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Ecological Evaluation of the Ilisu Nature Reserve Soils in the Azerbaijan Republic

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Abstract

The humanity realizes a great significance of bio variety for the evaluation and preservation of the biosphere systems supporting life, is anxious with that bio variety essentially decreases as a result of some human activity kinds. It is necessary to foresee the possibility of the essential reduction or bio variety loss, to protect and remove its reason. Reserve of the biological variety remains one of the main directions in the nature reserve activity departments of the Azerbaijan Republic. As a result of the received measures the special guarding nature zones were extended, their area rises from 478 thousand hectares to the present 876 thousand hectares in 2003. At present this network consisting of 9 national parks, 11 nature reserves and 24 preserves occupies 10, 1 % of the country territory. We performed the researches in the Ilisu State Nature Reserve zone which is situated in the Gakh region on the south slope of the Great Caucasus province in the Republic. At this time the present soil-ecological condition from the Reserve zone, the reserve zone soil map was composed on the basis of the soil cover through investigation; evaluation of the investigative soils was performed by quality; and bonitet scale was established; the special appraisal scales according to the signs appearance degrees were composed for the zone soils; an ecological evaluation of the Ilisu State Reserve soils was conducted and ecological –appraisal map was composed. The consequence are presented the article.

Keywords

Ilisu State Reserve, Ecological Scale, Environment Factors, Mountain-Forest Brown Soils

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1. Introduction

The scientific theoretic and methodological bases of the soils ecological appraisal worked out by an academician G.Sh. Mammadov [12] at the beginnings of the 90th years in the XX century. The historical necessity of the new scientific direction establishment as an ecological estimation connected with the following reasons in Soil Science.

1 "Soil ecology" and "soils evaluation" scientific directions development and improvement took place, both scientific directions parallel developed for a long time, "soils ecological evaluation" scientific direction scientific theoretical bases and methodology were established in these two instruction joint at the beginning of the 90th years;

2 Setting up of the ecological problems connecting with the soil which is biosphere important content part in our republic as in the whole world and sharpening processes occurred since the second half of the XX century.

Because of the developing the researches in the field of the soils ecological estimation at the beginning of the XX century a need was created for the new principles and conceptions. In this connection a new conception of the appearance degree in the soil fertility and environment factors evaluating by scores was prepared and scales were composed in S.Z.Mammadova's [14] doctoral dissertation work. A new method was worked out, receiving a total scheme in soils ecological estimation, a total ecological score finding idea was proposed and a corresponding formula was

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suggested for soils ecological score calculation, using of the concrete numbers (score) but not from the notions (mean, high, good and so on) while evaluating the soil-ecological indications.

On the basis of this method S.Z. Mammadova [14] established the special evaluation scales due to the separate signs appearance degrees of the Lankaran province soils, performed the tea, grape and under grain soils ecological estimation and composed an ecological appraisal map on a scale 1:100000 in the Lankaran province soils, using from the indications expressed by score in the special appraisal scales due to the appreance degrees of the other soil characters not taken as a criterion and using of soils bonitet scores, soil and its fertility forming environment factors.

Protection of the natural ecosystems and biodiversity was one of the ecology present problems, organization of the control for the environment state, strengthening of the nature protective measures, preservation of the separate biosphere components, including forest cover and soils forming under it, establishment and intensifying of the biological potential require the scientific researches performing in the special protecting nature zones. The researches in this direction were fulfilled in the Hyrkan National Park by A.S.Orujov for the first time in our republic, present morphogenetic and bioecological characters of soils were defined, the evaluating scale of the appearance degree due to the soils inclination was offered, ecological evaluation in the zone soils was performed on the basis of the composed scales and an ecological appraisal map on a scale of 1:50000 on the basis of the contemporary computer technologies was composed [11].

The other researches work over an ecological appraisal of the special protective zones was performed by T.A. Kholina in the Turyanchay State Nature Reserve. The soil-ecological researches were conducted the landscape complexes were separated and ecological estimation of the natural landscape complexes was performed by researcher. For the first time the slopes exposition was received as an ecological factor, and ecological-appraisal map was composed, performing an ecological evaluation in the Turyanchay State Nature Reserve by taking into account the soil indications and environment factors. The works over an ecological evaluation in the Ilisu State Nature Reserve soils may be considered continuity of the researches carried out in this direction [13].

2. The Research Object

The research object is the Ilisu State Nature Reserve soils. A total area of the Reserve is 17382, 0 hectares.

3. The Work Method

G.Sh.Mammadov [12], D.S. Bulgakov [5], S.Z. Mammadova's [14] methods where used while performing the Ilisu State Nature Reserve soils estimation.

4. Analysis and Discussion

The researches over an ecological evaluation in the Ilisu State Nature Reserve soils were conducted with the following sequence over G.Sh. Mammadov's scheme of the method [12]:

1. Revealing and characterizing all the ecological factors influencing on soils the Ilisu State Nature Reserve;

2. Distinguishing of the soils stable diagnostic signs and changeable indications as appraisal criteria and correcting coefficients, the mathematics statistical analysis and correlated relation with the plant formation productivity;

3. Evaluation of the Ilisu State Nature Reserve soils performing establishing of the main bonitet scale, finding of the total bonitet scores by an application of the correcting coefficient; fulfilling of the soils agro industrial grouping a finding of the soils comparative worth coefficient;

4. Preparation of the special evaluating scales due to the soils separate signs appearance degrees paying attention to the plant formations ecological need of the alp and subalp meadow, mezophyl and xerophyl forests, steppe and semi desert and plain forests;

5. Preparation of the generalized ecological scale and ecological-appraisal map of the Ilisu State Nature Reserve.

During the soils ecological evaluation one of the most important elements is composition of the special evaluating scales due to the soil separate appearance degrees. It is evident that an ecological condition and state are thoroughly determined by a soils state.

In this connection a problem forming an ecological evaluating system, criteria an indications system which gives an opportunity for estimating the concrete ecosystem and biogeocenoz activity appears with its importance and urgency [6, 9].

Conducting of the soils ecological state analysis is important for correct identification of the separate factors role in some or other characters appearance of soils. Therefore it is possible to fulfill the measures over protections, improvement and rational use of the soil cover and to fulfill the works over soils evaluating.

The researches were performed on this method till S.Z. Mammadova's [14] new conception in the field of soils

ecological estimation. According to the method offered by S.Z. Mammadova [14] while some or other signs parameters of the soil and environment get an appraisal corresponding the plant ecological need, it is used from a score system but not the notions as an appraisal criterion, i.e. the plant attitude to any sign of the appearance degree is expressed by a score.

S.Z. Mammadova [14] summarized the ecological factors in two groups for expressing the appearance degree of the soil and environment signs by a score corresponding the plant ecological requirement:

1) the environment factors – height: rainfalls: Md index: ∑T>100C bioclimatic potential and so on:

2) the soil factors – bonitet scores calculated on the basis of soil main fertility indications: pH: salinization and water – resistant quantity and so on.

During our researches conducted in the area of the ecological evaluating the main plant formations extended in the zone were defined (alp and subalp meadow, mezophyl and xerophyl forests, steppe and semi desert plant and plain forests), according to the S.Z.Mamadova's [14] method the evaluating scales corresponding the separate signs appearance degrees in the Ilisu State Nature Reserve zone soils to the abovementioned plant formation ecological need were composed [2, 4, 10] (Table 1).

Table 1. Special evaluating scales due to the soils separate signs appearance degress in the Ilisu State Nature Reserve

Indications	Plant formations					
	Alp and subalp meadow	Mezophyl forests	Xerophyl forests	Steppe plant	Semidesrt plant	Plain forests
For the zone height (m)						
0-200	-	-	-	90	100	100
200-500	-	-	80	100	80	80
500-1000	-	80	100	80	-	-
1000-1500	80	100	90	-	-	-
1500-2000	100	100	60	-	-	-
2000-2500	100	80	-	-	-	-
For the temperature (^{0}C)						
12-14	-	-	-	90	100	100
10-12	70	80	100	100	90	100
8-10	100	100	90	70	60	80
6-8	100	90	70	50	-	-
4-6	80	70	50	-	-	-
2-4	60	-	-	-	-	-
For the rainfalls (mm)						
<200	-	-	-	60	80	80
200-300	-	-	-	80	90	90
300-500	-	-	50	90	100	100
500-700	50	50	80	100	100	100
700-1000	70	80	100	100	-	-
1000-1200	90	100	100	80	-	-
1200-1400	100	100	80	-	-	-
For the Md index						
>0,45	100	90	80	-	-	-
0,35-0,45	100	100	100	50	-	-
0,25-0,35	70	70	90	90	80	80
0,15-0,25	-	50	60	100	100	100
0,10-0,15	-	-	-	90	100	100
<0,10	-	-	-	60	70	70
For the pH degree						
4-5	80	80	50	50	-	50
5-6	90	100	80	80	70	80
6-7	100	100	100	100	100	100
7-8	80	80	90	90	100	90
8-9	60	60	70	80	80	70
For the granulometric structure						
20-30	95	95	90	90	80	90
30-40	100	100	100	100	100	100
40-50	80	90	100	100	100	100
50-60	70	80	80	90	90	80
60-70	50	60	70	70	70	60

Indications	Plant formations					
	Alp and subalp meadow	Mezophyl forests	Xerophyl forests	Steppe plant	Semidesrt plant	Plain forests
For the salinization degree						
<0,10	-	-	-	100	100	100
0,10-0,25	-	-	-	80	90	80
0,25-0,50	-	-	-	60	70	60
0,50-1,00	-	-	-	40	50	40
1,00-2,00	-	-	-	20	20	20
For the inclination$^{(0)}$ [13]						
0-3	100					
3-10	100-83					
10-15	83-70					
15-20	70-58					
20-25	58-45					
25-30	45-33					
30-35	33-20					

As is obvious from the table the indications gathered on the special evaluating scales that we have composed according to the soils separate signs appearance degrees can be divided into two groups:

1 The environment factors: height, inclination, temperature, rainfalls, Md index.

2 Soil factors: pH, granulometric content, salinization degree.

The special evaluating scales due to the separate signs appearance degrees in the Ilisu State Nature Reserve and Gakh State Nature Prohibition soils were used during the zone soils ecological condition evaluating.

While ecologically evaluating the Ilisu State Nature Reserve soils on the basis of the present state thoroughly, S.Z. Mammadova's [14] formula that is used for soils ecological scorers calculation. At this time some or other sign parameters of the soil get an appraisal expressed by a score, comparing with the special evaluating scales according to the same signs appearance degrees.

$$E_b = \frac{(m_1 + m_2 + m_3 + m_n ...) + B_b + (t_1 + t_2 + t_3 + t_n ...)}{S_n}$$

Here,

Eb – concrete soil ecological score:

m1, m2, m3, .mn - an indication expressed by a score of the enviroment factors participating in evaluating

Bb – a bonitet score found on the basis of the soil main diagnostic indications (humus, nitrogen, phosphorus, absorbed bases sum)

t1, t2, t3. tn - an index expressed by a score of the other soil factors participating in evaluating;

Sn – a quantity of the ecological appraisal criteria

While calculating the reserve and prohibition soils ecological scores, three groups of informations were used:

1 The environment factors which in the soil and its fertility form (height, inclination, temperature, rainfalls, Md index);

2 Bonitet scores found on the basis of the soils inside diagnostic parameters; (humus, nitrogen, phosphorus supply and absorbed bases sum);

3 Other soil indications not taken as criterion during the soils evaluating; (pH, granulometric content, salinization degree).

Using of each three-group indices we found the ecological appraisals concerning the ecological need of the main plant formations in the Ilisu State Nature Reserve soils extended in the zone. The Ilisu State Nature Reserve soil-cover ecological-appraisal map (1:50000 scaled) was composed as a result of the carried out researches [16]. 13 types and subtypes due to the different regional zone extended in the zone is obvious from the man legend. 9 of them concern the mountain-meadow, middle and low mountainous forest soils of the high upland, 4 concern the steppe and interzonal soils of the foothill and plain zone. Initially, the bonitet scores were found on the basis of these soils fertility indications, at this time the leached mountain forest brown soils possessing the highest fertility was taken as a standard soil for the upland zone, but the mountain grey-brown soils were taken for foothill-plain zone (100 scores) [1,3,7,8,15].

While paying attention to an ecological appraisal scale of the Leached Soddy mountain-meadow soils we see an optimum state of many environment and soil parameters, only high inclination of the slopes (45 scores) and being low of the average yearly temperature (80 scores) participates as a limiting factor (Table 2).

Table 2. Estimation of ecological condition of the soils in Ilisu State Nature Reserve

Names of the soils	Height,m	Inclination,^{0C}	Temperature,^{0}C	Rainfalls, mm	Md	Bonitet mark	pH	<0,01 mm, %	Dry remnant, %	Ecological mark
Mountain-meadow soils of the high upland and and forestry soils of the midlle and low upland										
Leached soddy mountain-meadow	2000-2500 100	20-25 45	4,8 80	1200-1300 100	0,45-0.55 100	87	6,7100	30,01100	---	90
Leached mountain-forestry brown	2000-2500 80	20-25 45	5,7 70	1000-1200 100	0,45-0.50 90	100	6,1100	37,2100	---	86
Typical mountain-forestry brown	1500-2000 100	16-20 58	6,5 90	1000-1200 100	0,45-0.50 90	94	6,6100	40,32100	---	92
Carbonatic mountain-forestry brown	1300-1700 100	14-18 65	6,5 90	800-1000 80	0,35-0,45 100	91	7,4 80	42,54 90	---	88
Steppe carbonatic mountain brown	1000-1500 100	14-18 65	8,5 100	600-900 80	0,35-0,45 100	72	7,5 80	45,18 90	---	86
Leached mountain forestry brown	1000-1500 90	10-15 70	8,5 90	600-800 100	0,25-0,35 90	91	6,9 100	40,0 100	---	91
Typical mountain-forestry brown	1000-1200 90	10-15 70	10,4 100	600-800 100	0,25-0,35 90	87	7,0 100	43,16 100	---	92
Carbonatic mountain-forestry brown	800-1000 100	10-15 70	10,4 100	600-800 100	0,25-0,30 80	85	7,4 90	50,81 80	---	91
Steppe carbonatic mountain-brown	500-900 100	8-10 83	10,4 100	400-650 80	0,20-0,25 80	69	7,5 90	52,17 90	---	85
Steppe and interzonal soils of the foothill and plain zone										
Mountain grey-brown	400-650 100	8-10 83	11,8 100	400-500 100	0,15-0,25 100	100	7,9 90	52,17 90	0,15 80	94
Grey-brown	400-650 100	5-7 87	13,2 90	300-350 80	0,15-0,20 100	86	8,2 80	54,91 90	0,27 60	88
Carbonatic meadow-forestry	150-300 100	1-3 100	14,1 100	240-260 90	0,10-0,15 100	80	7,5 90	31,48 100	0,21 80	93
Alluvial-meadow	150-200 100	1-3 100	14,1 100	240-260 90	0,10-0,15 100	72	7,5 90	37,92 100	0,34 70	91

While paying attention to the leached mountain-forest brown soils ecological scale, we see that being lower of all the environment factors than optimum (except the rainfall quantity) (height 80 scores, inclination - 45 scores, temperature - 70 scores, Md index - 90 scores) caused decreasing of the ecological score - 86 scores.

An observation of the same tendency in the typical and carbonatic mountain-forest brown soils is seen: the soil indications of these soils are in optimal level (100 scores), unsatisfactory of the environment indices (45-90 scores) caused descending of these soils ecological score in comparison with the bonitet score: typical mountain-forest brown soils (bonitet score - 94, ecological score - 92) and carbonatic mountain-forest brown soils (bonitet score - 91, ecological score - 88 scores).

In the steppe mountain brown soils the height, temperature and Md index from the environment factors are in an optimum level, here inclination (65 scores), rainfalls quantity (80 scores) and all the soils indices are lower than optimum - a bonitet score - 72 scores, pH index - 80 scores, a granulometric content - 90 scores, as a result the soil ecological score - 86 scores.

While paying attention to the extended mountain-forest brown soils ecological parameters the enough difference over subtypes is seen. The bonitet scores of the Leached and typical mountain-forest brown soils were high, pH index and granulometric structure are in an optimum level - 100 scores. The soils inclination (70 scores), height (90 scores) and Md index (90 scores) don't correspond the ecological requirement of the extended xerophyl forest in this zone.

The height and temperature indications are in optimum level for the carbonatic mountain-forest brown and steppe mountain-brown soils (100 scores), being 80 scores of Md index shows aridity process in the zone where these soils extend. Being heavy of the granulometric structure (80 scores) and pH index (90 scores) in the these soils participates a limiting factor. As a result of the ecological condition complex evaluating the mountain-forest brown soils bonitet scores (69-91 scores) rises enoughly and the total ecological scores were 85-92 scores.

All the environment indications are in an optimum level (except the slope inclination - 83 scores) for the extended mountain grey-brown soils at the foothill zone of the Ilisu State Nature Reserve, but being lower of all the soil indications than optimum - pH index (90 scores), granulometric structure (90 scores) and salinization signs decreased these soils ecological score being distinguished as a standard for this zone (94 scores).

The height from the environment factors and Md index are optimum for grey-brown soils (100 scores), the slopes

inclination (87 scores), the zone average yearly temperature (90 scores) and the rainfalls quantity (80 scores) are unsatisfactory. All the soil indices of these soils are lower than optimum-bonitet score (86 score), pH index (80 scores), granulometric structure (90 scores) and dry residue quantity (60 scores). A total ecological score of grey-brown soils slightly rises and forms (88 scores).

The environment factors are in an optimum level for the carbonatic meadow-forest and alluvial-meadow soils in the plain zone (except the rainfalls quantity - 90 scores); a granulometric structure from the soil parameters corresponds the optimum, pH index (90 scores) and dry residue quantity (70-80 scores) participates a limiting factor. As a result of the ecological condition complex evaluating the high scores got over the environment and soil indications enoughly rised a total ecological score of the interzonal soils (bonitet scores 72-80 scores).

5. Conclusions

1. A main bonitet scale was composed, performing the soils evaluation by quality on the basis of the present soil-ecological condition investigation in the Ilisu State Nature Reserve as a result of the literature, fund materials and personal researches consequences and analysis; the other soils bonitet scores were identified as compared with them, being distinguished mountain-grey brown soils as a standard for the foothill-plain zone, and the leached mountain-forest brown soils for mean Low upland zone, mountain-meadow for the high mountainous zone.

2. According to the evaluation works result the bonitet scores of the high and mean upland zone soils as high fertile soils change by 85-94, in this area only steppe mountain-brown soils possess comparatively (69-72 scores). The bonitet scores of the foothill and zone soils enoughly change by 72-100 scores.

3. As a result of the researches, possessing of high inclination the slopes in all the upland zone soils from the Ilisu State Nature Reserve (45-70 scores), low temperature for high and mean mountainous zone (70-90 scores), not enough rainfalls for the mezophyl forests zone (80 scores), participation of the height indices (90 scores) for the xerophyl forests zone and climate aridity (80-90 scores) as a limiting factor was determined. Being a limiting factor of the rainfalls quantity (80 scores), ph index (90 scores), dry residue quantity (70-80 scores) for the steppe plant and lowland forests was defined in the foothill and plain soils.

4. The mountain grey-brown (94 scores) and carbonate meadow-forest (93 scores) soils got the highest scores ecologically i the zone of the Ilisu State Nature Reserve.

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