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NATURAL RESOURCES

NATURAL AGROGENIC SOIL CATENA OF SOUTHERN PRIMORIE

Conflict of Interest
None declared.

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Abstract
The study of the impact of anthropogenic factors on natural soil is possible to trace when studying natural soil agrogenic catenas. This research was conducted on Southern Primorie in the experimental fields. Granulometric composition of the soil catena first element is coarse-silty light loam. In general, studied soils have low anti-erosion resistance. These soils have enough water-stable structure and a satisfactory ability to aggregation in agrohumic horizon. In the eluvial horizon metamorphic indicators erosion constants decrease, suggesting greater vulnerability of soil material by water currents. In general, studied soils have low anti-erosion resistance. Second element of the soil catena have stable homogeneous particle size distribution throughout the soil profile: silty light clay - light silty clay sandy - silty clay medium - light silty clay. Ability to aggregation is sufficient in all genetic horizons. Anti-erosion resistance is high. Third element of the soil catena have heavy granulometric composition in general. Erosion resistance of soil, based on the results obtained structural factors and the factor of dispersion, as well as at special erosion studies the authors confirmed the high stability of the erosion control of dark humic horizon, average - gley stability and low erosion control - parent rock. The content of heavy metals in agrogenic soil catena isn´t exceeds the maximum allowable concentration (MAC). Studying catena is representative to the conditions of formation of soils across agrogene Southern Primorie floodplain hilly - ridged district.

Keyword: *Southern Primorie, soil, agrogenic catena, granulometric composition, heavy metal.*

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1 Introduction.

In recent years in Primorsky Krai increasing the tendency of transmission of the agricultural lands to foreign entrepreneurs for growing field crops, therefore, it became necessary to study the impact of anthropogenic factors on natural soil and identify the causes of acquisition by them the signs of agrogenic process. This transformation is possible to trace when studying natural soil agrogenic catenas (Surzhik et. al., 2014).

2 Objective, objects and methods

To explore the physical, mechanical, chemical and physico-chemical properties of soils.

Southern Primorie natural-agrogenic soil catena, located in the experimental field of the Maritime Vegetable Research Station All-Russian Research Institute of Horticulture of the Russian Academy of Agricultural Sciences.

Analytical work was carried out by conventional methods. For determining the soils has been used classification (Shishov et. al., 2004).

3 Results of research

First element of soil catena: agrogenic soil textural-differentiated average arable deeply bleached on talus deposits (Surzhik et. al., 2014). Genetic horizons has the following features.

P (0-23 cm) - agrohumic horizon, gray, fresh, densified, medium fine lumpy; transition to the underlying horizon is clear.

Elm (23-36 cm) - eluvial-metamorphic horizon, gray-whitish with a yellowish tinge, thinly laminated, fine-pored, medium, compact, occur iron concretions and siliceous powder; transition is gradual.

BT (36-94 cm) - textural horizon, clayey, brown, fresh, dense, lumpy, sticky, glossy shine on the cut; transition is gradual.

C (94-140 cm) - soil-forming rock, on the common brown background is ferruginous nodules in the form of smears and tiny pellets, very dense, clay, breaks up into large blocks, weakly aggregated.

Granulometric composition of these soils is coarse-silty light loam. Eluvial-metamorphic and textural horizons are heavy loamy. They are characterized by argillization in the lower part of the profile. The clay content of agrohumic horizon to the underlying increases gradually from 14 to 19%. Physical clay fraction emphasizes the presence in the soil profile eluvial-metamorphic horizon, decreasing from

51% to 47% in agrohumic horizon, and then increasing again to 57% in the bedrock. According to the results of the particle size distribution and microaggregate analyzes found that these soils have enough water-stable structure and a satisfactory ability to aggregation in agrohumic horizon, indicating a low degree of destruction of aggregates in water. Value varies by a factor of structural morphological profile from satisfactory to a minor. This fact explains the same variable anti-erosion resistance of soils: from high to low to the horizon agrohumic in bedrock. In the eluvial horizon metamorphic indicators erosion constants decrease, suggesting greater vulnerability of soil material by water currents. In general, studied soils have low anti-erosion resistance.

According to the degree of acidity, these soils are differentiated on the acidic in the upper part and strongly acidic in the lower horizons. Humus content in the upper soil horizon is low. In the eluvial metamorphic horizon percentage of humus is minimal (0.19%), and in the textured horizon increases again to 0.53%. This confirms the specificity of the horizon Elm, from which, thanks to its morphological addition and chemical properties washed out of the clay fraction with humic substances (Table 1).

Table 1 – Physico-chemical characterization of texture-differentiated medium arable deeply bleached agrogenic soil.

Soil profile	Genetic horizons	Thickness, cm	pH_{salt}	$pH_{water.}$	K_2O	P_2O_5	%		
					mg/100 g soil		C	Humus	Nitrogen general
First element of soil catena	P	0-23	4,8	6,3	13,3	26,4	1,49	2,57	0,2
	Elm	23-36	3,3	4,6	10,4	2,8	0,11	0,19	0
	BT	36-94	3,1	4,9	7,6	33,5	0,31	0,53	0
	C	94-140	3,2	4,5	13,3	0,2	0,37	0,64	0

Availability of exchangeable potassium is medium and mobile phosphorus - very high in agrohumic horizon. In eluvial-metamorphic horizon, there is a reduction of nutrients and increase in the textured horizon and soil-forming. The test results (Table 2) shows that the content of heavy metals in agrogenic soils texture-differentiated typical medium arable deeply bleached not exceeds the maximum allowable concentration (MAC).

Table 2 – The content of mobile forms of heavy metals in texture-differentiated typical medium arable deeply bleached agrogenic soil, mg/kg of soil.

Horizon	Thikness, cm	Pb	Mn	Cd	Cr	Co	Fe	Cu	Ni	Zn
P	0-23	0,25	5,26	n/a	0,28	0,04	8,05	0,07	0,13	0,96
Elm	23-36	0,91	4,07	n/a	0,31	0,02	22,03	0,08	0,20	0,23
BT	36-94	1,02	4,80	n/a	0,31	0,39	17,78	0,07	1,17	0,55
C	94-140	2,41	7,02	n/a	0,54	0,46	79,58	0,21	1,20	0,56
MAC		6,0	60	5,0	6,0	5,0	-	3,0	4,0	23,0

II element of the catena - soil: dark humic gley deeply bleached characterized by the soil profile 3Sur 2013, laid on the transition of gently sloping ridge trail in the valley of the stream under the canopy of the reed grasses, sedges, wheat grass, sagebrush and detached willows, maples, alders, poplars.

AU (0-35 cm) - dark humic horizon, dark gray, loose, fine lumpy, fresh, loamy; transition is clear.

ELnng (35-51 cm) - eluvial-metamorphic horizon, dense, layered rough, loamy, fresh, siliceous powder and ferruginous concretions; transition is noticeable.

BTg (51-74 cm) - textural horizon is dark brown with gray-bluish streaks, lumpy, fresh, very tight; transition to the underlying horizon is gradual.

G (74 - 92 cm) - gley horizon, dove gray, wet, clayey, structureless, compacted, smeared, the transition to the parent rocks (horizontal CG) gradually increasing the amount of brown-rusty spots.

This soil catena have stable homogeneous particle size distribution throughout the soil profile: silty light clay - light silty clay sandy - silty clay medium - light silty clay. Down the profile, the clay fraction increases sharply from 16 to 42%. Results of the microaggregate analysis showed that the predominant fractions of these soils are coarse dust (25-45%) and fine sand (27-44%).

The content of the clay fraction is practically unchanged in layers and does not exceed 1-4%. According to the results of the particle size distribution and microaggregate analyzes evaluated the structural condition of the soils that have water-stable structure throughout the profile. Ability to aggregation is sufficient in all genetic horizons. Anti-erosion resistance is high.

According to the degree of acidity of these soils are very strongly acidic. Humus content in the dark humic horizon is low.

Eluvial-metamorphic, textural horizons and soil-forming rock - very low-humic with the index just 0,88-1,14% (Table 3). Availability of exchangeable potassium is average. The content of mobile phosphorus is small. The test results shown in Table. Four show that in these soils content of heavy metals does not exceed the MAC (Table 4).

Table 3 – Physico-chemical characterization of dark humic gley deep bleached soils

Soil profile	Genetic horizons	Thickness, cm	pH salt.	pH water.	K_2O	P_2O_5	%		
					mg/100 g soil		C	Humus	Nitrogen general
Second element of the soil catena	AU	0-35	3,9	5,2	14,3	1,4	2,70	4,68	0,2
	Elnng	35-51	3,5	5,0	13,4	1,1	0,55	0,95	0,1
	BTg	51-74	3,5	5,0	11,8	0,7	0,66	1,14	0,1
	G	74-92	3,5	5,0	10,9	1,0	0,51	0,88	0,1

Table 4 – The content of mobile forms of heavy metals in dark humic gley deep bleached soils, mg / kg of soil

Horizon	Thikness, cm	Pb	Mn	Cd	Cr	Co	Fe	Cu	Ni	Zn
AU	0-35	1,78	17,59	n/a	0,41	0,12	109,2	0,02	0,53	0,08
Elnng	35-51	1,96	9,08	n/a	0,25	0,24	31,73	0,23	1,33	0,47
BTg	51-74	2,09	6,11	n/a	0,32	0,08	28,04	0,24	1,45	0,61
G	74-92	2,19	7,32	n/a	0,35	0,12	24,42	0,16	1,45	0,89
MAC		6,0	60	5,0	6,0	5,0	-	3,0	4,0	23,0

The upper part of III element of catena located between the lake and the foot of the ridge trail on tussock surface overgrown with cattails, sedges, and burnet. Submitted by soils - darkhumic gley typical middle small deep gleying on lake sediments, which have the following morphological characters.

AU (0-21 cm) - dark humus horizon, dark gray, wet, sticky, weak structured; transition to the underlying horizon is clear.

G (21-89 cm) - gley horizon, wet, water oozes from the walls, gray-bluish color, structureless, greasy; gradual transition.

CG (89-110 cm) - gley soil-forming rocks, represented by rusty gleying fine wet sand. From the bottom the section slowly filled with water.

These soil granulometric compositions in general are heavy. The particle size distribution of the horizon: AU - silty light clay, G - fine silty light clay, CG - sandy loam. Results of the microaggregate analysis showed that in these soils clearly predominant is fraction of coarse dust. The content of the clay fraction remains practically unchanged in layers and do not exceed 1%.

The structural state of the soil is such. First, they have a satisfactory water-stable structure and ability to aggregation in dark humic horizon. In gley horizon and soil-forming rock, ability to aggregation is minor. The degree of aggregation is weak. Thus, erosion resistance of soil, based on the results obtained structural factors and the factor of dispersion, as well as at special erosion studies the authors (Derbentseva et. al., 2015, 2015b) confirmed the high stability of the erosion control of dark humic horizon, average - gley stability and low erosion control - parent rock.

According to the degree of acidity, these soils are acidic throughout the profile. Humus content is low (Table 5).

Table 5 – Physical-chemical characterization of dark humic deeply gleyed soils

Soil profile	Genetic horizons	Thickness, cm	pH salt.	pH water.	K_2O	P_2O_5	%		
					mg/100 g soil		C	Humus	Nitrogen general
Third element of the soil catena	AU	0-21	4,8	5,6	4,7	2,4	2,51	4,33	0,3
	G	21-89	4,2	5,4	5,3	5,6	1,97	3,40	0,2
	CG	89-110	4,3	5,6	5,9	3,2	0,76	1,31	0,1

Provision of exchange potassium is low, mobile phosphorus - is also low.

As the results of analyzes presented in Table 6, the high content of Mn (4-7 MAC) and Fe in dark humic - gley typical deeply gleyed soils indicates the regional characteristics of soil formation factors.

Table 6 – The content of mobile forms of heavy metals in dark humic typical deeply gleyed soils, mg / kg of soil

Horizon	Thikness, cm	Pb	Mn	Cd	Cr	Co	Fe	Cu	Ni	Zn
AU	0-21	1,11	246,9	n/a	0,44	0,31	613,7	0,14	0,15	0,76
G	21-89	2,81	440,7	n/a	0,32	1,00	1313,7	0,22	0,74	1,59
CG	89-110	1,14	331,4	n/a	0,06	0,87	204,4	n/a	0,35	2,97
MAC		6,0	60	5,0	6,0	5,0	-	3,0	4,0	23,0

Specifically the formation of soils on silicate weathering crust and intense weathering and leaching, leading to the formation of Fe-Mn-nodules.

4 Conclusion

1. Studying catena is representative to the conditions of formation of soils across agrogene Southern Primorie floodplain hilly - ridged district.

2. Analytical work confirmed the regional specificities of dark humic - gley typical middle small deeply gleyed soils.

3. The obtained results of the catena soil properties elements can be used by land monitoring service and land cadastre service.

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