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Contemporary Fertility Character of the Guba- Khachmaz Zone Mountain-Forest Brown Soils in the Azerbaijan Republic

Sh. Z. Jafarova*

Institute of Soil Science, Agrochemistry of ANAS, Baku, Azerbaijan

Abstract

Our researches were performed in the Guba-Khachmaz zone of the Azerbaijan Republic. The favourable natural-climatically and social-economical peculiarities are characterized for this territory: proximity of the industry and transportable developed cities, such as Baku, Sumgait, Darband creates overall favourable conditions for agricultural development. The Guba-Khachmaz zone is one of the large agricultural regions in the Azerbaijan Republic. The soils from this zone are mainly used in horticulture, vegetable-growing, grain-growing, viticulture and stock-breeding.The arable soils occupy 12,2% of the total area or 26,8% from an area of the agricultural lands. These soils are mainly used under the vegetable and grain cultures.As a result of the conducted soil researches in the Guba-Khachmaz zone it was established that the types, subtypes and diversities in the mountain-forest, mountain-steppe and arid steppe zone soils extended corresponding to the vertical zonality law inside the zone. The stepped mountain-brown soils in the mountain- steppe zone possess high fertility (humus quantity 4,45- 6,18%) and are used under agricultural plants (fruit plants, grain, vegetable and so on).

Keywords

Guba-KhachmazZone, Mountain-Forest Brown Soils, Humus, Physico-Chemical Indicators

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1. Research Object and Method

As a research object the mountain- forest brown soils in the Great Caucasus north-eastern slope were taken. A total area forms 184514 hectares. For defining a present fertility level of soils, 35 soil sections were put in the investigative zone. The physic- chemical analyses over the following methods of the soil samples being taken during the field soil researches were performed: a granulometric composition by Kachinsky; by a hygroscopic humidity- thermical method; constant water weight by D.I.Ivanov′s method; total humus by I.V.Tyurin′s method; total nitrogen by Kyeldal′s method; the environment reaction – pH by metre; calcareous by calcimetre.

2. Analysis and Discussion

The Guba-Khachmaz zone is situated in the north- eastern part of the republic, it borders on Dagistan from north-west, on Main Caucasus range from south- west, on the Caspean Sea from east. This region forms 6965000 hectares. of the total area surrounding Guba, Gusar, Davachi, Siyazan and Khachmaz regions. The relief being mountainous from south and west occupies a north- east slope of the Main Caucasus range and south- eastern part of the side range. The Shahdag summit is considered the highest summit (4252 m) in north-west, Beshbarmag mountain (800 m) is the highest summit in north-east. The canyons, watersheds, plateaus, inter mountain hollows, landslides and collapses widely extended in the zone. The Guba-Gusar inclined plain is at a height of 250-

* Corresponding author
E-mail address: shahla.jafarova@yandex.ru

600 m and decreases towards east- the Caspean Sea. A relief of this part gradually falls down and joins the seashore plain covered by the Caspean Sea ancient deposits. The soilforming rocks consists of the third, fourth period and ancient deposits of the Caspean Sea.

The region climate is moderate warm in the plain and foothill part, in the high mountainous zones its cold and the summer is moderate warm and dry in the Samur-Davachi plain and semidesertand arid steppe climatic condition is dominant. The vertical zonality is noticeable on the plant cover depending on the relief and climate condition in the region. The alpine and subalpine meadows are formed in the high mountainous zones, the broad- leaved forests in the middle and low uplands, steppe grass plants xerophite forest-bushes at the foot. The steppe plants, semi- desert plants extend in the Guba-Gusar inclined plain, the saline; semi-desert and boggy plants in the seashore plain.

A main part of the soil resources in the region is 4626000 hectares (66,4%) and it is situated in the upland zones. 42,3% of the total soil fund in the region consist of mountain-forest soils. Here the brown mountain-forest and steppe brown mountain-forest soils form 61,2% of the forest fund soils, brown mountain-forest soils are 37,3%. Recently, Extending of the unforested zone borders causes widening of erosion and torrent phenomenon. The mountain-grey-brown soils being used widely in a development of fruit- growing, horticulture, grain-growing form 3,0% of the soil fund. The meadow- brown and grey- brown soils being used under fruit- growing and grain- crops form 15,0% of the total soil fund. The Tugay forests occupy 6,1%- 44000 hectares of the zone.

Brown soils zone under the middle and low upland xerophyle forests. The mountain-forest brown soils extend between mountain-forest brown and mountain- steppe soil zones at 400-1200 m above sea-level, in the Guba-Khachmaz zone middle and low mountainous parts, low forest zone. The spreading areal of these soils on the north-eastern slope of these soils on the north-eastern slope of the Great Caucasus extends from north-west to south-east and east. The mountain- forest brown soils are formed under a warmer and dryer climatic condition, xerophyle oak forests, bushes diverse grass [9,1,2]. These soils develop on the carbonatic clays weathering rocks of the paleogenic period, the carbonatic sandstones of the jura period develop on lime-stone and mergels.

H.A.Aliyev[6] separated the brown soils type developed on the clayey schists and other rocks in the forest zone dry parts on the east and north- eastern slopes of the Great Caucasus. Spreading of the following subtypes in the mountain- forest brown soils inside Guba-Khachmazzone was specified: leached, typical and carbonatic mountain brown soils.

2.1. Leached Mountain- Forest Brown Soils

The leached mountain- forest brown soils are formed on upper parts of the low mountainous zone in Guba-Khachmaz, at a height of 800- 1200 m on the north and north- eastern slopes, under the oak- hornbeam mezophyl forests. A total area is 114551 hectares. These soils border on mountain-forest brown soils from the top upon typical mountain-forest brown soils from the bottom. The mountain- forest brown soils are mainly created on carbonatic clays at the paleogen period, on weathering products of limestone and marls at the chalk period.

The main genetical peculiarities of the leached mountain-forest brown soils are this: preserving the main characters of the brown forest soils, collecting carbonates on the illuvial part meddle part (B and BC layer), an accumulative- humus stratum in a tautened state, collecting the high molecular substances on the mean and low part of the profile, humus and nutrient in a high quantity, graying and hardening the profile in connection with the leaching process [16].

The humus quantity was high in the mountain-forest brown soils under an influence of the shattering products in the oak-horn-beam forests organic residues: 2,94- 5,76% the humus quantity was 1,85- 3,09% at 1- metre layer reducing along the profile. The total nitrogen quantity is accordingly 0,16- 0,7% on upper stratum (0-20 cm), decreases towards low horizons 0,4- 0,25%. Gathering of carbonates on the low horizons by leaching from the upper layers neutralized a soil solution reaction at one-metre stratum in these soils: 7,1- 7,4.

The leached mountain-forest soils possess heavy loamy and clayey mechanical composition according to the analysis consequences of the soil sections being taken from the research objects; a quantity of <0,01 mm of particals at 0-100 cm of layer is 28,23- 59,44%, but the silt particals quantity forms 9,51-23,74%. The physical clay collection is observed on the profile middle part.

These soils possess a high absorption capacity according to the carbonates distribution character and other pecularities; the absorbed bases number is 29,20- 39,16 mg-ekv at 0-20 cm of layer, 28,38- 35,93 mg-ekv at 0-50 cm of layer. Ca^{2+}cations in a composition of the absorbed bases change 30-35 mg-ekv, Mg^{2+}cations change in a number of 3-7 mg-ekv. H^{+}cationsisn′t [5]. Na^{+}cations number is 0,3-0,mg-ekv. The soil solution reaction is a neutral characteristics: 7,1-7,4 (Table 1).

Table 1. Physico-chemical indications of the Guba- Khachmaz zone mountain-forest brown soils.

Soil characteristics	leached mountain-forest brown		typical mountain-forest brown		carbonatic mountain forest -brown	
	İnterval	M	İnterval	M	İnterval	M
Particle size data (%)						
0–100 cm						
<0.01 mm	28,23-59,44	50,15	29,71-62,39	55,21	31,06-61,85	55,80
<0.001 mm	9,51-23,74	15,80	11,48-25,10	20,32	15,83-28,70	22,03
Humus, %, 0-20 cm	2,94-5,76	4,26	3,16-6,18	4,65	2,78-5,51	7,25
0- 50 cm	2,15-3,59	2,81	2,38-3,97	3,06	2,07-3,39	2,61
0- 100 cm	1,85-3,09	1,96	1,64-3,10	2,11	1,43-2,73	1,83
Nitrogen,%,0- 20 cm	0,16-0,27	0,24	0,21-0,31	0,26	0,17-0,25	0,22
0- 50 cm	0,14-0,25	0,19	0,16-0,30	0,21	0,14-0,24	0,18
Phosphorus,, %, 0- 20 cm	0,16-0,25	0,20	0,16-0,28	0,23	0,15-0,25	0,20
0-50 cm	0,12-0,21	0,16	0,15-0,25	0,20	0,12-0,18	0,15
Adsorbed bases, meq/ 100 g 0-20cm	29,20-39,16	31,24	25,31-34,48	30,64	25,43-34,15	29,91
0- 50cm	28,38-35,93	31,86	24,99-34,13	31,60	21,21-32,51	27,88
pH, 0-100 cm	7,1-7,4	7,3	7,1-7,8	7,5	7,1-8,0	7,7
CaCO3, %,	-	-	3,57-13,02	8,44	4,16-18,30	11,82

The typical mountain-forest brown soils are found as separate spots in the north- west and north of the zone, on slightly inclined slopes, at a height of 600- 900 m above sea- level in Guba-Khachmaz. A total area is 34584 hectares. A profile of the typical mountain-forest brown soils possess a weak forest litter under the oak and oak- hornbeam forests, they are distinquished by distinctly expressed brown colour, enough number of humus and its distribution along the profile, neutral and weak alkaline reaction, high absorption capacity and claying signs.

A number of humus is high on the upper part 3,16-6,8% in the typical mountain-forest brown soils as a result of a gradual gathering as humat combinations form shattering the surface biomass of the forest litter in the oak and oak-hornbeam forests [2,8]. While increasing depth in these soils, the humus quantity gradual decrease and tautening of humus layer till 1,5 metre of depth are observed:2,38- 3,97% at 0-50 cm of layer, 1,64- 3,10% at 0-100 cm of layer (Table 1).

An enough quantity of total nitrogen (0,21-0,1%) and reduction while increasing the depth (0,6-0,0%) connected with the total number of organic combinations and nutrient.

The total phosphorus quantity at half- metric layer is satisfactory and it forms 0,16-0,8%. As a result of the need of the oak-tree which is a leading plant in the xerophyl forests for calcium, nitrogen and phosphorus, these elements decrease is observed on the upper layer in soil profile.

Carbonates in the typical mountain-forest brown soils are found as small spots below from humus layer, as big white 3,7-13,02% at 0-100 cm of layer. Their number gradually rises in the places the maternal rocks exist. On the low strata where the carbonates quantity rises the soil layer is shot with the whitish ash. The soil environment reaction is weak on the surface, and alkalizatesto wards the low layers: 7,-7,8.

The typical mountain-forest brown soils possess a high absorption capacity due to the gleyey mechanical composition, carbonates distribution character and other properties: the absorbed bases sum on surface is 25,31-34,48 mg-ekv, decreases towards low layers: 24,99-34,13 mg-ekv. Ca^{2+}cations number is 80- 90%, Mg^{2+} quantity is 2- 4 mg-ekv. In absorbing complex content. Ca^{2+} high quantity is connected with the carbonatic character of the soil forming rocks [4].

The silt particles number in the typical mountain- forest brown soils profile (<0,001 mm) – 11,48-25,10% and reduces while increasing the depth, but the clay particles quantity is (<0,01 mm) – 29,71-62,30% (0-100 cm of layer) and this shows that the soils possess heavy loamy and gleyeygranulometric content.

2.2. Carbonatic Mountain-Forest Brown Soils

These soils are at a height of 500-900 in the center, on the north- west and west part in the zone of Guba-Khachmaz. A total area is 31201 hectares. On an upper boundary of these soils there are typical and leached mountain-forest brown soils, and stepped mountain-forest brown and mountain grey-brown soils on the low boundary nearness of the carbonatic mountain-forest brown soils the steppe zone was a reason for drier climatic condition [15].

As soil forming rocks, mainly limestones, lime sandstones and lime conglomerates gravelly weathering crusts are considered. These soils develop over hardened limestones, marls, thick gravelly eluvial on the very upper parts of the middle mountainous zone.

From morphological standpoint the carbonatic mountain-forest brown soils are characterized by clearly appearing the profile bright coloured horizons, calcareous of the whole profile, aggregation of the horizon mean part to a high degree, weak gleying signs. In these soils the humus number on the

surface (0-20 cm) is high- 2,78-5,51%, reduction is observed towards low layers: 2,07-3,39% (0- 50 cm), 1,43-2,73% (0-100 cm of layer). According to the humus quantity a total nitrogen number on the surface is 0,17-0,5%, a total phosphorus quantity forms 0,5-0,25%.

One of the characteristic diagnostical indications of the carbonatic soils is an observation of carbonates on the upper layers. The carbonates number on the surface 5-10%, increases towards low layers and 4,6-18,0% at 0-100 cm of layer.

The carbonatic soils are close to the typical mountain- forest brown soils due to absorbed bases quantity: an absorption capacity is 25,43-34,15 mg.ekv. at 0-20 cm of layer, but it forms 21,21-32,51 mg.ekv. decreasing at 0-50 cm of layer. A quantity of Ca^{2+} inside cations forms 80-95% of the total number on upper stratum; this shows saturation of the absorbing complex with calcium cation to a high degree. Mg^{2+}cation number forms 5-12%. H^{+}cationsaren't observed. Saturation of the absorbed complex to a high degree is proved by pH value, the environment reaction in carbonatic soils is weak alkaline on the upper layer and alkaline characteristic on the low strata- 7,1-8,0.

A granulometric content of the carbonatic mountain-forest brown soils is mainly represented by heavy loamy and gleyey diversity. The gley particles quantity is 31,06- 61,85% at one-metre horizon. One of these soils characteristic peculiarities is an observation of the silt particles high quantity on the profile middle part and it shows a presence of gleying signs. The silt particles quantity forms 15,82-28,70%.

2.3. Stepped Brown Soils Under the Low Upland Mountainous Mountain- Steppe

The stepped mountain- brown soils spread between the mountain- forest and mountain- steppe zones. They are separated in the Gonagkand region from the Great Caucasus by HasanAliyev for the first time [5]. The stepped massives large areas were covered with the arid xerophylforests in which the mountain- forest brown soils developed in the past. Creation and formation of the soil steppe types are connected with hydrothermic condition change, naturally replacement of the plant cover as a result of evolution, i.e. replacement of the forestry by arid steppe plants, a human's economical action (cutting the forests, fires) erosion processes and so on [7].

Extending of the stepped mountain-brown soils leached, typical, carbonatic and cultivated subtypes was determined in the centre and north- east zone of Guba- Khachmaz. Before using of the areas cleaned after forest cutting under the agricultural plants influenced on the soils formation, at this time the morphological signs, colour, structure and mechanical structure of the soils upper horizon begin to be resembled to the steppe type [1].

Table 2. Physico-chemical indications of the Guba-Khachmaz zone stepped mountain- brown soils.

Soil characteristics	leached stepped mountain- brown		typical stepped mountain-brown		carbonatic stepped mountain- brown		Cultured mountain-brown	
	İnterval	M	İnterval	M	İnterval	M	İnterval	M
Particle size data (%)								
0–100 cm								
<0.01 mm	44,4-62,76	51,64	46,8-64,08	53,12	48,32-64,70	55,08	45,04-58,81	51,69
<0.001 mm	15,48-25,84	18,52	17,60-28,57	20,38	18,98-27,60	21,40	11,96-23,55	21,10
Humus, %, 0-20 cm	2,11-4,26	3,19	2,34-4,76	3,37	2,05-4,18	3,06	2,09-4,45	3,22
0- 50 cm	1,96-3,16	2,10	1,91-3,84	2,20	1,57-2,94	2,28	1,94-3,09	2,48
0- 100 cm	1,31-2,69	1,70	1,50-2,85	1,93	1,35-2,53	1,65	1,06-1,74	1,39
Nitrogen,%,								
0- 20 cm	0,16-0,22	0,19	0,15-0,25	0,21	0,15-0,23	0,18	0,17-0,25	0,20
0- 50 cm	0,15-0,17	0,15	0,15-0,20	0,17	0,13-0,20	0,17	0,13-0,21	0,17
Phosphorus,, %,0- 20 cm	0,18-0,23	0,21	0,18-0,26	0,23	0,17-0,24	0,21	0,19-0,23	0,20
0-50 cm	0,16-0,21	0,19	0,18-0.23	0,21	0,15-0,20	0,18	0,16-0,20	0,18
Adsorbed bases, meq/ 100g								
0-20cm	24,91-35,31	31,17	24,74-38,17	32,16	28,62-35,82	30,79	23,70-35,60	30,88
0-50cm	25,29-36,23	30,25	25,95-38,86	32,21	25,73-35,14	29,51	21,36-34,21	30,25
pH, 0-100 cm	7,0-8,0	7,5	7,5-8,3	8,0	7,5-8,5	8,1	7,1-8,3	7,2
CaCO3, %,	-	-	7,43-15,87	11,21	11,16-19,32	15,83	6,71-14,54	8,42

The humus quantity was accordingly 2,11-4,6% and 2,4-4,6% on the upper part of the typical mountain-brown soils being leached as a result of stepping and unforestating. The carbonatic mountain-brown soils exposed to stepped process, in these soils the humus number is 2,05-4,18% reducing on the upper layer and 1,35-2,53% at one-metre

horizon hearness of the ration of humin acids to fulvoacids the unit shows the steppe sign intensification. The nitrogen quantity forms 0,16-0,22% according to the humus number on the surface leached subtype, 0,15-0,25% in typical subtype, 0,15-0,23% in carbonatic subtype. A total phosphorus number isn′t high, it changes by 0,17-0,6% over the subtypes (Table 2).

According to the carbonates quantity in the soil wholly leaching of the sections upper layer from carbonates is observed under the versions of the leached soils, the white soft spots in these sections are found on the second half-metre layer, here an influence of the past forests is felt [13].

These carbonates are found in the different depth [2] of soil depending on slopes exposition, humidity level, climate dryness and soilforming rocks character. $CaCO_3$ quantity is 7,43-15,7% in the stepped typical mountain-brown soils, 11,6-19,2% in the carbonatic mountain-brown soils[14]. The solution reaction is a weak alkaline characteristic under the leached version (7,0-8,0), but it was with weak alkaline and alkaline reaction in the typical and carbonatic soils(7,5-8,5).

Due to the section analysis consequences, the stepped mountain- brown soils possess a high absorption capacity: leached (0-50 cm of layer) – 25,29-36,23 mg- ekv., typical – 25,95-36,23 mg-ekv., typical – 25,95-38,86 mg-ekv., the carbonatic mountain-brown soils have lower absorption capacity: 25,73-35,14 mg-ekv. Ca^{2+} quantity is high in the absorbed bases sum in connection with the stepped soils genetic morphological characters: 30-35 mg-ekv. The absorbed magnesium quantity isn′t more and changes by 3-5%. H^+cationsaren′t found, changing the ecological situation and stepped process was a reason for it. Na^+quantity slightness renders an absence of the solonetzification signs in these soils profile. An absence of solonetzification and salinity signs in the stepped mountain-brown soils shows their genetically connection with the brown mountain-forest soils [10].

The whole subtypes of the stepped mountain- brown soils in Guba- Khachmaz possess a high clayey according to the analysis consequences due to the soils mechanical structure:<0,01 mm particles quantity is 44,4-62,76% in the leached subtype, 46,80-64,08% in the typical subtype, 48,32-64,70% in the carbonatic subtype. Gleying process begins to be observed from the second half- metre in all the subtypes and under tillage layer.

A quantity of the silt particles changes in 15,48-28,7% of the boundaries over all the subtypes. Replacement of the forest cover by steppe plant intensifies steppe process in the stepped mountain-brown soils, weakened insidesoil weathering process in connection with the gradual drying of the soil profile. As a result removing process of the forest soilforming processes residue signs intensifies.

3. Conclusion

As a result of the soil researches being performed in the brown soils zone under middle and low mountainous xerophyl forests (oak-hornbeam) in Guba- Khachmaz it was determined that extending of the leached, typical and carbonatic subtypes of the mountain-forest brown soils were specified according to the vertical zonality law in the zone. The soils in the stepped brown soils zone under low upland mountain-steppes possess a high fertility and are intensively used under different agricultural plants (fruit plants, grain, vegetable and so on).

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