Journal of Earth Science and Engineering 4 (2014) 667-674
doi: 10.17265/2159-581X/2014.11.002

The Landscape Analysis of Viticulture and Enology in Georgia

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Received: October 5, 2014 / Accepted: October 28, 2014 / Published: November 25, 2014.

Abstract: Georgia has been the country of vines and wine since ancient times, and historically vine growing and wine making has performed the function of one of the leading branches of economy. The diverse and rich information about growing vines and producing wine in Georgia can be found in historical and modem scientific literatures as well. Javakhishvili reviewed 413 vine species from the ancient period in his work: “Economic History of Georgia”. Nowadays there are more than 420 species in Georgia or 2.5% of the whole world assortment, from which 27 are for wine, 14 edible and 41 standard species. According to the ecological and economic conditions, Georgia is divided into 11 main regions from the viewpoint of specialization and concentration of vine growing, of which Kakheti, Kartli, Imereti, Racha and Lechkhumi are the most important regions. All these regions are both producers and users of grapes and wine. The climate of Kakheti is favorable to develop the vine industry here. They are: Rkatsiteli, Saperavi, Mtsvane, Kaberne and Khikhvi. Kakheti gives more than half of branded wines of the republic. Fifty-four percent of vineyards of the country are placed, and 65%-68% of total wines in Georgia are produced in Kakheti.

Key words: Viticulture, ecology, landscape approach, landscape-geographic analysis, Georgia.

1. Introduction

One of the important issues in the study of landscapes is the determination of natural potential of each unit. In these terms, the determination of the potential of agro resources of landscapes plays one of the most essential roles that are the elicitation of the natural resources that have impact on this or that agro production. Obviously, the question demands the analyzing evaluation of a whole lot of indicators and complex geographical research. In the list of these indicators, all the specificities that influence agricultural-farm production (type of specialization, productivity) are included.

Comprehensive assessment of agricultural resource potential of landscapes is important for both scientific and practical points of view. Firstly, it’s connected with the decision of many economical issues, facilitating a regular decision in territorial planning and sustainable use of natural resources. From the point of view of scientific value, multi-factor analysis is important, particularly, the mutual analysis of a dramatically different range of numerical values and different dimensions, which is a rather difficult scientific task. So, use of the mathematical method is very urgent, which makes it possible to estimate the data comprehensively.

Since Georgia has been the country of vines and wine since ancient times, and historically viticulture and wine-making has performed the function of one of the leading branches of economy and fulfills this function nowadays as well, the research of viticulture in these terms is especially important amongst agricultures.

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The main purpose of research is to analyze the landscape-geographic features of viticulture and enology in Georgia on the basis of complex assessment.

2. Material

The research was carried out in several stages:

- correlating the data amassed in different sources;
- creating the DB (database) of GIS (geographic information system), which describes about 850 species of vine. DB includes more than 50 attributes;
- evaluation the main factors and parameters determining the territorial distribution of viticulture and enology in Georgia.

Revealing the peculiarities of territorial distribution of agri resource potential of landscapes according to viticulture and enology was conducted on four main directions: different altitudes, landscapes, administrative regions and viticulture micro-zones. Such approach showed a more vivid picture and gave us the opportunity to determine a set of territorial peculiarities. Analysis of agri resource potential of viticulture was reveled on the base of five altitude levels: 0-200, 200-500, 500-800, 800-1,000, and more than 1,000 m and all data (physiographic, meteorological, and edaphic) have been grouped according these levels. A similar analysis was conducted according to administrative units of Georgia (11 regions), viticulture micro-zones (82 micro-zones) and landscapes (71 genera).

This work is based on ampelographical, historical, geographical and cartographical data [1-5]. According to landscapes, the analysis of the spread of vines is based on various cartographic sources, in particular, the map of the viticulture of Georgia [Gvelesiani, G., Aslanikashvili, Al., and Zautashvili, E. Georgian Viticulture. Map, 1964. Scale 1 : 2,500,000], the landscape maps of the Caucasus and Georgia [Beruchashvili, N. Landscape Map of Caucasus, 1979. Scale 1 : 1,000,000. Tbilisi]. On the Georgian landscape map the types of natural-territorial complexes are depicted according to the types of agricultural lands.

For the sake of analysis and visualization of the specificities of spatial distribution of vine species, the data were treated with GIS-technologies. The database which unites more than 500 aboriginal species of vine is compiled as a result of analyzing literary sources. Besides, it includes all non-local, imported and hybrid species that have ever spread on the territory of Georgia (about 850 species of vine). Many species of vine are known under different names in different regions of Georgia. That’s why the database unites more than 900 names of vine species (including synonyms) [6]. There are various types of information about each vine species in the database, which are: grape varieties, types of grape according to the color (white, black, pink, red), time of ripening (earlier, average period, later), distributions according to physiographic (landscapes) and administrative (regions, districts) units, etc..

Obviously, such detailed and complete information is not available for every vine species. Some species are mentioned only in historical sources. In such cases instead of numerical data, evaluating terms are offered, for example: highly yield, low in sugar, etc..

3. Study Area

Vine basically grows in the countries with mild and temperate climate. The regions of viticulture and wine-making are in the territories throughout the latitude 30 and 50 degrees of the both hemispheres. On the continent of Eurasia the viticulture and wine making zones are distributed from the Mediterranean till the Pacific, taking the Caucasus and Central Asia into consideration [7]. Among those regions Georgia has eminent rank. A diverse agro climate and soil condition make the best environment for original and high standard viticulture and wine production here.

The Georgia is the oldest country in consideration of viticulture and wine-making. It is divided into

abruptly different macro zones: the East and the West Georgia. The East Georgia has temperate continental transitional to dry subtropical climate while the West Georgia has damp subtropical climate due to the influence of the Black Sea. Those macro zones are divided into five regions and 13 zones. In turn, those zones are divided into micro zones. Amongst inhabited regions Kakheti is particular. Seventy percent of Georgian wine is produced in Kakheti [8].

Javakhishvili [5] reviewed 413 vine species from the ancient period in his work "Economic History of Georgia". Nowadays, there are more than 420 species in Georgia or 2.5% of the whole world assortment, from which 27 are for wine, 14 edible and 41 standard species.

4. Results and Discussion

4.1 Viticulture-Winery Zones and Problems of Its Identification

In terms of viticulture and winery, Georgia is divided into two sharply different macro-zones: the East and West Georgia. East Georgia is characterized with moderate continental, flowing into dry subtropical climate, whereas Western Georgia with the influence of the Black Sea, with humid subtropical one. According to the ecological and esconomic conditions, also from the viewpoint of specialization and concentration of vine growing and winery, these microzones are divided into five regions and 13 zones (Table 1).

But this is not the only classification. Different authors variously outline the region and zone borders. There is some likeness between them, but in various scientific literature the question of rationing of Georgian territory is not reviewed the same.

The relative comparison of noted rationing made us see not only the terminological inappropriateness, but also the physical geographical characteristics which are not thought to be the leading factor of separation of classifying units. In particular, the region is identified as a historic-geographic province. And in the region limits, the identification of separated micro-regions/micro-zones are basically based off of the administrative territorial units created in the former USSR—agricultural units ("Sabcho").

This approach is justified first of all by economic means, because a territory in one administrative unit is easy to plan and control in terms of economic work, also in terms of vinery-wine development. Also, similar economic work united the agricultural councils of council territories. This is why this approach truly has a real objective basis.

And concerning the zone, its separation is primarily based on the hypsometric factor. According to zones, the characteristics of natural conditions are revealed, such as surface character, the coordination of warmth and humidity, edaphic conditions. All those determine the specification of viticulture and wine production, fertility of vine and the quantity of sugar in it, sort and quality of wine and other biological and ampelographic characteristics.

The existing practice of separating of viticulture, which is primarily based on absolute height, still is not flawless. The reason for this is that various zone boundaries are distinguished in different ways in different regions of Georgia forming more or less uniform physical-geographical micro-regions. This is why it is true to draw the zone borders on the basis of landscape.

4.2 The Main Features of Territorial Distribution of Vine and Vineyard

The diversity of natural conditions led to very unequal distribution of vine species across Georgian territory. The most amounts are upon four regions: Kakheti, Kartli, Imereti and Racha-Lechkhumi, where the overall amount of vine species exceeds 100.

Kakheti, Kartli, Imereti, Racha and Lechkhumi are the most important regions. All these regions are both producers and users of grapes and wine (Fig. 1). The area of Kakhetian vineyards composes 65%-68% of the total area of Georgian vineyards.

Table 1 Classification of Georgia in terms of viticulture and winery

Regions	Kakheti	Kartli	Imereti	Racha-Lechkhumi	The Black Sea shoreline
Zones	Gare Kakheti	Kvemo Kartli	Kvemo Imereti	Racha-Lechkhumi	Guria
	Shida Kakheti	Shua Katli	Shua Imereti		Adjaria
		Zemo Kartli	Zemo Imereti		Samegrelo
					Abkhazia

From administrative districts, Ambrolauri is especially distinguished, where vine species exceed 50. In general, Racha-Lechkhumi and especially Amrolauri District is distinguished by well-developed vines. Vine is traditional here and high-quality branded semi-sweet dry and naturally sweet table wines are produced. Though, only 3.5% of the vineyards of the republic are observed here.

A different characteristic is observed during the analyzing of the density of vine species, in particular, in these terms, Guria and Racha-Lechkhumi are obvious leaders which can be explained with the small area of these regions.

Kakheti is especially distinguished by the areas of industrial vineyards. The natural conditions of Kakheti are favorable to develop diverse grape varieties and high-quality industrial vines. They are: Rkatsiteli, Saperavi, Mtsvane, Kaberne, Khikhvi. Kakheti gives more than half of branded wines of the republic. Fifty-four percent of vineyards of the country are placed and 65%-68% of total wine in Georgia is produced in Kakheti. Alazani Valley is situated 250-300 m above sea level (Fig. 2). Within these heights vine grows everywhere and gives abundant crop, but typical Kakhetian wines are made from the vines situated on the slopes, the height of which are between 400-450 m and 700 m (Kakheti regional development strategy 2009-2014).

Among the micro zones of vine-growing of Kakheti, the following are distinguished: (1) eeast, south and south-west slopes of Gombori range; (2) neighboring territories of the Alazani valley, which are favorable conditions for vine growing. The main trait of the landscapes of this area is lowlands and mildly humid subtropical climate. Alazani plain, compared with the other landscapes of the plains of Eastern Georgia, is characterized by the mildest and the wettest climate; (3) south-west and south-east slopes of the Kakhetian Great Caucasus; (4) left bank of river Alazan.

Outside Kakheti vineyards are mainly spread on the southern slopes of the Gombori range and in some places they are laid out at the height of 1,000 m. Gurdjaani district is distinguished by vineyard area (more than 5.9 thousand ha). Rkatsiteli is the leading sort among the spread vine sorts (60%-70% of all existing species), Kakhuri Mtsvane, Saperavi, Khikvi, etc.

The opposite of these areas are dry subtropical landscapes of the semi-desert of Eldari's plain, which cause the forming of semi-desert plants and desert soils. The climate of the Eldari's landscapes is unfavorable for vines. Vine is spread out in many Georgian landscapes and in big hypsometric diapason, starting from sea level to 1,200 (1,340) meters. It holds a large hypsometric diapason in Western Georgia (Adjara, Guria and Samegrelo). Especially Adjara is distinguished, and vine is spread on all height levels, where vine is found generally in Georgia and contains 14 landscape genera. Kartli is also distinguished for 13 landscape types for vine development.

The favorable condition for vine is the land up to 1,200 m altitude. Davitaya was writing, that the sort of vine and the place from which it is received are reflected in the wine as if in a mirror [10]. In lowlands, vines grow well and give the heavy harvest, but as it is confirmed by research for many times and practices as well, wines harvested are is of lower quality than that of the slopes. It is known, that vine-growing countries of the world are mainly placed within the zones of subtropical and mild climates, where the rays of the

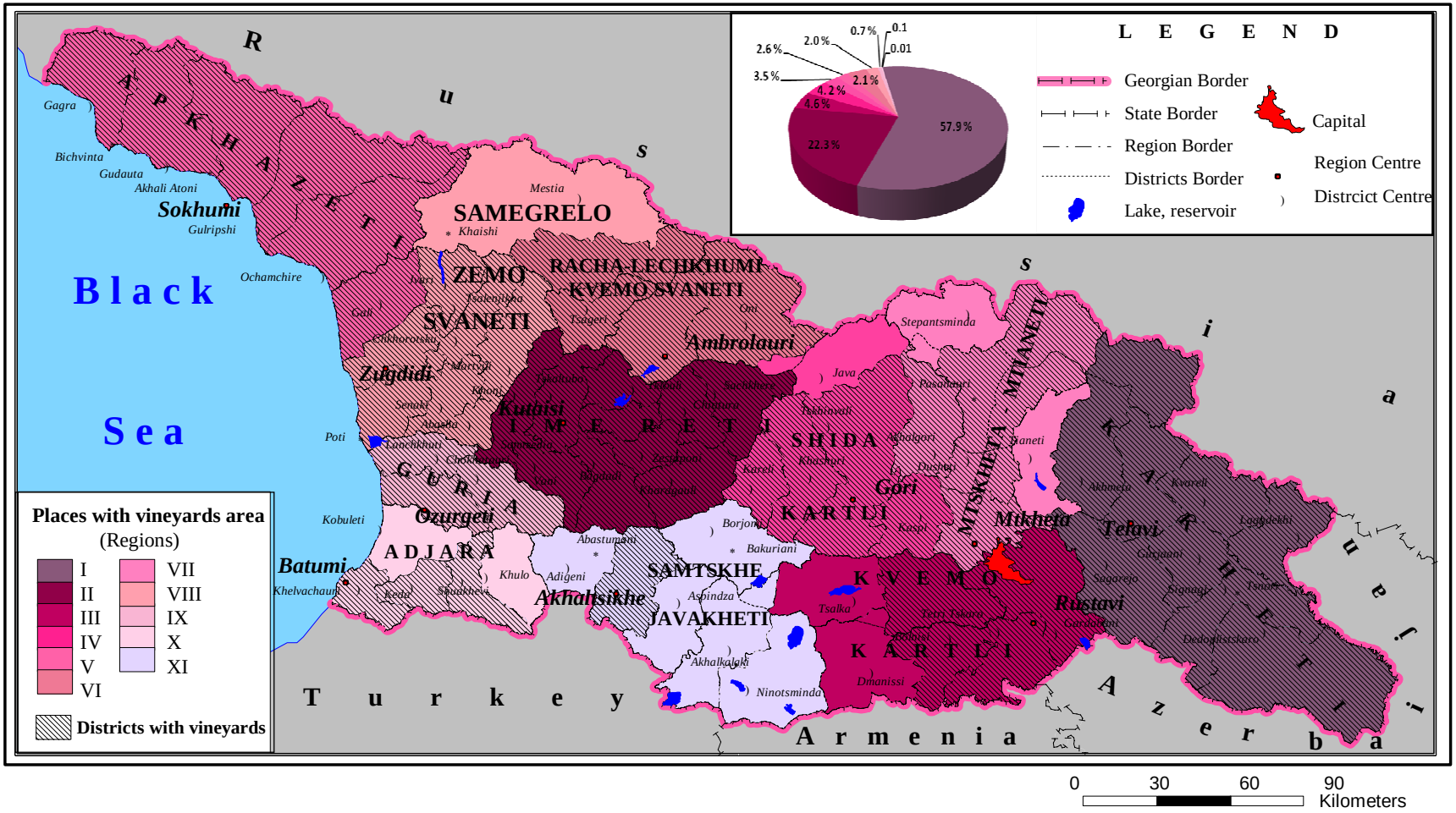

Fig. 1 Vineyards area according to administrative units of Georgia.

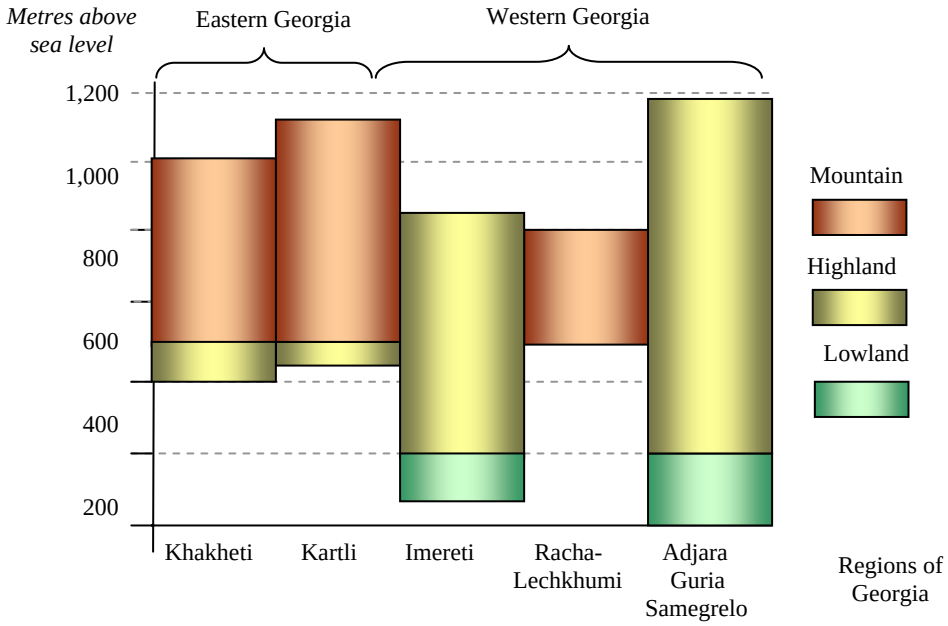

Fig. 2 The main altitudinal zones of vineyards in Georgia.

sun are bent from the right angle less than that in the northern areas. For this reason amount of sunshine and warmth are comparatively higher here. That's why exposition and steepness of surface have a great importance.

According to area of vineyard Kvemo Kartli occupies the second place in Georgia. Viticulture is the dominating agriculture here. The natural conditions of Shida Kartli are distinguished for their diversity that has a certain influence on the development of the fields of agriculture. Kvemo Kartli is specialized in producing ordinary table wines. The main sorts planted here are: Rkatsiteli, Tavkveri, Tavrizi, Saperavi, Chinuri and Aligote. Vine-growing of Shida Kartli is specialized in producing wine materials of champagne and sparkling wine of high quality: Chinuri, Goruli, Mtsvane, Rkatsiteli, Aligote, Pinoebi, Shavkapito and Saperavi. That is more than 12% of whole area of Georgia's vineyards. The climate of western part of Shida Kartli is semi-moderate or semi-arid with hot summer and rather mild winter. We can own it up to the northern variety of the climate of the Mediterranean Sea climate, the landscapes of which are similar to the lowland landscapes of Northem Italy, particularly Lombardia lying at the bottom of the Alps [9].

The smallest height range is characteristic of Racha-Lechkhumi (three landscape genus) despite the fact that in terms of amount of vine species, it holds the first place in Georgia.

Obviously, different characteristics were revealed during the analyzing of the characteristics of territorial distribution of industrial vine species. The overall area of vineyards is more than 37 hectares.

High-quality wines are produced in Imereti at an altitude of 150-200 m above sea-level, in Racha and Lechkhumi at 400-500 m, in Kartli (Ateni valley and Mukhrani plain) at 600-700 m and Alazani plain at 500-600 m.

4.3 The Diversity of Vine Species According to Georgia's Landscapes

Grape varieties can be met in a wide hypsometrical range—in 41 species (from 71). Within lowlands, vines can be met almost everywhere except in hydromorphic and arid areas. And in the mountainous landscapes, vines have been spread from lower mountains in the landscapes to average mountain forests.

In terms of diversity of ancient and modern vine species, West Georgia is prominent despite the fact that vineyards take up much more area in Eastern Georgia. This characteristic is revealed in a whole height spectrum. In Western Georgia's valleys and foothill scopes the overall amount of vine species exceeds 300, whereas in Eastern Georgia it exceed 220. This difference is even larger in the lower mountainous landscape scopes and integrates, more than 280 and 70 respectively.

In terms of diversity of vine species, a few landscape types are prominent, which also coincide with the most important areas of vine distribution of Georgia (Fig. 3). Their most part falls upon valley landscapes. Among mountainous landscapes, the Racha cavern is distinguished with an especially high diversity of vine species. Concerning Alazani Valley—the most important area of the distribution of Georgia's vineyards, in terms of diversity, it gets behind other territories. It is characterized with a uniform relief and natural conditions, mostly a few vine species were cultivated. A different situation is in the landscapes with are characterized with mountain different conditions that gave the vine species a chance for more diversity. In particular, in these terms, the Colchic lowlands and foothills, as well as Kartli valley landscapes rather exceed the Alazani valley.

In terms of density of vine species (amount of species on area unit), we have a different picture. In this way, the southern Colchic foothills, where more than 20 species grow, are distinguished. Other districts of the Colchic foothill trail and the Racha cavern are also distinguished. And concerning Eastern Georgia, this indicator is the highest on the Kartli valley, the Gombori Ridge foothill and the south-east part of Alazani valley, and is the lowest in the mid-mountain landscapes. Here, on every 100 km^2, there are 2-3 vine species on average. From the lower-mountain landscapes, the Southern Colchic and Racha cavernous landscapes are distinguished.

So, the landscapes where the below-mentioned conditions (or their majority) are fulfilled simultaneously are especially diverse vine species:

- producing traditional vine species;
- covering a large area;
- having high hypsometric level;
- bing within different humid environments.

4.4 The Classification of Georgian Landscapes According to Areas Useful for Vinery

With the landscape approach, the complex evaluation of landscapes convenient for the growth-sdevelopment of vine has become possible by means of the integral indicator. In particular, each of Georgia's landscapes was evaluated according to the natural factors which play the leading roles in the growth and development of vine.

The leading climate factors for vine-growing and wine-making are: annual precipitation; which creates a certain regime of soil humidity; amount of temperatures above 10 °C; average temperature of the warmest month.

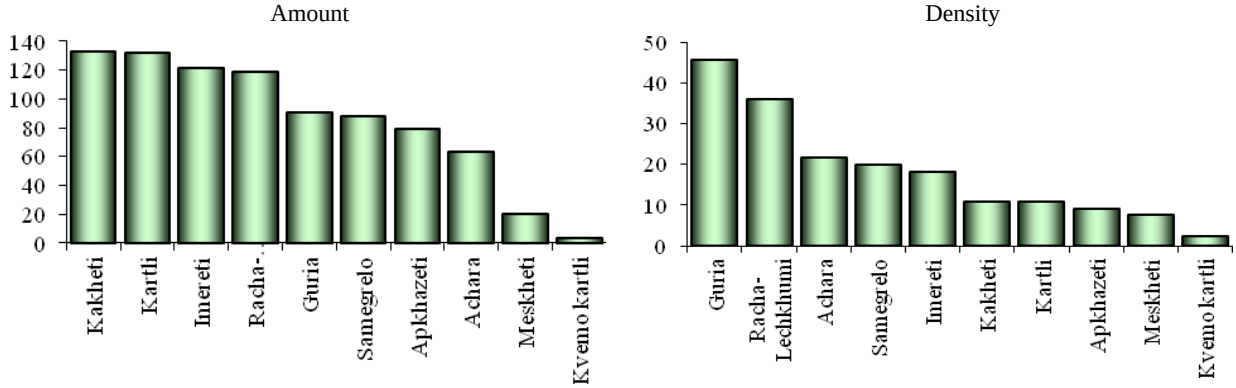

Fig. 3 Territorial distribution of grape varieties according to Georgia's Provinces.

Landscapes with high potential take up 6.57 km^2 area (9.4% of the general area of Georgia). This mainly coincides with the most important regions for the vinery-winemaking development in Western Georgia, just as in Eastern Georgia. It unites mainly the valley, foothill landscapes, in part lower mountain (Racha caverns) landscapes. The high-potential landscapes take up 6.84 km^2 area (9.8%). They also get share of Western, just as Eastern Georgia's valley and foothill landscapes, also Western Georgia's lower mountain's Karst and Southern Georgia's mountainous cavern landscapes. Medium-potential landscapes take up 10.28 km^2 (14.8%). The valley and foothill landscapes come upon them, which are intensely humidified for the growth-development of vines, or the soils are with less fertilizer, just as most of the lower mountainous landscape. As for the low and very low potential landscapes, they take up most of the area and most of the territory comes upon the high-mountain, swamped, semiarid and arid districts.

5. Conclusions

From the point of view of analysis of different factors, the study revealed the agricultural resource potential of Georgia's landscapes.

The most important results of the research are:

- A database of ancient and modern Georgian vine species has been compiled (up to 800 locations and 20 indicators). This database allows comparing different landscapes and using data for the evaluation of their agri resource potential;
- A map of vineyards area of Georgia has been compiled. This map allows comparing different regions and using data for the assessment of their agri resource potential;
- Some of the regional characteristics of territorial distribution of viticulture and enology have been estimated (according to landscapes). So, the study permits the conclusion that the using the landscape approach in such researches is representative for the evaluation of the agri resource potential of any territory.

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