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Research Paper

Assessment of Agro-Resource Potential of the Western Georgia and Physical-Geographical Zoning

Geography

KEYWORDS : *landscape, agro-resource potential, hydrothermal coefficient, agro-climatic characteristics.*

Seperteladze Zurab Kh.	Doctor of Geographical Sciences, Full Professor, Department of Geography, Ivane Javakhishvili Tbilisi State University, Chavchavadze Ave. 3, 0179, Tbilisi, Georgia
Davitaia Eter F.	Academic Doctor of Geography, Assistant Professor, Department of Geography, Ivane Javakhishvili Tbilisi State University, Chavchavadze Ave. 3, 0179, Tbilisi, Georgia.
Aleksidze Tamar I.	Academic Doctor of Geography, Assistant Professor, Department of Geography, Ivane Javakhishvili Tbilisi State University, Chavchavadze Ave. 3, 0179, Tbilisi, Georgia
Rukhadze Nino E.	Doctoral Candidate, Department of Geography, Ivane Javakhishvili Tbilisi State University, Chavchavadze Ave. 3, 0179, Tbilisi, Georgia
Gaprindashvili George M.	PhD student at Ivane Javakhishvili Tbilisi State University, Institute of Geography, Chavchavadze Ave. 3, 0179, Tbilisi, Georgia

ABSTRACT

Agro landscape study has quite a long history in Georgia, as natural-resource potential of the country and agro-resource potential, in particular, greatly depends on it. Scientific research was carried out aiming at implementing the program of desiccation the high humidity and swamp soils of Kolkheti and their agricultural utilization. The group of geographers and the authors of the article among them took active part in it. Finally it was agreed, that apart from the traditional industries (citrus, maize, tea and tobacco industries), it is quite possible to develop seaside resort industry as well, that will completely provide the tourist demand on agricultural products. In order to implement this program, it's necessary to find out the factor that limits the cultivation of agricultural cultures, determines the quantity and quality of the yield. Territorial planning should be based not only on climatic indices, but on the agro landscape potential in general by selecting the optimal variant of spatial organization.

Introduction

Western Georgia is one of the most utilized regions from the agricultural point of view. It determined the basic transformation of its unique and exotic damp subtropical landscapes rich with endemic and relic bio-elements. Here we can trace several modifications of agro complexes classified (Seperteladze, Davitaia, Alpenidze, 2012) according to the character of anthropogenic impact and degree of natural component transformation. These modifications are phytogenic, pedogenic, lithogenic and absolutely new neo-landscapes can be also created, the typical example of which can be considered, the so-called polders – rather fertile agro-landscapes molded after the utilization of sea shelf (so successfully applied in Holland).

It must be noted, that agro landscape is generally an open system. It means that constant transformation of substance and energy can be traced not only in its structures, but between the neighboring natural systems as well. Its spatial structure is primarily defined by natural factors. As for the agro-landscape efficiency, it depends on natural potential together with socio-economic and technical conditions (Dyakonov, 1974).

It must be noted, that agro system has the capacity of functioning for a long term (in condition of systematic monitoring on its station), but as soon as the anthropogenic impact on it over, immediately it is replaced by a secondary, no cultural landscape. Besides that the capacity of stability and homeostasis is also characteristic to agro landscape, as to one of the mobile modifications of anthropogenic landscapes (Davitaia, Seperteladze, 2009). This latter capacity depends on various factors factors (Seperteladze, 2009), though the most important among them is agricultural crops and physicochemical features of soil. This very issue will be analyzed in more detail in the main part of the work. But here we are determined to note that the landscapes having suffered from industrial impact are less stable (at least in the short term period). The structure of agro complexes is rather simplified compared to its preceding natural (background) landscape, the main representative of which is monocultures created on the place of diverse natural phyto association. This latter basically changes the situation, soil features in particular, it devours organic and chemical linkages thus hindering the restoring processes in soil. For instance, in the damp subtropical landscapes of western Georgia (Kartvelishvili, 2011) namely in tea plantations, it's easy to observe three times more absorption of nickel and 1,7 times more absorption of magnum from the soil by tea leaves, than by the leaves of lime and chestnut trees in the same zone. Besides that, they have double aluminum consistency (Seperteladze, Davitaia, Alpenidze, 2012).

On the basis of the research works conducted under the aegis of the UN convention on climate changeability (Gvasalya, 1989; Elizbarashvili E; Elizbarashvili M. 2006), it was decided that some corrections must be made in the tendency of climate changes during the last decade (2005-2010), what can be observed on the figure 1. According to this scheme during the 20th century and at the beginning of the 21st century the average annual thermal change velocity of air was - 0,3° in damp subtropical landscapes of humid forest lowlands in Kolkheti (type A), while 0,07° - in subtropical sub arid (type B) and humid forest highland landscapes (type H). Moreover, the warming process has replaced the process of cold spell in humid landscapes. This hypothesis will certainly have its impact on the agro resource potential of Kolkheti (Kolkheti lowland. 1990), as according to the current forecast, the transformation of Caucasus climate is expected in several decades.

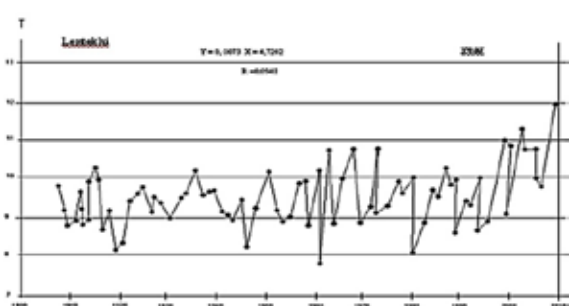

Figure 1. Air temperature annual fluctuation in Lentekhi region during a century (humid landscapes of mountainous forest, Type H)

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Materials and Methods
The issues discussed in the article and their outcomes are basically based on the scientific works dedicated to this problem and mostly on the results of expeditions and experimental researches conducted by the authors. Apart from the approved methods of agro landscape research, the methods of time-space analysis and synthesis were also used while carrying out the research (Tamm, 2003).

Results and Discussion
Agriculture together with tourist-recreational potential can be considered as the basis for the sustainable socio-economic development of Georgia (Agriculture of Georgia. 2011). Western Georgia, especially the Kolkheti region is to play one of the major roles in it. Soil-climatic conditions (citrus, maize, tea, tobacco industries) with the intensive application of winter vegetation period, in their turn are main determining factors of agro landscape potential.

Various types of soils developed in damp subtropical conditions in the region play important role in forming the agro landscapes in western Georgia, the most significant among them are yellow podzolic soils. They are characterized with extremely differentiated profile and A_1A_2-A_2 (g) – B_1- B_2 = BC-C structure. The main diagnostic index of these soils is well distinguished by alluvial horizon, impoverished silt fraction and 1/5 oxides (Table 1). The total area of yellow podzoic soils in Georgia is 2% of the whole country (137600 hectares) and are mostly common to damp subtropical zones of western Georgia (30-200m sea level).

Table 1. General agro chemical data of yellow podzolic soils

Horizon depth (cm)	PH (H_2O)	Humus %	Hydrolysis # mg/100g	Mobile P_2O_5 mg/100g	Exchangeable K_2O mg/100g
0-25	6.7	4.56	13.0	46.0	45.5
25-41	6.2	3.09	11.1	16.4	41.5
41-65	5.35	1.39	9.9	5.6	41.1
65-94	5.15	0.82	7.75	0	28.5
94-122	5.7	0.24	6.9	0	22.9
122-179	5.95	0.07	4.4	0	22.7

As we can see from the table 1, yellow podzolic soils are characterized by acid reaction, especially in alluvial horizons, as for its depth, the tendency of reduction can be traced. They are humus soils. Humus type is phulvatic. Such soils are very useful for cultivation of citrus, tobacco, maize, tea and vegetables. The soils need to be limed (except tea).

Agro landscape of redsoils. Redsoils are characterized by red tint, tendency to clay and strong A-AB-B-BC-C structure profile. The total area of redsoils in Georgia is 1,9% of the whole country (130400 hectares) and are mostly common in the south-west of western Georgia (100-300m sea level). They are characterized by acid reaction, PH magnitude slightly changes according to the profile. Humus consistency is generally average, sometimes-high with fulvat type. Redsoils are often used for cultivation of tea, citrus and other subtropical cultures. Aiming at getting good yield it is very important to conduct high quality agro technical and melioration arrangements.

Subtropical gley podzolic soils. These types of soils are characterized by sharply differentiated A-A_1A_2- B_1B_2- BC-CD (g)-G structure. According to the development conditions these soils are similar to yellow podzolic soils, but differ from them with ground and surface drainage waters and more humidity. The total area of the subtropical gley podzolic soils in Georgia is 0,7% of the whole country (14200 hectares). These soils are common in the same area as the yellow podzolic soils and they are used for cultivation of one-year cultures as maize, vegetables, fruits. They require special melioration and agro technical arrangements (organic and mineral fertilizing, sideration, etc).

Alluvial acid-eutric flavisoils. Alluvial acid soils are more frequent in new river terrace areas. They are distinguished by less differentiated, simple profile, with little humus (1,6-2,2%) and nitrogen (0.12-0,16%) and comparatively more phosphorus consistency. The profile structure is A-AB-B-BC-C. These soils are utilized in agriculture for maize, vegetable, volatile oil and tobacco cultivation. Sometimes they are used for vineyard cultivation as well.

As we have mentioned before, one of the main determining factor of agro-resource potential (together with soil conditions) is agro climatic indices, the most important among them is duration of day-night temperature period above average 10^0C (Table 2).

Table 2. Duration of day-night temperature period above average 10^0C with various provisions

#	Average duration (day)	Provision %				
		95	75	50	25	5
1	220	190	205	220	235	250
2	230	200	215	230	245	260
3	240	210	225	240	255	270
4	250	220	235	250	265	280

The research has showed that during the vegetation period the average indices of hydrothermal coefficient in different parts of Georgia ranges between 1,5 and 3,5, while its maximum is observed in Adjara-Guria regions (Chakvi).

One of the main determining characteristics of agro-resource potential is sun shine duration. The maximum sun shine duration is characteristic to Samegrelo region (Nikolaishvili, Sperteladze, Davitaia, Kikvadze, Donadze, 2013. Kolkheti lowland, 1990) the lower coefficient can be observed in Adjara-Guria region (unlike the previous data). In Anaklia this coefficient equals to 2223 $^h/_{sec}$, in Poti – 2183 $^h/_{sec}$. the research has also revealed that territorial distribution of atmospheric precipitation in this area is of inversion character and doesn't accord with natural regularity. But generally the tendency of its reduction from the sea to inner regions can still be observed.

It must be noted that drainage works carried out (in 2000-2010s) didn't have any serious impact on Kolkheti climate humidity. In our opinion, the reason of it is that humidity is generally dependent on climate determining factors, such as sun radiation, atmospheric circulation, lower surface character, the global changes of which haven't occurred yet. This question is still a subject of discussions, but one thing is certain, that as a result of the mire area utilization, hydro-climatic changes generally occur at the expense of total evaporation changes. It is calculated (Svanidze, 1983; Bondirev, Tavartkiladze, 2007), that annual drainage increase after mire area utilization in Kolkheti equals to 5%, during the vegetation period it is raised to 10%, but during the cold period it remains practically unchanged. The above mentioned indices are of great importance fro agricultural development phases in western Georgia, the main determining factors of which are soil humidity, plant characteristics and climate regime. That's why it is so important to use the following attitude:

$$E = \beta E_o \psi(w)$$

Where β- determining parameter of plant development dependency on total evaporation, E_o - is evaporation, ψ (w) - soil humidity function. According to the given attitude, the dependency parameters of humidity provision and yielding of main cultures have been defined (Figure 2). It has been determined that during the grape vegetation period in Georgia, the lower index of optimal soil humidity ranges from 60 to80%, for citrus this index is – 65-90%, for tea -75-95%, for maize – 60-85%.

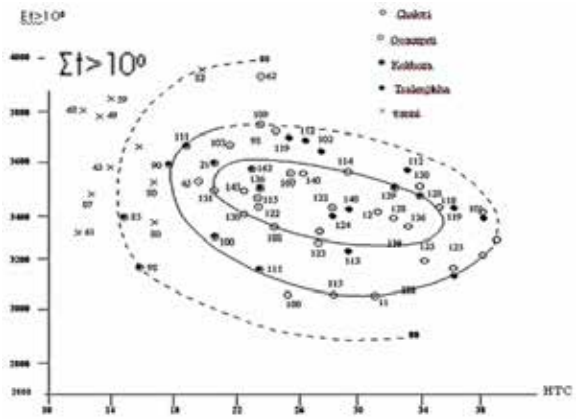

Figure 2. Tea yield (centner/hectare) dependency on actual total temperature and hydrothermal coefficient (HTR).

Table 3. Agro-climatic zoning of western Georgia

Region	Sub districts	Zone	Region
Western Georgia	1.Kolkheti 2.Imereti highlands	I	a,b,c,d
		I	c,d
		II	c,d
		IV	c,d
		V	c,a
	1.Adjara-Guria highlands	II	c
		III	d
		IV	c
		V	c
		VI	b
		VII	a
	Western Caucasus	II	a,c
		III	c
		IV	a
		V	c
		VI	a

Each agro-climatic zone given in the above table, slightly but still differ from each other with some parameters (Table 4).

Table. 4. Agro-climatic zone characteristics in Western Georgia

Zone	Altitude from sea level (m)	Actual temperature total (more than 10%)	Average of absolute and minimal temperature (°C)	Nonfreezing days
I	0-350	4000-4500	-3	280-310
II	351-560	3500-4000	-14-16	190-275
II	561-780	3000-3500	-18-8	186-267
IV	781-990	2500-3000	-12-22	175-216
V	991-1250	2000-2500	-14-23	140-205
VI	1251-1750	1500-2000	-15-28	120-180
VII	1751-2100	1000-1500	-19-29	100-150

Thus, the researched region landscapes have great agro-resource potential the determination of which was implemented by complex analysis of quantitative and qualitative indices of agro-climate resources and soil fertility and structural peculiarities. In spite of the fact that western Georgia is one of the most utilized regions of the country and well researched in agro-climatic respect, aiming at optimal utilization of its agro- resources and at better arrangement of nature protection and ecological issues, we think it will be reasonable if scientific analysis of natural and anthropogenic transformation of all agro-landscape modifications are carried out by using modern research methods. These activities will reveal its agro-resource potential in many respects and will encourage agro-system structural stability and will improve ecological situation.

Conclusion

On the basis of landscape analysis and material obtained after the field research works, three sub districts and 7 agro zones have been distinguished in western Georgia (Table 3) with appropriate regions classed according to humidity rate (a – high humidity, b – humid, c – mildly humid, d – mildly arid).

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