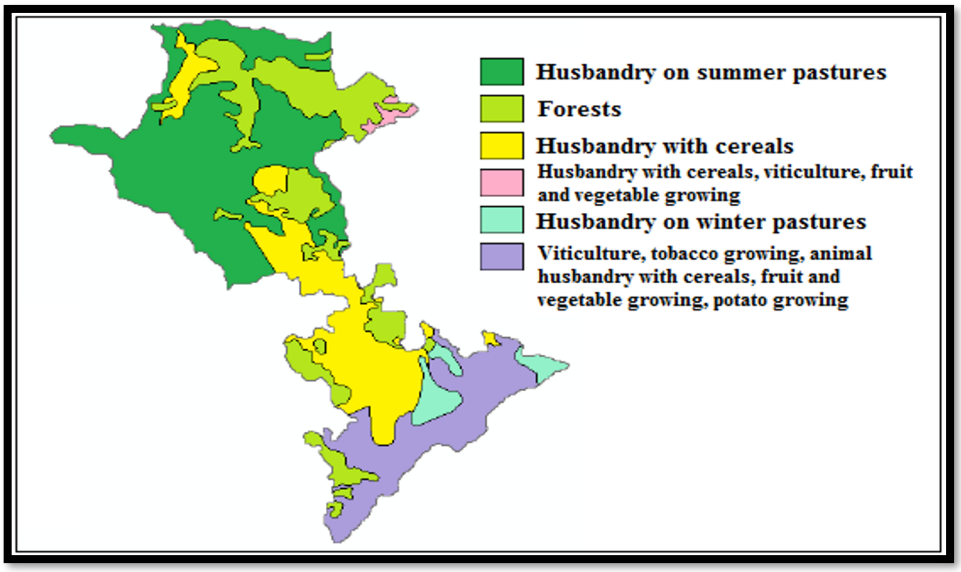

Fig. 4. The zoning map-scheme reflecting the agricultural development of the Eastern Zangezur region.

As can be seen from Figure 4, the northern slopes of the Kalbajar and Lachin districts are primarily inclined to the development of summer pastures and grain cultivation, while part of this territory is unsuitable for agricultural use due to forest cover. In contrast, the central and southern districts, including Gubadli, Zangilan and Jabrail, have favorable conditions for the development of livestock and agriculture. Especially in the southern districts, there is potential for significant productivity in agricultural sectors such as viticulture, horticulture and vegetable growing, which is directly related to climatic, soil and relief factors. In addition, the mountain meadow landscapes in the northern zone are of critical importance for

the development of livestock farming, as these areas are suitable for summer pastures. Moreover, the cold climatic conditions of the highland areas play an unrivaled role in the development of beekeeping and the production of high-yielding honey, propolis and other bee products. Therefore, honey produced in the Kalbajar-Lachin region is considered to be the highest quality in Azerbaijan.

4 Conclusions

In conclusion, the following can be noted:

1. The territory of the East Zangezur region is characterized by fertile soils, favorable relief and climatic conditions.

2. The mountainous terrain necessitates the development of animal husbandry. In this region, it is possible to develop cattle breeding, sheep breeding, beekeeping and poultry farming.

3. The East Zangezur region has natural pastures suitable for animal husbandry.

4. In the region, it is possible to develop various branches of plant growing, including grain growing, horticulture and vegetable growing, viticulture, etc.

The development of the region will create the necessary conditions for fully satisfying the needs of the population for meat, dairy and grain products, as well as provide high-quality food. Therefore, it is necessary to focus on the agrarian-oriented development of the region, rooted in historical traditions. This approach will stimulate the development of the agricultural sector of Azerbaijan and increase the share of the non-oil sector.

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