ПЛОДОРОДИЕ ПОЧВ

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FERTILITY PARAMETERS AND MONITORING OF THE TIMBER SOILS IN THE SOUTH-EAST PART OF THE GREAT CAUCASUS

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*Abstract.*The soil- ecological parameters have been determined for the totally developed brown mountain-forest and brown mountain–forest soils of the indications formingbioproductivity and fertility of the forest biogeocenosis based on field and laboratorial researches in the Great Caucasus south-eastern part. The conceptual directions of the forest restoration works realization and timber soils monitoring, protection have been suggested on the basis of them.

Key words: beech, hornbeam, oak, humus, nitrogen, brown mountain-forest soils.

INTRODUCTION

A quick growth of the population at a global scale and an intensification of the men's industrial activity confronted the humanity with two serious global problems in the XX century:a danger of natural resources exhaustion and the environment deterioration These processes are going on in the XXIcentury by rising their scale and rate.

Though the very serious administrative, legal and organization measures are performed in the field of the nature protection in Azerbaijan as in some places of the world, many natural resources of the country (soil, water, bioresources, some minerals and etc) are deteriorating and the environment factors of vital importance for a man are qualitatively aggravating. The problem solution requires some pressing measures, including transition from an alternative and other inexhaustible energy sources in energetic to the wind and sun energy use, working out of the more rational use methods from soil resources by an application of the new technologies in town-building and agriculture, replacement of the traditional fish procurements by the aquaculture in the Caspian Sea and other natural water basins, transformation of the available forestry into reserve zones or National parks, complete processing of the life garbages, natural resources protection and the environment improvement. There is a special importance of the forest vegetation in Azerbaijan National resources. Our republic is considered less-forest in comparison with some countries of the world. A total area of our country is 8641506 hectares. A total area of the Azerbaijan forests is 1213,7 thousand hectares. An area covered with the forest forms 1021,88 thousand hectares, it is 11,8 % of the total zone.

The forest vegetation map of Azerbaijan has been shown in figure 1.

Figure 1 – The forest vegetation map of Azerbaijan

0,12 hectares of the forest area approximately fall per head and that is 4 times (0,48 h) less than corresponding mean number at the world scale. Only nearly 90000 hectares of the forest remained in the plain zones and it forms 10 % of the area covered with the forest in

the republic. 52000 hectares of the plain forests are in Ganikh-Haftaran valley, nearly 15000 hectares are in Samur-Davachi plain, 2000 hectares are in Lankaran plain and 21000 hectares are along the Kur (Tugay forests). More parts of the mountain forests i.e. 360000 hectares spread in the Great Caucasus. The area covered with forest is 250000 hectares in the Little Caucasus, but 134000 hectares on the Talish-mountains. Though a rate of the zone covered with the forest is less than 10 %, a role of the forest ecosystems is great in formation of the meso- and microclimate, soil and water resources. Although the very serious measures are performed in the field of the forest resources guarding, restoration and increase at state-level for a long time including passing important laws, the work which must be performed is still much. Lawless forest cutting in the plain and at the foothill zones causes special anxiety in connection with the serious economical situation in the country. Abolishment of the forest vegetation intensifies erosion processes, raises aridity, diminishes water resources, aggravates mezzo-and microclimate condition.

The problems in connection with the forest vegetation protection, restoration and increase, the spring-summer rainfalls like shower, more inclination of relief, sensitivity of the soilrock layer for the stream processes actualized the forest protection and restoration work in these zones. The composed ecological fertility models of the brown-mountain-forest soil groups in the xenophile forests and brown mountain-forest in the mesophyll forests andoak, hornbeam and others of the middle upland can be a good means in realization of the forest protection and restoration work in the research region.

OBJECTS AND METHODS

The research object is the Great Caucasus south-east part. While performing monitoring in the timber soils of the research object, G.Sh. Mammadov [1] and S.Z. Mammadova [2] methods have been used.

RESULTS AND DISCUSSION

The use of the ecological fertility models in the timber soils is related to some problems from either a scientific-theoretical or methodic standpoint. It can be explained by the available main differences between the forest biogeocenosis and agroecosystems (natural ecosystems). These are the followings:

1. The forest biogeocenosis possess the richest kind (tree, bush, grass and etc.) structure unlike the agrosystems (grape, grain, cotton and etc) consisting of monoculture;

2. Regulation of the forest biogeocenosis development based on outward factors and inner relations (inter kinds).

The forest biogeocenosis have iyerarx, multi-stage-inner structure and (secretion-climax-sucretion) development system. Not depending on conceptual, regional, ecological and other forms, a main aim of the fertility models use is an utilization of the agromeliorative-meliorative rules in south expedient management of fertility by paying attention to the soil-ecological requirements of the agricultural plants. Some different purposs are realized while preparing the ecological fertility models of the timber soils; guarding of the forest biogeocenosis (soil-plant system), its restoration or location in the zone.

The south-east part of the Great Caucasus is considered one of the zones, where the forest massive ecologically assume a great importance. In last decades reduction of the forest areas quickens in spite of the protection measures.

There are some reasons:

1) intensifying aridity in the zone and reduction of the forest self-restoration potential;

2) lowering of the upper border of the forest 100-500 m I the high mountainous zone for the unnecessary grazing;

3) increase of the upper border of the field and dry field plant-growing 100-

200 m for the purpose of the anthropogenic (enlargement of the living settlements, grazing, cutting of forests in connection with the economical difficulties and etc.).

In this connection preparation of the scientific-industrial foundations of protection and restoration of the forests spreading spreading in the south-east part in the Great Caucasus assumes actuality. Therefore, preparation of the ecological fertility models in mesophyll timber-brown-mountain-forest and xerophyl brown-mountain-forest soils of the same region can serve a practical solution of the problem. A method of the fertility models utilization was sufficiently interpreted in the scientific references. Forest little

The forest possesses an opportunity to affect the environment actively, many leaves, small and big branches, flowers and fruits of the trees and bushes fall every year here and millions of insect residues mix with them. These residues gradually dry, shather and form a thick organic mass. This mass is called forest litter. The forest litter has a great importance. It absorbs rain waters and preserve them for a long time. While there are more rains, the forest litter gradually passes the water into soil. The forest litter is a dynamic part of the forest biocenosis and it is considered the activest element in soil forming process. It is a main source of humus substance and other organic mineral combinations in the soil, without participation of the forest litter it is impossible to imagine a little biological circle of forest biogeocenosis. The beech forests gains first place for the forest litter supply in our research object. The forest litter supply is 22,4 t/h in the brown mountain-forest soils, of the beech forests ; 13,2 t/h in the hornbeam forest; 14,9 t/h in the oak forests; 9,2 t/h in the brown-mountain-forest soils of the hornbeam forests; 13,1 t/h in the oak forest.

In the XX century the human s economic activities threatened biospheric complexes including forest biogeocenosis availability. This problem didn't bypass the republic. The plain and mountain forest complexes occupying 30-35 % of the zone formed a cover in the part less than 10 % of the republic zone. But this figure doesn't also reflect a real state of our forests. Because the investigations show that all the areas of the state forest fund don't possess a tree cover. Some of them were thinned out. In this connection to protect the available forest cover and restore it require realization of some legal, administrative, economic, technical project measures. We should note that the aridity's often happened in the different zones of the republic or the heavy rains observed for last years and stream phenomena are connected with the enough forest cover absence for the natural regulation of the water resources and humidification condition [3].

Being 40 % of the zones surrounded by the erosion processes in the mountains and plains, increase of aridity till the middle mountainous areas and being of the mean yearly temperature 0,6^{o}C are explained by the forest areas reduction. Thus protection, restoration and broadening of the republic forest cover, including its restoration on the previous natural-historical borders are the most important daily problems.

The ecological fertility models of the timber soils which have been worked out by us can be a valuable means in this problem solution that is characteristic for the Great Caucasus south-eastern part: because the ecological fertility models of the timber soils can be used in practical work performance including technical projects preparation in some directions according to its presentation form (ecological passport), information density and systematicity (blockage).

We suggest their following conceptual directions:

1. An ecological monitoring building (forest monitoring) on the forest biogeocenosis;

2. Forest biogeocenosis restoration inside natural-hystoric borders;

3. Restoration of the forest biogecenosis in their natural-historic structures in the structure before anthropogenic change).

Ecological monitoring on the forest biogeocenosis

The forest monitoring consists of the observation system to the forest fund state in order to organize effective work in the field of revealing the changes occurring as a result of the different factors impact on the environment, evaluating them, prognosticating preventing from the negative processes, the forests use, restoration, protection and guarding in the indications which characterize productivity, protecting, ecological and other natural peculiarities and dynamics. We present the following block indications of the biogeocenosis parameters which will be controlled: (1) The parameters which on will be performed observations during a year: 1) the forest microclimate indications: temperature and humidity of soil on 0-20, 20-50, 50-100sm layers; 2) the soil fermentative activity, respiration and nitrogen fixation; 3) the soil oxidization and reduction processes; 4) pH; 5) microbiological activity; (2) the indications which on will be performed observations for once a year or two years. 1) The biocenosis block indications: a tree composition (new sprouts), a state of the forest litter; 2) humus quantity, composition and balance; 3) a quantity of nitrogen, phosphorus, potassium, sum of absorbed bases in the soil (3). The indications which on will be performed observations once in five years: 1) changed in the forestless areas of the forest fund: 2) in the upper and low borders; 3) erosion state; 4) silting and mineralization state in the rivers flowing from the wooded areas or water-collecting. As is noted the forests ecological parameters deteriorate infinitely in our republic for last decades. Though this process weakens, the tendencies are going on. Absence of the ecological control on the forest biogeocenosis doesn't give a chance to get complete information about the processes occurring inside the forest cover in the republic, their scale and intensity. This doesn't reduce an importance of the protection and forest restoration work at present.

The total humus and nitrogen have been analyzed by Turin method, but some of the absorbed bases by Ivanov in soil samples taken from Ismayilli forest economy belonging to the forest biogeocenosis of the South-east part in the Great Caucasus under laboratorial condition [4]. According to the analysis, results the monitoring was performed by comparing the parameters of 1996 with the indices of 2016.

Table 1 – Monitoring of the fertility indices timber lands in the South-Eastern part of the Great Caucasus

Fertility indices	Brown mountain –forest soils			Brown mountain-forest soils		
	1996	2016	difference	1996	2016	difference
Humus supply0-20, t/h	9.8	7.1	2.7	5.4	4.5	0.9
0-50	2.5	1.8	0.72	1.8	1.7	0.1
0-100	1.4	0.17	1.32	0.42	0.62	0.2
Total nitrogen, %	0.33	0.48	0.14	0.37	0.31	0.06
SAB, ekv/100gr soil 0-20	32.5	36.2	3.7	24.0	26.8	2.8
0-50	28.5	30.2	1.7	18.0	20.4	2.4

The humus supply (in 0-20, 0-50, 0-100 layer) total nitrogen with percentage (%), sum of absorbed bases in ekv/100gr layer (0-20, 0-50 layer) have been comparatively shown on the table. If we have a look at the indices of 1996 in the brown mountain-forest soils, the humus supply is 9,8 t/h at 0-20 cm layer, then it is 7,1 in the parameters of 2016. That is it was known that difference was 2,7t/h. According to the results of 1996 it was 2,5 t/h at 0-50 cm layer, but it was 1,8 t/h in 2016. The difference was 0,72 t/h. At 0-100sm layer the difference is 1,32 t/h while comparing 2016 with 1996 years. The humus supply is 5,4 t/h at 0-20cm stratum according to the parameters of 1996 in the brown mountain-forest soils, but decrease (4,5 t/h) was observed in 2016. There is 0,9 t/h difference. While it was 1,8 t/h at 0-50 cm layer in 1996, the difference was 1,7 cm in 2016, it is totally 0,1 t/h. It was 0,42 at 0-100 cm stratum in 1996, but 0,62 in 2016. The difference is 0,2. If we glance at the consequences of total nitrogen in the brownmountain forest soils it was 0,37 % in 1996, but 0,31 % in 2016, slight decrease 0,06 % was observed. We explained reduction of humus and nitrogen quantity and supply forms with some reasons:

-global climate changes and exposing of soils to aridity and desertification in the research object as in the whole region;

-intensive greezing feeding of the young tree shoots and a part of the forest letter because of control absence.

At ekv/100 gr of SAB was 32,5 at 0-20 cm layer for information of 1996, but it was 36,2 in 2016. It was 28,5 at 0-50 cm layer in 1996, but 30,2 in 2016. SAB ekv/100 gr at 0-20 cm layer was 24.0 in the brown- mountain-forest soils, it was 26,8 in 2016. The difference is 2,8. According to the information of 1996 SAB was 18,0 at 0-50 cm layer, it was 20,4 for the indices in 2016. Here the difference is equal to 2,4.

Forest biogeocenosis restoration inside natural-historic borders on the Great Caucasus south eastern slope

Restoration of the forest biogeocenosis inside natural-historical borders isn't completely possible a great reason is to be used the same zones under the dwelling points, sowing, pasture and hayfields [5]. However the investigations performed in the soil fund show that there is an enough potential in soil resources separation for the forest cover restoration. They are the followings:

1. The areas separation for the afforestation on the upper border at the expense of the migratory cattlebreeding limitation. There are 26,5000 h areas eroded to a different degree inside the former borders of the forest in the upland Shirvan zone, it is possible to use them in fulfillment of the forest restoration works.

2. Restoration of the ways particular to the state soil fund, planting trees and shrubs along other communication lines and river beds, rehabilitation of the available field-protective and water-protective forest cover. A total area of the soils from the category on the south-eastern slope of the Great Caucasus is by 9-12000 hectares.

3. Abolishment of the thinning inside the forest fund in the separate areas, afforestation of the fields or rehabilitation of the forestless areas belonging to the state forest fund at the expense of retrieval of the seized parts by the separate citizens at the end of the 80th years, before the 90th years. A total area of such areas is some thousand hectares.

4. There are some soil areas in municipal properties of the Ismayilli, Shamakhi and Aghsu districts, they are situated in 15-20^0 inclined zones (on the low border of the forest and the countryside areas).These zones are unfit for tillage and that's why they are used as a pasture area.

A total area of these zones are till 5-7000 hectares, they can be gone out of the agriouttural use and they may be used

for the new afforestation. The necessary legal base formation is required for it [6].

In the natural-historical structures of the forest biogeocenosis (in previous structure of the anthropogenic changes).

To some researchers, the modern plant structure(plant mixtures) [7-9] of the forest fund in Azerbaijan, including the Great Caucasus was formed as a result of the human's expedient impact on forest cover for many years (to cut by selecting, grazing, fires and etc). The hornbeam, hornbeam-lime, hornbeam-oak (oak) structural forests formed in the places where the valuable beech forests were cut down for last 50-60 years, for100 years in some places of the Basqal, Topchu and Aghsu forest famings, such changes vibrate by 5-100 % in all the forest quarters situated on the Great Caucasus south-eastern slope. Having large ecological parameters (living ability)and adaptation opportunities of the hornbeam and other some trees, shrubs gives a chance to take the ecological voids in the places where the beech forests were cut down. Alternation of the leader-dominant plant by an artificial or natural method due to the biogeocenological laws causes all the structural change. We often meet this situation in the Great Caucasus south-eastern part. The reason is that the forests expose to anthropogenic pressures more intensively in comparison with the other forest zones of Azerbaijan [10, 11].

CONCLUSION

It was known as a result of the observations that the humus supply was 2,7 % at 0-20 cm layer in the brown maintain-forest soils in 2016 in comparison with 1996. But the difference was 0,72 % at 0-50 cm layer. It was seen 0,14 % at 0-100 cm stratum. The humus supply was 0,9 % at 0-20 cm layer in 2016 in comparison with 1996. 0,1 % reduction was observed at 0-50 cm stratum. The decrease is 0,2 % at 0-100 cm layer. The difference in the brown mountain-forest soils is 0,14 % for 1996. There is slight decrease of total nitrogen (0,06 %) in indices of 2016 in comparison with 1996. There is difference 3,7 of SAB at 0-20 cm layer in the brown mountain-forestsoils, an increase is observed. There is an increase at 0-50 cm stratum (i.e. difference is 1,7ekv/100 gr) A difference of SAB at 0-20 cm in the brown mountain-forest soils is 2,8. The difference of SAB is 2,4 at 0-50 cm layer.

The conceptual directions of realization of the timber soils monitoring, protection and restoration have been proposed on the basis of the ecological fertility models.

However restoration of the forest biogeocenoses, especially the beech and beech mixed forests is principally possible in the structure before the anthropogenic changes and especially in its natural-historical structures. Therefore the following terms are required: 1. Precision of the natural-historical borders of the beech forests by the scientific investigations and referendum; 2. To restore a natural structure of the beech forests by performing the forest farming works, cutting works by selection; planning; 3. Selection of the trees and shrubs characteristic for the beech and beech mixture forests during the forest restoration works. So, it is real to protect, restore and increase a forest cover with the rich structure of the Great Caucasus by compiling technical-project plans of the forest farming works based on these principles.

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ТҮЙІН

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ҮЛКЕН КАВКАЗДЫҢ ОҢТҮСТІК-ШЫҒЫС БӨЛІГІНДЕГІ ОРМАН ТОПЫРАҚТАРЫНЫҢ МОНИТОРИНГІСІ МЕН ҚҰНАРЛЫЛЫҚ КӨРСЕТКІШТЕРІ

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Үлкен Кавказдың оңтүстік-шығыс бөлігінде жүргізілген далалық және зертханалық зерттеулердің негізінде орман биогеоценоздарының құнарлылық жіне биоөнімділік көрсеткіштерін қалыптастыратын толық дамыған таулы-орманды құба және таулы-орманды қоңыр топырақтардың топырақ-экологиялық параметрлері анықталды. Осылардың негізінде мониторинг жүргізудің, орман топырақтарын қорғау және орманды қайта қалпына келтіру жұмыстарының концептуалды бағыттары ұсынылды.

Түйінді сөздер: шамшат, қызылқайың, емен, гумус, азот, таулы-орманды құба топырақтар.

РЕЗЮМЕ

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МОНИТОРИНГ И ПОКАЗАТЕЛИ ПЛОДОРОДИЯ ЛЕСНЫХ ПОЧВ ЮГО-ВОСТОЧНОЙ ЧАСТИ БОЛЬШОГО КАВКАЗА

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Выявлены почвенно-экологические параметры для полно развитых бурых горно-лесных и коричневых горно-лесных почв, формирующих показатели плодородия и биопродуктивности лесных биогеоценозов на основании полевых и лабораторных исследований, проведенных на юго-восточной части Большого Кавказа. И на этом основании были предложены концептуальные направления проведения мониторинга, охраны лесных почв и лесовосстановления.

Ключевые слова: бук, граб, дуб, гумус, азот, бурые горно-лесные почвы.