Научная статья
УДК 631.421(510:517.3)
DOI: 10.18101/2542-0623-2021-4-92-104

QUALITY ASSESSMENT OF SOIL NUTRIENTS IN THE STEPPE REGION OF THE MONGOLIAN PLATEAU

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Abstract. Characteristics of soil nutrient quality assessment of steppe region in Mongolian Plateau are presented. The research has conducted mainly vertical and horizontal changes in soil fertility quality assessment in Mongolian and Inner Mongolian research areas. The results show that along vertical direction of soil fertility gradually decreased with increasing depth (in the form of 0–5<5–10<10–20 cm). In addition, change differences of soil fertility in Uzemchin, Inner Mongolia and Sukhbaatar of Mongolia, gradually decreased with increasing depth. Horizontal changes in soil fertility quality assessment in Sukhbaatar of Mongolia was better than in Uzemchin area of Inner Mongolian, especially in 0-5 cm soil layer and the southeastern part of the Uzemchin. Further, I will make analysis in its causes and provide preventative and protective measures to maintain ecological balance.
Keywords: soil nutrients quality, steppe zone of Mongolian Plateau, Mongolian Sukhbaatar, Inner Mongolian Uzemchin, grey correlation analysis method.

Acknowledgments. This work was funded by Chifeng University introduces talents for scientific research start-up funding project “Comparative Study on Soil Characteristics of Typical Steppe of Mongolian Plateau Based on Country”(QDJRCYJ059) — Provincial General Project of China, “Research on Geographical Migration of Chahar Tribe in Yuan, Ming and Qing Dynasties” (XXCHE202014), National Social Science Foundation Project of China “Drought in Inner Mongolia Pastoral Areas Promoting Poverty Rebound Risk Assessment and Prevention Research” (20BTJ043). Thank you to our teachers and supervisor-professors, who provided us great support, valuable advice and recommendations on writing this article.

For citation
Mantegeer, Wulantuya, Bao Yuhai. Quality Assessment of Soil Nutrients in the Steppe Region of the Mongolian Plateau. *Nature of Inner Asia.* 2021; 4(19): 92–104.
DOI: 10.18101/2542-0623-2021-4-92-104

Introduction

Soil is the base of the inhabitation and development of the mankind [Tang xuan et al., 2009] and is of important for the first and second doings (animal husbandry, farming and mining industry). Soil fertility becomes an important element of the soil system [Xijie Yue et al., 2010]. Soil fertility provides nutritious elements required for plants and its volume is one of the factors affecting the growth of plants [Xingjie Zhang et al., 2009].

The region selected for the research is the main part of Mongolia's elevated steppe zone which connects the two countries (China and Mongolia). The research work has been conducted on the example of Uzemchin, Xilinguole Province, Inner Mongolia, China and Sukhbaatar Province, Mongolia (Figure 1.1). The similar regions were selected as a research region for the comparatively less destructed and destructed state due to different use and soil samples were collected with the purpose of comparing the soil fertilities of this research region, observing the changes in the soil fertility and provide scientific facts for the proper use of soil. Therefore, it is very important to study and evaluate the soil nutrients.

In general, qualitative and quantitative analyses are made for soil assessment. Qualitative analysis assesses any soil properties for relatively good or bad. Use of this method has been reduced now. Quantitative method has been used widely for soil assessment in connection with soil analysis. Quantitative method uses various mathematics based methods, estimates soil elements and assesses soil properties by calculating its general percentage.

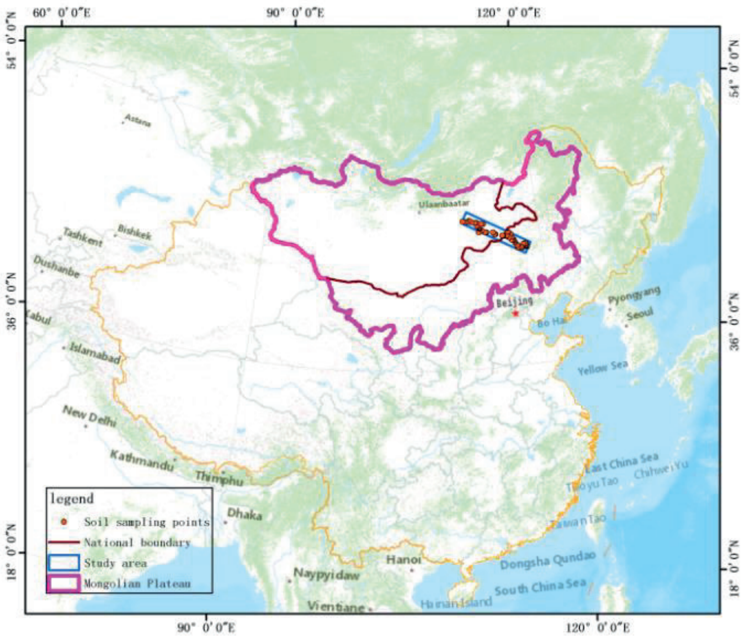

Fig. 1.1 Sketch map of geography location of the study area

Analytic hierarchy process (AHP), artificial neural networks (ANN), set pair analysis (SPA), Generalized assessment method by weird number, GIS and mathematical methods are used for the quantitative method [Tang xuan et al., 2009]. GIS and mathematical method are the most widely used models. GIS and Grey correlation analysis were used for this research work.

Materials and methods

Results of the field surveys conducted in 2015, 2016 and late July and early August 2017 were used for this research work. When obtaining soil samples, the surface area was chosen as a representative area, representing the whole area and the location of the sampling points

Areas with flat surface were selected from the entire region in order to collect soil samples and the locations of sampling are shown in Figure 2.1. During the research, 29 samples were taken from Inner Mongolia, China and 25 samples were collected from Mongolia. Each sample was divided into 0-5, 5-10, and 10 -20 cm at the top layer of soil, taken from each three layers by using the cutting ring and 500 g of soil was kept in each bag of high quality.

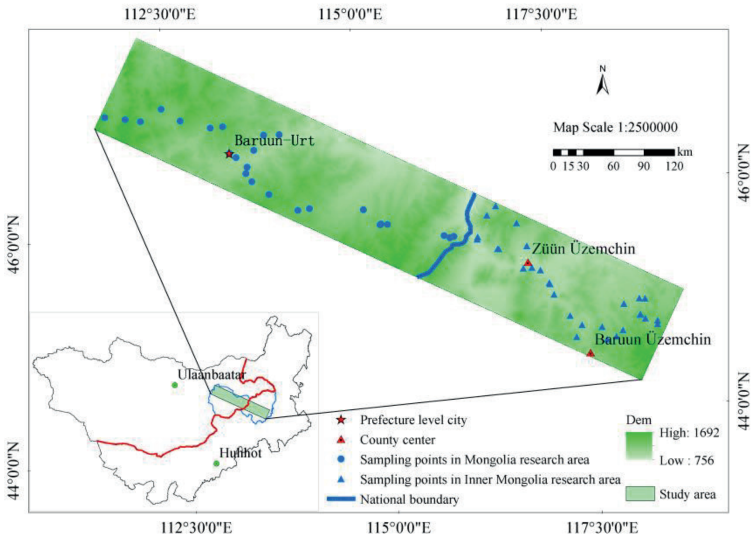

Fig. 2.1 Sketch map of distribution of the sampling sites

The soil samples were analyzed at the soil laboratory of the School of Geography of Inner Mongolian University of Education for the identification of soil organic, phosphorus, potassium, nitrogen, phosphorus mobility, potassium mobility and nitrogen mobility. The method to determine those indicators was based on the Soil agro-chemical analysis book by Shidan Bao (2013).

Statistical data was estimated by using SPSS20 statistics software. The data was compiled with Microsoft Excel software program and general quality sequence of the soil nutrients was developed under the Grey correlation analysis method [Yuerong WU et al., 2008]. Quality assessment mapping of the soil nutrients quality was made by using the Excel2007, Origin9.1 and ArcGis10.3 software.

Grey system theory was developed in 1987 by a Chinese Professor Julong Deng of Huazhong University of Science and Technology (Jianhua XU, 2004). This system theory of the Grey correlation analysis collects all cumulative numerical data with multiple curves. The closer their geometric shapes are and parallel to each other, the more they change and the greater the degree of correlation.

Data closer to the required parameters will be reflected to the assessment indicators of correlation values. The maximum correlation value will be considered as the highest value [Yuerong W. U. et al., 2008]. Therefore, the evaluation parameters will be compared in accordance with the sequence of correlation values. The following formula was used for the calculation:

(1) Deletion of the units and sequence of the evaluation parameters

Parameters of the soil nutrients have different meanings. In general, the parameters of soil nutrients differ from each other by numerical sequences and units. Therefore, the units and sequence of the evaluation parameters are deleted by using the formula of average numerical change in order to scientifically solve the problem. Formula for the mean numerical method (2.1):

$$x'i(t) = \frac{xi(t)}{\bar{x}i} \quad (i = 1,2,\cdots,N; t = 1,2,\cdots,M) \tag{2.1}$$

Where, $\bar{x}i = 1/M \sum_{t=1}^{M} xi(t)$; $N = 55; M = 7$

(2) Formula of the Grey correlation analysis method

The maximum value of the parameters was selected from the numerical data of the reference indicators. Where, $x0(t) = \{x0(1), x0(2), \cdots, x0(M),\}$ and the maximum value is found from the Table 3.1. The formula of the Grey correlation analysis method is used under the following two processes.

Formula of the correlation coefficient of the indicator t at $x0$ and xi – 2.2:

$$\varepsilon i(t) = \frac{min\ i\ min\ t|x0(t) - xi(t)| + \rho\ max\ i\ max\ t|x0(t) - xi(t)|}{|x0(t) - xi(t)| + \rho\ max\ i\ max\ t|x0(t) - xi(t)|} \tag{2.2}$$

Where, $min\ i\ min\ t|x0(t) - xi(t)|$ is the minimum value,

and $max\ i\ max\ t|x0(t) - xi(t)|$ is the maximum value.

ρ is grey number at $[0,1]$, always $\rho = 0.5$

Formula of the correlation value (2.3):

$$ri = \frac{\sum_{t=1}^{n} \varepsilon i(t)}{M} \tag{2.3}$$

Results

General description of soil nutrients

General description of the soil nutrients is expressed on the example of the elevated steppe region of Mongolia or Uzemchin, Inner Mongolia and Sukhbaatar Province, Mongolia (Table 3.1). According to this table, variations in the soil nutrients at 0–5, 5–10 and 10–20 cm layers along the vertical direction reduce in the depth of soil. Variations in the horizontal direction and the variations in the soil nutrients from the southeast to the northwest of the steppe region of Mongolia tend to increase.

Table 3.1

Descriptive statistics

soil nutrients	soil depth (cm)	Uzemchin N=29					Sukhbaatar N=25					Mean	Sig.
		Minimum	Maximum	Mean	Std. Deviation	coefficient of variation(%)	Minimum	Maximum	Mean	Std. Deviation	coefficient of variation(%)		
soil organic matter (g/kg)	0-5	14.96	68.06	30.54	12.37	40.49	20.76	98.00	39.59	15.98	40.36	**35.07**	0.02
	5-10	11.76	47.52	26.79	8.82	32.92	15.56	46.56	29.19	7.79	26.68	**27.99**	0.26
	10-20	7.28	38.80	21.80	7.69	35.29	10.68	42.96	23.75	6.96	29.32	**22.78**	0.32
	0-20	11.33	47.92	**26.38**	8.55	32.42	15.67	56.50	**30.84**	9.13	29.59	28.61	0.06
soil available phosphorus (mg/kg)	0-5	3.75	12.92	6.12	2.44	39.91	3.65	30.05	8.8182	5.40443	61.29	**7.47**	0.02
	5-10	2.05	5.90	3.72	0.93	25.06	2.71	16.55	4.2290	2.76486	65.38	**3.97**	0.36
	10-20	1.96	4.65	3.34	0.69	20.77	1.71	19.40	4.5868	4.07698	88.89	**3.97**	0.12
	0-20	2.59	7.21	**4.39**	1.10	24.93	3.05	20.90	**5.88**	3.59	61.07	5.14	0.05
soil available potassium (mg/kg)	0-5	90.23	529.38	276.99	103.43	37.34	135.80	851.19	339.08	169.21	49.90	**308.04**	0.10
	5-10	48.04	383.73	156.22	61.75	39.53	80.02	721.54	182.31	146.41	80.31	**169.26**	0.39
	10-20	24.23	249.63	124.29	60.52	48.70	51.54	469.94	114.06	93.12	81.64	**119.17**	0.58
	0-20	87.47	297.17	**185.83**	52.97	28.50	90.96	639.77	**211.82**	129.59	61.18	198.82	0.33
soil available nitrogen (mg/kg)	0-5	75.25	671.76	228.39	130.80	57.27	152.68	323.68	258.98	39.89	15.40	**243.69**	0.24
	5-10	97.72	451.72	211.72	88.70	41.89	185.06	318.49	250.61	36.43	14.54	**231.17**	0.04
	10-20	83.75	718.52	195.31	121.38	62.15	93.28	497.88	235.47	75.86	32.22	**215.39**	0.14
	0-20	109.07	431.47	**211.81**	90.97	42.95	206.11	340.64	**248.35**	34.49	13.89	230.08	0.05
soil total phosphorus (g/kg)	0-5	.23	1.56	0.62	0.27	44.11	.47	3.07	1.21	0.61	50.25	**0.92**	0.00
	5-10	.20	1.16	0.57	0.26	45.27	.34	3.46	0.98	0.68	68.87	**0.77**	0.00
	10-20	.17	1.17	0.54	0.27	49.79	.34	2.90	0.88	0.63	71.15	**0.71**	0.01
	0-20	0.25	1.25	**0.58**	0.25	42.89	0.40	3.14	**1.02**	0.62	60.04	0.80	0.00
soil total potassium (g/kg)	0-5	2.82	17.33	8.33	4.17	50.11	4.18	20.94	12.46	4.03	32.37	**10.40**	0.00
	5-10	3.02	15.68	6.95	3.68	52.96	3.74	19.53	10.96	4.55	41.47	**8.96**	0.00
	10-20	1.57	23.61	7.11	5.12	72.01	2.20	20.07	9.65	4.66	48.36	**8.38**	0.06
	0-20	3.31	16.04	**7.46**	3.81	51.10	3.50	18.19	**11.02**	4.16	37.74	9.24	0.00
soil total nitrogen (g/kg)	0-5	.75	3.97	1.88	0.76	40.27	1.36	6.61	3.08	1.12	36.40	**2.48**	0.00
	5-10	.60	2.82	1.66	0.55	33.08	1.21	3.69	2.34	0.61	26.27	**2.00**	0.00
	10-20	.42	2.52	1.30	0.52	39.87	0.55	3.21	1.85	0.56	30.32	**1.57**	0.00
	0-20	.62	2.75	**1.61**	0.53	33.02	1.04	4.10	**2.42**	0.68	27.99	2.02	0.00

Low or high coefficients of variance express the approximate dispersion and average percentage and determine the variances in the research indicators.

Variance is less if CV<10%, is average if 10%≤CV≤100% and is high if CV≥100% [Fangli Shao et al., 2012]. Coefficient of variance in the soil nutrients for this research expresses the mean variance.

According to the variance analysis (ANOVA), organic matter and phosphorus mobility in the soil samples of Uzemchin and Sukhbaatar were different from each other in 0–5 cm upper soil layer ($p<0.05$) but were same in 5–10 and 10–20 cm layers. Potassium mobility in the soil samples was same in 0–5, 5–10 and 10–20 cm layers. Nitrogen mobility in the soil samples differs in 5–10 and 0–20 cm layers ($p<0.05$) but was same in 0–5 and 10–20 cm layers.

Total phosphorus, potassium and nitrogen etc indicators in the soil samples were significantly different in 0–5, 5–10 and 10–20 cm layers ($p<0.05$).

Grey correlation analysis on quality of soil nutrients

Based on the sequence of correlation value for the Grey system theory, quality of the reference parameters is considered as the best in the system. If the correlation value between the evaluation parameters and reference parameters was greater, the quality will be higher and vice versa.

Sequence of the correlation values between the indicators of soil nutrients was estimated by using the Microsoft Excel program and the Grey correlation formula (Table 3.2). The Table 3.2 shows that the sequence of correlation values in the soil samples collected from Sukhbaatar, Mongolia is significantly higher than the soil sampes taken from Uzemchin, Iinner Mongolia. It also shows that the quality of soil nutrients in Sukhbaatar was higher in the soil nutrients in Uzemchin.

Grassland soil quality is rated under the following five degrees [Li Bo, 1997]: the first degree if $r \gg 0.90$, the second degree if $0.75 \ll r < 0.90$, the third degree if $0.55 \ll r < 0.75$, the fourth degree if $0.40 \ll r < 0.55$ and the fifth degree if $r < 0.40$ [Yuerong W. U. et al., 2008]. The Table 3.3 shows the quality degree of the soil nutrients involved in the research work.

Table 3.2

Reference indicators and sequence of the correlation values between the indicators of soil nutrients

0-5				5-10				10-20				0-20			
№	Uzemchin	№	Sukhbaatar	№	Uzemchin	№	Sukhbaatar	№	Uzemchin	№	Sukhbaatar	№	Uzemchin	№	Sukhbaatar
22	0.605	13	0.814	23	0.663	13	0.899	23	0.591	13	0.780	23	0.661	13	0.898
19	0.594	2	0.743	4	0.611	22	0.700	26	0.572	19	0.659	25	0.623	22	0.727
23	0.589	22	0.699	25	0.610	19	0.680	12	0.572	4	0.609	22	0.622	2	0.705
27	0.580	19	0.637	21	0.606	4	0.671	25	0.551	9	0.604	19	0.622	19	0.701
4	0.580	20	0.625	26	0.602	2	0.665	24	0.549	22	0.603	4	0.619	4	0.678
20	0.578	16	0.599	27	0.597	8	0.664	22	0.546	8	0.595	26	0.611	20	0.666
25	0.563	4	0.595	19	0.596	20	0.635	5	0.543	20	0.592	27	0.609	8	0.655
29	0.551	18	0.592	6	0.584	18	0.623	6	0.537	16	0.562	20	0.608	16	0.640
21	0.543	15	0.587	24	0.583	16	0.614	19	0.535	18	0.559	12	0.599	18	0.638
18	0.540	25	0.587	20	0.576	10	0.612	28	0.533	10	0.548	6	0.590	10	0.629
6	0.535	10	0.581	18	0.574	15	0.596	15	0.528	7	0.548	21	0.587	15	0.618
9	0.530	5	0.565	15	0.569	11	0.591	20	0.527	11	0.534	24	0.585	9	0.609
1	0.528	23	0.564	17	0.568	9	0.586	4	0.527	21	0.533	18	0.582	25	0.604
26	0.527	9	0.561	22	0.567	3	0.582	10	0.514	3	0.532	5	0.578	5	0.601
5	0.527	1	0.558	5	0.564	5	0.581	27	0.512	15	0.527	15	0.571	3	0.597
28	0.522	17	0.556	12	0.562	25	0.581	18	0.511	2	0.522	28	0.570	11	0.595
24	0.520	8	0.555	10	0.560	23	0.579	17	0.509	17	0.520	17	0.568	23	0.595
8	0.520	3	0.546	28	0.560	17	0.578	21	0.507	5	0.520	1	0.565	17	0.591
15	0.519	21	0.545	9	0.558	21	0.576	2	0.506	1	0.511	29	0.562	21	0.590
12	0.517	11	0.540	1	0.558	14	0.572	1	0.498	14	0.508	9	0.561	1	0.589
17	0.516	14	0.539	14	0.554	1	0.566	9	0.492	23	0.505	8	0.554	7	0.587
11	0.514	24	0.534	8	0.544	7	0.560	11	0.491	25	0.502	10	0.554	14	0.582
7	0.510	12	0.524	3	0.539	24	0.556	3	0.489	12	0.494	11	0.551	24	0.568
2	0.498	7	0.517	2	0.537	12	0.551	14	0.485	24	0.488	2	0.546	12	0.564
10	0.493	6	0.516	11	0.536	6	0.548	8	0.483	6	0.471	14	0.541	6	0.552
14	0.489			29	0.528			7	0.480			7	0.537		
13	0.488			7	0.513			29	0.477			3	0.536		
3	0.488			13	0.505			13	0.459			13	0.518		
16	0.484			16	0.500			16	0.457			16	0.513		

Results of the quality sequence of the soil nutrients were estimated under the Grey correlation analysis (Table 3.2). Figures of the quality evaluation of the soil nutrients along the vertical and horizontal directions were made by using the Origin 9.1 scientific data analysis and graphing software (Figures 3.1 and 3.2).

Table 3.3

Quality degree of the soil nutrients

	Grade one (good)		Grade two (higher)		Grade three (average)		Grade four (satisfactory)		Grade five (poor)	
	U	S	U	S	U	S	U	S	U	S
Soil status	The soil is porous and nutrient, and contains less salt		There is no explicit change but the soil hardness increased slightly		The soil hardness was almost doubled and the soil surface has a trace of collapse. Salt volume of low and moist land increased		The soil hardness was almost doubled, organic matter volume decreased explicitly, and the sand surface or salt accumulation is observed on the top layer of soil		The value of use was depreciated	
Results of the soil quality in 0–20 cm layers	No		No	13	1, 4–6, 8–12,15, 17–29	1–5, 7–12, 14–25	2–3, 7, 13–14, 16	6	No	

* Li Bo,1997 . U-Uzemchin, S-Sukhbaatar.

As shown in the Figure 3.1, the nutrient properties of different soil layers increased in the research region in the direction of direction from the southeast to the northwest. The nutrients contained in the soil layers in the depth of 0-5 and 10-20 cm was less than in the 5–10 cm soil layer.

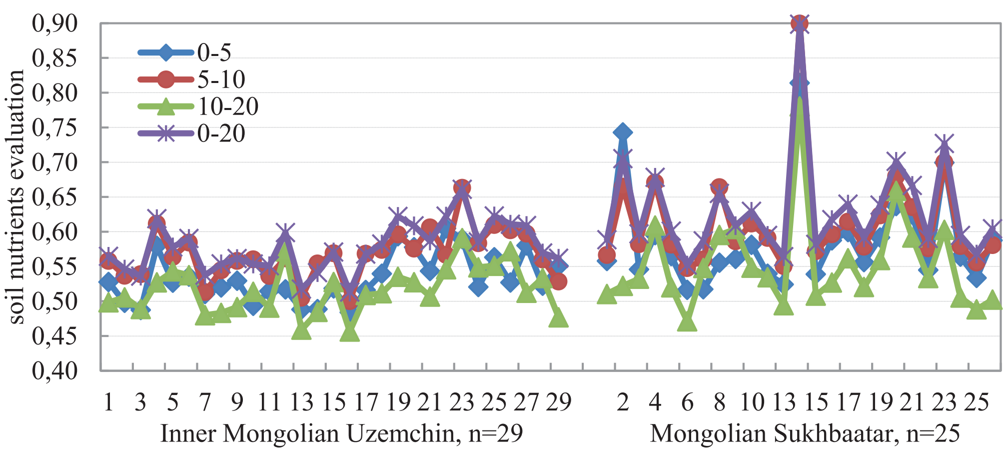

Fig. 3.1 Nutrients of the different soil layers in the research region along the direction to the northwest from the southeast

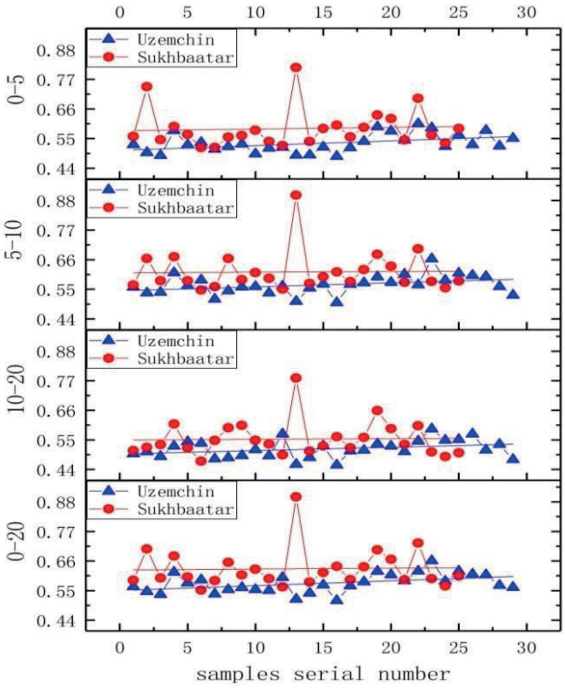

Fig. 3.2. Soil nutrients of different soil layers in the research region along the direction to the northwest from the southeast

As shown in the Figure 3.2, the nutrients in different soil layers in Sukhbaatar, Mongolia was much better than the soil nutrients in Uzemchin, Inner Mongolia and there was almost no change in the nutrients of soil layers along the direction from the southeast to the northwest. The nutrients in different soil layers in Uzemchin was much poorer compared to the soil layers in Sukhbaatar and the nutrients of soil improved apparently along the direction from the southeast to the northwest. Moreover, the differences between the nutrients of soil layers of the research region between the two countries decrease to the extent of the increase in soil depth (0–5<5–10<10–20 cm). In brief, the nutrients of soil in Sukhbaatar in the research region was distinctively better than the soil in Uzemchin.

General changes in the soil nutrients

The results of quality sequence of the soil nutrients in the research region (Table 3.2) were divided into five degrees (Figure 3.3) by using the ArcGIS10.3 software. As shown in the Figure 3.3, soil layers ranked to the third and fourth grades dominate in 0–5, 5–10, and 10–20 cm layers and in 0-20 cm layer which is the average of the abovementioned three layers, the second grade soil was less distributed and there is no soil included in the first and fifth grades.

The soil nutrients were relatively good in the direction from the southeast to the northwest. Nutrients in the 5–10 cm soil layer were explicitly better than the soil layers in the depth of 0–5 and 10–20 cm. Variations in the soil nutrients in Uzemchin were comparatively poor than the soil nutrients in Sukhbaatar when compared the nutrients in

0-5 cm soil layer with the 5-10 cm soil layer. Soil nutrients in the research region varied when compared the nutrients in the 10-20 cm layer with 5-10 cm layer.

Percentage in the variations in the soil nutrients ate shown in the Figure 3.4. In the 0-5 cm layer, the third grade soil was 71% and the fourth grade soil occupied 29%. In the 5-10 cm layer, the third grade soil occupied 94% and the fourth grade soil was 6%. In the 10-20 cm layer, the third grade soil was 36% and the fourth grade soil was 64%. In the 0-20 cm layer, the third grade soil occupied 98% and the fourth grade soil was 2%. In general, the third grade soil dominates in Sukhbaatar and the fourth grade soil dominates in Uzemchin. The soil grade in Uzemchin, Inner Mongolia was one grade lower than Sukhbaatar.

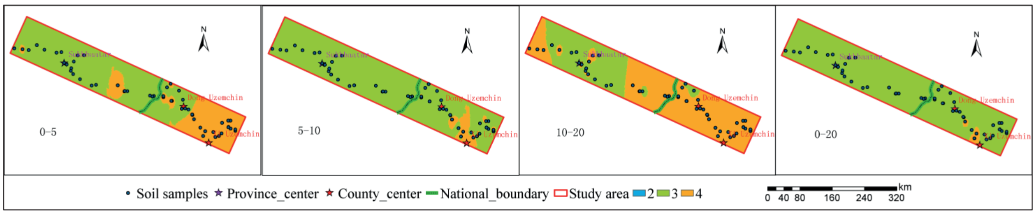

Fig. 3.3 General variations in the soil nutrients

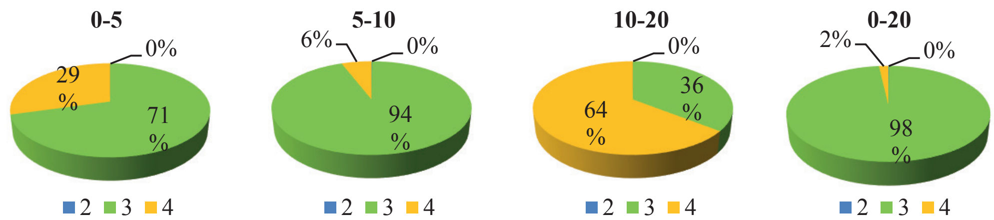

Fig. 3.4 Percentage of the general variations in the soil nutrients

Discussion

Organic matter in the soil is residues of plants and animals existing on the earth surface and soil profile and is their product which had been changed in the certain extent. It also includes the organic substances (fertilizers, pesticides and household waste) which are supplied to the soil due to human activities. Approximately 85% of the organic matters in soil contain residuals of plants and animals and 15% is the living organisms and growing plants [Avaadorj D., 2014].

Therefore, organic matters in the soil are closely linked with human activities and get changed the most in the soil. Main elements of the plant feeding are nitrogen, phosphorus and potassium [Avaadorj D., 2014] and nitrogen mobility, phosphorus mobility and potassium mobility. Nitrogen is more required in minerals and organic matters and more than 90% of the soil nitrogen is contained in the organic part (Avargaor D, 2014) and is not contained in rocks. Therefore, it is entirely related to human activities and varies the most in the soil [Avaadorj D., 2014].

Total phosphorus content depends on the composition of minerals and organic matters in the host rocks. Potassium in the soil is almost entirely dependent on the composition of minerals. Variation of the potassium volume in the soil is related to the composition of the mineral sources, soil formation, laterization, ablation and accumulation. Nutrients in the soil of Mongolia's steppe region were different in terms of organic matter and phosphorous mobility in 0–5 cm layer due to the different use ($p<0.05$) but those indicators were same in 5–10 and 10–20 cm layers.

Nitrogen mobility volumes in the soils of research region were different in 5–10 and 0–20 cm layers ($p<0.05$) but were not different in 0–5 and 10-20 cm layers. Potassium mobility volumes were same in 0–5, 5–10 and 10–20 cm layers. Total phosphorus, potassium and nitrogen etc indicators were significantly different in 0–5, 5–10 and 10–20 cm layers ($p <0.05$) of the soils in Uzemchin and Sukhbaatar.

The nutrients in different soil layers in Sukhbaatar were higher than the nutrients of soil layers in Uzemchin and the soil nutrients were almost unchanged along the direction to the northwest to the southeast. The nutrients of different soil layers in Uzemchin were apparently poorer than Sukhbaatar but significantly improved in the direction to the northwest to the southeast.

Additionally, the difference in the quality of soil nutrients between the two countries in the study region is accompanied by lowering the depth of soil (0–5 <5–10 <10–20cm). Moreover, the differences of the soil nutrients in the research region reduces to the extent of the soil depth (0–5<5–10<10–20 cm). The nutrients in 5–10 cm soil layers were higher than the nutrients in the 0–5 and 10–20 cm soil layers.

Variations in the soil nutrients in Uzemchin were comparatively poor than the soil nutrients in Sukhbaatar when compared the nutrients in 0–5 cm soil layer with the 5–10 cm soil layer. Soil nutrients in the research region varied when compared the nutrients in the 10–20 cm layer with 5–10 cm layer.

In brief, the nutrients in the soil of Sukhbaatar soil, included in the research region, were apparently higher than in Uzemchin, especially 0–5 cm top layer was totally different from the top soil layer in the southeast of Uzemchin. Main reason of this difference might have been the different land use of the two countries.

According to the Figure 3.3 General variations in the soil nutrients and the Table on the soil nutrient degrees (Li Bo, 1997), hardness of the soil in the steppe region of Mongolia increased by almost one or two times, the soil surface has traces of erosion, salt accumulation increased in low and moist areas, organic matters have decreased significantly, and sand has increased on the top layer of soil. There is no apparent change in the soil of the research region but the soil hardness has increased slightly. These phenomena conform to the current soil and vegetation situation.

Conclusion

Soil organic and phosphorus mobility of Uzemchin and Sukhbaatar are different between them in 0–5 cm thick soil layer ($p<0.05$), but these two indicators have no differences in 5–10 cm and 10–20 cm soil layers.

Soil potassium mobility of two countries in the study region showed no apparent difference between 0–5 cm, 5–10 cm and 10–20 cm soil layers. Soil nitrogen mobility has some difference between 5–10 cm and 0–20 cm layers ($p<0.05$), but there is no difference between 0–5 cm and 10–20 cm soil layers.

Total phosphorus, potassium and nitrogen etc indicators in the soil samples collected from the two research countries were significantly different in 0–5, 5–10 and 10–20 cm layers ($p<0.05$).

The quality of soil nutrients in the study region of Sukhbaatar, Mongolia is apparently better than the Uzemchin, Inner Mongolia, particularly it has significant difference in the topsoil 0–5 cm layer, and in the south-east part of Uzemchin. Additionally, the difference in the quality of soil nutrients between the two countries in the study region is accompanied by lowering the depth of soil (0–5<5–10<10–20cm).

The hardness of the soil in the study region Sukhbaatar increased by almost one time, the soil surface has traces of erosion, salt accumulation increased in low and moist areas, organic matters have decreased significantly, and sand has increased on the top layer of soil. There is no apparent change in the soil of the research region but the soil hardness has increased slightly. These phenomena conform to the current soil and vegetation situation.

Soil hardness of Uzemchin region has increased almost twice, amount of organic substances reduced significantly, sand increased in the topsoil layer or the phenomena of becoming salty is noticed. There is no apparent change in the soil in the lower parts of the study region, but soil hardness has increased slightly.

We aim to make more detailed analysis in the further study to identify the reason of having such a significant change in the quality of this steppe region soil nutrient and the influencing factors in it.

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The article was submitted 24.10.2021; approved after reviewing 16.1.2021; accepted for publication 20.12.2021.

ОЦЕНКА КАЧЕСТВА ПИТАТЕЛЬНЫХ ВЕЩЕСТВ
ТИПИЧНЫХ СТЕПНЫХ ПОЧВ МОНГОЛЬСКОГО НАГОРЬЯ

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Аннотация. В статье представлена детальная характеристика оценки качества питательных веществ в типичных степных почвах Монгольского нагорья. В рамках этой работы были проведены как вертикальные, так и горизонтальные исследования по оценке качества питательных веществ почвы в районе Внутренней Монголии и Монголии. Результаты показывают, что содержание питательных веществ в почве постепенно снижается в вертикальном направлении при увеличении глубины (в форме 0–5 < 5–10 < 10–20 см). Кроме того, с увеличением глубины разница в питательных веществах почвы в Узимчине (Внутренняя Монголия) и в Сухэ-Баторе постепенно уменьшается. В районе Сухэ-Батора (Монголия) качество питательных веществ почвы лучше, чем в районе Узимчин (Внутренняя Монголия). В дальнейшем мы проанализируем причины и предложим меры по обеспечению экологической безопасности.
Ключевые слова: почвоведение; Монгольское нагорье; Монголия Сухэ-Батор; Внутренняя Монголия Узимчин; статистическая обработка.

Благодарности. Эта работа финансировалась Чифэнским университетом «Сравнительное исследование характеристик почв типичных степей Монгольского плато на основе страны» (QDJRCYJ059), Провинциальный генеральный проект Китая «Исследование географической миграции Чахара. Племя в династиях Юань, Мин и Цин» (XXCHE202014), Проект Национального фонда социальных наук Китая

«Засуха на пастбищах Внутренней Монголии, оценка риска и исследования по ее предотвращению» (20BTJ043). Спасибо нашим преподавателям и научным руководителям, которые оказали нам большую поддержку, за ценные советы и рекомендации по написанию этой статьи.

For citation
Мантгар, Улаантуяа, Юхай Бао. Оценка качества питательных веществ типичных степных почв Монгольского нагорья // Природа Внутренней Азии. Nature of Inner Asia. 2021. № 4(19). С. 92–104. DOI: 10.18101/2542-0623-2021-4-92-104

Статья поступила в редакцию 24.10.2021; одобрена после рецензирования 16.11.2021; принята к публикации 20.12.2021.