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Evaluation of the Irrigative Soils Ecological State in the Garabagh Plain from the Azerbaijan Republic

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Abstract
The irrigative soils fertility is identified by a human productive activity to a considerable extent. In connection with the intensive use of these lands in agriculture, without a necessary attention to the soil fertility reproduction was revealed tendency for their productive ability reduction. The ecological condition of soils which are commonly contaminated with the different xenobiotics significantly changed. All the indicating occurrences are unlikely revealed in the different regions of the republic in connection with the variety of lytological-geomorphological, hydrochemical and other peculiarities from the natural situations. It requires definite differentiation of the economical activities, because this wholly considered soils regional characteristics and was directed to the rational use of their potential fertility. The research consequences in a direction of the ecological evaluation in the Garabagh plain irrigative soils were reflected in the presented article. Initially, a present soil-ecological condition of the investigative region was learnt, the bonitet scores of the Garabagh plain soils of the Azerbaijan Republic were defined. The main limiting factors were determined for the different agricultural plants being grown in the zone soils at the following period, the ecological value scales were used for it. At last the soil subtypes fit for agriculture were ecologically defined performing an ecological evaluation of the Garabagh plain soils.

1. Introduction

The Azerbaijan Nature scientists paid a great attention to the problems settlement in connection with the soil ecology, especially from beginning of the 90th years of the last century Mammadov's researches are notable in this field. In Mammadov's (1998) researches the soils ecological evaluation was formed as a present (new) scientific direction and it connected with the composition of the ecological appraisal for the first periods. The soils ecological appraisal maps composed for this period differed from the previous soil maps by focusing the soils ecological characters or some or other information related to the soil ecology on itself. At this time a complex approach method was applied in ecological resources estimation and this made an opportunity to differentiate the zones possessing identical lythological, geomorphological structure, soil cover, climatical condition in the ecological appraisal maps.

It is evident that an ecological condition and situation are determined by a soil state. In this connection the criteria which give a chance to evaluate a concrete ecosystem and biogeocenoz activity and a problem that forms an indications system, ecological estimating system appear with their importance and urgency (Mammadov, 1992). At this

period the soils ecological evaluation was performed by the separate ecological scales informing on the separate parameters of the ecological situation in differential level. These ecological scales characterize the soil formation condition and the soil cover fitness for some or other purposes. The information is given about soil relief, geology, soilforming rocks, hydrological state, plant and soil cover, climatic condition and others as a base in such scales composition. While improving soils and preparing the use measures from them rationally it is important to know an ecological condition with some factors (relief, climate, hydrology, plant cover, geology, geomorphology, soilforming rocks, human economical activity and soon). At this time the different ecological factors are prevailed depending on researches purpose.

The climate factors being considered important natural resources among the ecological factors occupy a significant place, appraising the climate from potential opportunities standpoint assumes a great importance for agriculture and forestry. The sun energy potential, air motion, moisture supply being used in a man's economical activity are concerned them. The climatical elements being used in biomass creation by plant organisms are concerned the agroclimatical resources.

The most important gradation possesses soil cover in the ecological scales. It is known that it reacts to each mutability of the soilforming factors with the sensitivity, but natural soil zones reflect an ecological condition of the same region in itself (Vinokurov, Alijanova, 2010). The composed ecological scales give a chance to imagine a life condition in soil as a common system. At this time two purposes are achieved: soilforming condition of each soil is compared and the soil ecological condition is defined in the soil zone.

In order to increase the ecological scales significance it is necessary to enrich their gradations with the physico-chemical indications. These indications are usually distinguished according to the definite ecological condition(Plekhanov,1999). For evaluating of the Azerbaijan soils ecological condition the height and relief elements (inclination), rainfalls (humidity), temperature, humus, total nitrogen and phosphorus quantity,a sum of the absorbed bases, salinization and solonetzification degree eroded level, granulometric composition(<0,01mm and >0,25mm particles quantity) concern the distinguished indications. But during the researches we should take into account that a factual expression of the different factors can't identically be explained in regard for some or other plant from ecological point of view. For example, salinization degree to the same quantity effects on plants development differently depending on humidity, soil granulometric composition and other factors. The ecological scales give a chance to explain a role of the environment separate factors more exactly.

The environment ecological factors give comparative value of the condition grounding on its objective indications, simplify the zone ecological analysis. The consequences of some scientists' long researches are reflected in the ecological scales, a young soil scientist can even give a correct and detailed ecological character of the definite zone on the basis of these scales (Yusifova and Nuriyeva, 2013).

From time to time an influence of the soils separate characters on ecological appraisal wasn't only in a form of correction coefficients (salinization, solonetzification, eroding, according to granulometric composition, soft layer thickness and so on), but also was presented in the special small scales composed according to the appearance degree of some or other traces in soils quality.

2. Materials and Methods

The Garabagh plain soils are taken as a research object. The research object area is 301 thousand hectares.

For fulfillment of the problems on investigation of soil cover the field soil researches were performed on the investigated territory in 2012-2013 years, 50 soil sections were applied, the materials of the soil investigations which were fulfilled by the specialists of the Azerbaijan State Scientific-research Institute on Landstructure (320 sections)were generalized.

The physico-chemical analyses being taken from soil samples are performed on the following method; G.Sh. Mammadov (1992), D. S. Bulgakov (1999, 2002), S.Z. Mammadova's (2005) methods were used while conducting an ecological evaluation of the Garabagh plain soils.

3. Analysis and Discussion

Using of the notable scientists' research consequences, reference and fund materials the indications that characterize a quality of soils were collected in a form of some little scales and according to the appearance degree of the soils separate signs were named special evaluating scales by Mammadov (1992) for the first time in the Republic. While appraising the soil and environment signs for the appearance degreesMammadov (1992) and other researchers (Kirushin, 1996, Kuziev, 1994). used from the notions expressing the quality as an appraisal criterion ("high", "average", "low"). A new system in connection with the ecology science development at the beginning of the XXI century, was offered by Mammadova (2005). In this system the parameters of some or other traces in soil got a real appraisal according to the plant ecological requirement and the plant regard for the correspondence degree of the plant same sign is expressed by a score. Mammadova(2005) performed her researches in the Lankaran province agrocenozes and distributed the ecological factors into two groups into two groups corresponding to the tea, grape and grainplantecological need because of expressing an appearance degree of the environment indications by a score.

1) the environment factors – height; rainfalls; Md index; $\sum T > 10^0 S$ bioclimate potential;
2) soil factors – bonitet scores calculated on the basis of the soils main fertility parameters, pH, a quantity of

salinization and water – resistant aggregates.

A brief content of the works total being performed in this field is presented in this article because our researches are in a direction of ecological evaluation on the basis of the present soil – ecological character in the Garabagh plain irrigative soils.

The Garabagh plain is situated in the west part of the Kur-Araz lowland and general inclination directs from west towards East. A height of the foothill part is 500 m, the south-eastern part is below sea-level. A plain climate is moderate warm and arid subtropic. The following soil types spreadedin the Garabagh plain according to Babayev (1967,1984), Asgarova (1990), Nuriyeva(1994) and others' researchers (Nuriyeva,2007, Yusifova and Nuriyeva, 2014, Registrion of the soil cover in the Garabaghsteppe,2010): mountain-grey-brown, grey-brown, grey-meadow, meadow-grey soils.

Mountain grey-brown soils extend on a low boundary of the xerophyl forest lands and shrubbery places at a height of 250-500 metres on a foothill part of the Garabagh plain. The relief is in a form of transition from a low upland alluvial-prolluvial plain and is relatively smoothed. Here, the extended delluvial and prolluvial soft rocks are in a loessial form. The wormwood formation type prevails in vegetation. Tick, mean thick and fine varieties are found among mountain grey-brown soils. Dark, ordinary and light subtypes of the mountain-grey-brown soils spread in the zone. The ploughlayer is in a weak dusty and tightened state, distinct differentiation is observed in the cultivating soils. High tension of the biological processes, high calcareous, existence of carbonatic alluvial layer at 30-60 centimetres depth, density and solonetzification indications, skeletalness, gypsumness are characteristic indications for these soils. As is obvious from Table 1, the humus supply was 3,07-4,64% collecting on the upper A horizon. In the mountain grey-brown soils cultured kinds humus gradual reduction is observed while increasing the depth. Its quantity forms 1,82-2,13% at one-metre depth.

Table 1. *Fertility characteristics of soils of the Garabagh plain*

Soils	Humus,%			Nitrogen,%		Phosphorus,%		Adsorbed bases, meq/ 100 g	
	0-20	0-50	0-100	0-20	0-50	0-20	0-50	0-20	0-50
Dark mountain grey-brown	4,64	3,89	2,18	0,22	0,18	0,19	0,17	35,07	33,26
Ordinary mountain grey-brown	3,07	2,40	1,82	0,18	0,15	0,16	0,14	33,19	31,88
Light mountain grey-brown	1,92	1,54	1,13	0,15	0,12	0,16	0,14	29,55	28,89
Dark grey-brown	4,39	3,57	2,04	0,21	0,17	0,17	0,16	30,34	31,02
Ordinary grey-brown	3,00	2,44	1,64	0,16	0,13	0,17	0,15	26,78	27,29
Light grey-brown	1,80	1,45	1,10	0,12	0,11	0,14	0,12	24,79	26,27
Meadow grey-brown	3,10	2,29	1.75	0.16	0.13	0.20	0.17	30.49	31.16
Ordinarygrey-meadow	2,38	1,87	1.31	0.16	0.13	0,18	0,16	28,89	28,23
Light grey- meadow	1,51	1,22	0.97	0,12	0,10	0,17	0,15	25,59	26,71

Humin acids prevails in humus content. The most quantity of carbonates is found on the profile middle layer.

The mechanical composition of these soils is heavy clayey and light loamy. A quantity of < 0,01 mm particals is 57,3-58,8%. Collection of the silt particals on the upper and middle horizons is observed. These soils are wholly saturated with the absorbed bases (33,19-35,07 mg.ekv). The absorbed Ca quantity changes at 17-24 mg.ekv. limits. Na quantity rises in the solonetzificated variety while increasing the depth. pH index indicates the soil environment being alkaline property (pH-7,9-8,0).

The grey-brown soils widely extend in the Garabagh arid, subtropic plain. These soils develop under steppe wormwood-ephemer formation plants, on the delluvial-prolluvial carbonatic loessial loamy under moderate-warm climate. The grey-brown soils were cultivated being used widely under irrigative plants. These soils morphological profile were well differentiated over the genetic horizons. The upper horizon possesses powdery-granular structure but the lower layer have granular-heaplike structure. The upper horizon structure of the ancient irrigated grey-brown soils disturbed and hardened, humus, nitrogen supply and carbonates were leached towards lower layers under influence of the long watering. The humus quantity in the grey-brown soils is 4,0-4,5% at 0-20 cm of the dark subtype; 1,80-2,0% in the light subtype, but humus supply is 221-275 t/h at one meters of layer. The total nitrogen quantity is 0,16-0,21% on the upper layer, it reduces towards lower horizons. These soils are high carbonatic and form 11,22-12,61% at 0-100 cm of layer.

The carbonates maximum quantity was observed on B-horizon in the irrigative grey-brown soils, but on C-horizon in the ancient irrigative soils. These soils are gleyey and heavy loamy for the granulometric structure analyze. The most quantity of the physical clay and silt particals was observed on illuvial horizon and this is connected with the gleying process. The silt fraction in the ancient irrigative grey-brown soils collects on the deepest horizons. The upper layer possesses a high density in the cotton areas, the porosity is 50%. These soils absorbing capacity is 26,7-30,34 mg.ekv. on the upper layers. The absorbing capacity rises in the ancient irrigative grey-brown soils. The absorbed Na^+ quantity rises – 10-12% in these soils solonetzificated types. The solonetzificated evident signs appear in the light grey-brown soils. The environment reaction is alkaline characteristic in the grey-brown soils: pH 8,1-8,2. The dark and ordinary subtypes of the grey-brown soils aren't salinized, dry residue quantity in the light grey-brown soils is slight: 0,10-0,14% . Towards lower layers a quantity of the salts soluble in water increases at the expense of sulphates: 0,20%.

The grey-meadow soils. The subsoil waters level is 160-

280 cm in the irrigative grey-brown soils. At present soilforming process goes under an effect of subsoil waters here. These soils extend in foothill sloping delluvial-prolluvial and valley alluvial plain from geomorphological point of view. The ordinary and light subtypes spread in the grey-meadow soils. These soils are intensively used in agriculture, all the soils are irrigated, a main agricultural direction is cotton-growing.

The profile upper layer in the grey-meadow soils is light-grey coloured and boiling is observed under an influence of chloride acid. Towards lower layers the colour becomes dark, structure is heaplike –granular, towards the depth humidity rises, the structure disturbs, density, manycarbonatic spots are found. The humus quantity is 2-2,4% on upper layer in the grey-meadow soils, the humus quantity rises from new irrigative soils to ancient irrigative soils. These soils are carbonatic and their quantity changes at 10-12% of limits. The absorbing capacity is enough high and it is 25,59-28,81 mg.ekv. on upper horizons. Ca: Mg ratio is very little in the irrigative soils in comparison with the virgin soils. Na^+ quantity in the new cultivated soils rises after 30-40 cm, this is a reason for soils solonetzificating by increasing alkalinity.

The grey-meadow soil irrigative types aren't salinized from surface 0,18%. The dry residue quantity in the light grey-meadow soils is a little more: 0,26%. The deep salinized types are found among these soils. Generally salinized and solonetzificated types of the grey-meadow soils extend in the zone. The irrigative grey-meadow soils are rich in nutrient. The granulometric structure is light clayey and loamy, a quantity of <0,01mmparticals is 55,53-57,12% at 0-100 cm of depth, a maximal quantity of the silt particals are found at 40-60 cm of depth. Water-resistant aggregates quantity reduces at 25-45cm of depth. The plough layer hardening and densing occurs under irrigative waters effect, common porosity is correspondingly low.

As is commented above an ecological evaluating was performed on the basis of the corresponding method by applying special appraisal scales according to the appearance degrees of the soils separate signs (Nuriyeva, 2007) (Table 2), conducting mathematic-statistical scientific analysis and the last research materials over soil, climate and relief indications in the Garabagh plain irrigative soils.

As is obvious from Table 3, eight types and subtypes of the irrigative soils extend in the investigative zone. The bonitet scores were found on the basis of these soils fertility indications (Mammadov and others, 1997), at this time the dark mountain grey-brown soils possessing the highest fertility were taken as a standard soil-(100 scores). These soils ecological score descended under the environment factors (94 scores) effect. The height indications as main limiting factors (80 scores) and rainfalls participate (90 scores). A sum of the active temperatures pH index and dry residue quantity are in the optimal level for these soils (100 scores). Generally, the dark mountain grey-brown (94 scores) and dark grey-brown (91 scores) soils got the highest ecological score over the zone. Though the bonitet scores of the ordinary mountain grey-brown and grey-brown soils are 82 and 76 scores a total score rises (93 and 90 scores) because of being high of these soils ecological score over the environment factors and other soil indications.

Table 2. *Special appraisal scales*

pH

Characteristic	Evaluation, grade
6,0-6,5	70
6,5-7,0	80
7,0-7,5	100
7,5-8,0	100
8,0-8,5	100
8,5-9,0	80

Dry residue, %

Characteristic	Evaluation, grade
<0,10	100
0,10-0,25	90
0,25-0,50	80
0,50-1,00	60
1,00-2,00	20

Soil texture (particles <0.01 mm, %)

Characteristic	Evaluation, grade
20-30	70
30-40	90
40-50	100
50-60	80

Sum of temperatures >10°C

Characteristic	Evaluation, grade
< 2000	<50
2000-3000	80
3000-4000	90
4000-5000	100

$CaCO_3$ content, %

Characteristic	Evaluation, grade
5-10	70
10-15	90
15-20	100
20-25	100
25-30	95

Height, m a.s.l.

Characteristic	Evaluation, grade
1000-1500	20
500-1000	40
200-500	80
>28-200	100

Precipitation, mm

Characteristic	Evaluation, grade
<200	<30
200-300	70
300-500	90
500-700	100
700-1200	85

Md index

Characteristic	Evaluation, grade
<0,10	<50
0,10-0,25	80
0,15-0,25	100
0,25-0,35	100
0,35-0,45	70

Such tendency is observed in other soils. Though light mountain grey-brown and ordinary grey-meadow soils bonitet score is at a mean level (63 and 71 scores) the high ecological scores being got over the environment and soil indications rise a total ecological scores of these soils (90 scores). As is obvious from the table the light grey-brown and light grey-meadow soils got the lowest bonitet scores over the zone (58 and 57 scores). The bonitet score rises 20 scores as a result of the ecological condition complex evaluation and was accordingly 89 and 87 scores. It was determined as a result of the researches that the main limiting factors for the plain irrigative grey-brown and grey-meadow soils are the followings: from the climate indications: a rainfall quantity (90 scores), and the climate dryness (Md parameter- 80 scores), from soil indications: a heavy granulometric content (90 scores), and plain soils salinization (80 scores). Heat provision and pH appraisal (100 scores) are considered the optimal height indications for these soils. The height parameters (80 scores), rainfalls quantity (90 scores) and carbonates quantity (90 scores) are limiting factor for the foothill zone soils. The humid indication (Md), $>10^0$C active temperatures sum, soil solution reaction and dry residue quantity (100 scores) are optimal indications for these soils.

Table 3. *Ecological estimation of the Garabagh plain soils*

Name of soils	Height,m	Precipitation, mm	∑t>10^0C	Md	Bonitet mark of soil	<0,01 mm,%	pH	$CaC0_3$,%	Dry residue, %	Ecological mark
Dark mountain grey-brown	500 80	458 90	0,15 100	4000 100	100	57,3 90	7,9 100	13,47 90	___ 100	94
Ordinary mountain grey-brown	500 80	450 90	0,15 100	4000 100	82	58,8 90	8,0 100	17,30 100	_-_ 100	93
Light mountain grey-brown	300 80	450 90	0,15 100	4000 100	63	57,12 90	8,0 100	14,55 90	0,06 100	90
Dark grey-brown	300 80	410 90	0,10 80	4200 100	92	58,24 90	8,1 100	12,61 90	0,08 100	91
Ordinary grey-brown	200 100	410 90	0,10 80	4200 100	76	60,08 80	8,1 100	11,84 90	0,10 100	90
Light grey-brown	200 100	410 90	0,10 80	4200 100	58	59,36 90	8,2 100	11,22 90	0,14 90	89
Ordinarygrey-meadow	100 100	329 90	0,10 80	4400 100	71	57,12 90	8,3 100	10,05 90	0,18 90	90
Light grey-meadow	50 100	329 90	0,10 80	4460 100	57	55,53 90	8,4 100	12,21 90	0,26 80	87

4. Conclusion

1. A main bonitet scale was composed by performing of the Garabagh plain soils evaluation by quality on the basis of present soil-ecological condition studying in the investigative zone as a result of generalization and analysis of the literature and fund materials; as a result the zone soils bonitet scale was established: the soils having the highest fertility are dark mountain grey-brown soils (100 scores), enough fertile soils are dark grey-brown (92 scores) and ordinary mountain grey-brown (82 scores) soils. The least fertile soils are light grey-brown (58 scores) and light grey-meadow (57 scores) soils.

2. The main limiting factors were defined for the zone soils as a result of the researches: climate dryness, (Md indication-80 scores), heavy granulometric composition and soils salinization (80 scores), for the foothill part: height parameters (80 scores). The Garabagh plain soils evaluation was performed using from the ecological appraisal scales and conducting scientific analyses of all the collected research materials. It was determined that the best soils of the Garabagh plain are ecologically dark mountain grey-brown (94 scores) and dark grey-brown (93 scores) soils.

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