WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 7, July, 2023

STUDY OF THE CHEMICAL COMPOSITION OF THE SOIL OF THE MIRZACHUL REGION

Ugiljon Gofurova
Assistant teacher of the Department of "Food Technologies" of the Yangiyer branch of the Tashkent Institute of Chemical Technology

Bobur Kholmuradov
Assistant teacher of the Department of "Food Technologies" of the Yangiyer branch of the Tashkent Institute of Chemical Technology

Trobjon Makhkamov
Candidate of biological sciences, associate professor, associate professor of the "Forestry" department of "The Agrarian University of the Republic of Uzbekistan"
✉Corresponding author, E-mail: [1]ogiljon_inbox@mail.ru.
[2]boburxolmuradov@mail.ru

Abstract
In this research work, soil samples from 3 regions of the Mirzachul zone of the Republic of Uzbekistan (Boyovut district, Khovos district, and the city of Yangiyer) were analyzed and laboratory analysis was carried out. In laboratory analysis, soil humus, electrical conductivity, pH, humidity, CO_2, $NO^{3-}N$, NH_4+N, Fe, P_2O_5, Mo^{6+}, K_2O, Zn, Cl^-, Cu, SO_4^{2-}, Mn, Ca, Mg^{2+} the number of substances were studied. After studying the salinity level of the soils of 3 regions, it was found to be in the range of pH 7-8.

Keywords: the morphology of dunes, soil moisture, geographical location, relief, climatic features, soil acidity,

Introduction

Today, many scientific studies have shown that global climate change is causing the rate of desertification to increase continuously. Thus, desertification is one of the most important problems of humanity today.[1]

Changes in surface temperature and soil erosion have the most direct effects on the soil ecosystem. A 1°C increase in global temperature would increase the water-holding capacity of the atmosphere by about 7%. This change leads to an increase in water vapor in the atmosphere, which ultimately contributes to a more intense trend in precipitation events. [2]

In the last two decades, the rate of warming of dryland ecosystems in Central Asia is almost twice as fast as the average rate of global warming. [3]

Comparing desert ecosystems with forest ecosystems, it can be seen that biological diversity is relatively low in desert ecosystems. In addition, the desert ecosystem differs from the forest ecosystem in terms of biological productivity and biological instability. Therefore, the desert ecosystem is prone to rapid change by external forces.[4]

Soil fertility in desert ecosystems is low, and nutrient deficient, and nutrient cycling is simple. Thus, the soil is plastic and changeable. [5]

Deserts are important components of terrestrial ecosystems, occupying approximately 20% of the Earth's surface [6]

Despite the low soil fertility of the desert region, xerophytes have adapted to grow in this region. Therefore, studying the nutritional status of desert soils, chemical elements ratio, relief structure and their relationship with biotic and abiotic factors can be useful for desert ecosystem management and desertification control.

Dunes are common in desert regions around the world and are the main landform units of deserts [7,8,9,10].

The morphology of dunes differs significantly from the morphology of the desert. There are the following types of dunes. It can be divided into linear (longitudinal), transverse, pyramidal, and honeycomb-shaped dunes. Linear dunes are relatively stable because the dunes' trend generally follows the sand wind's annual direction. Soil pH and electrical conductivity (EC, ms cm-1) are determined by standard methods. [11]

Determining soil moisture as a substrate for plant growth Soil nutrient composition is the result of the interaction between topography, soil environment, and abiotic and biotic factors, and this interaction is the basis for many studies. . [12,13,14,15,16]

C: N_2:P in the soil is usually directly related to soil type, climate zone, and topography. [17,18,19,20] On a large scale, climate change is the most important factor affecting plant and soil cytochemistry. [21,22]

On the other hand, climate change on a narrow scale can affect soil cytochemistry, soil topography, microrelief form, distribution of plants, and soil pH with enzyme activity. [23,24,25,26]

Soil chemistry is often considered an ecological factor in analyzing plant-environment relationships. On the contrary, the chemical composition of the soil is influenced by plants and other environmental factors. For example, precipitation, land use, vegetation cover, ecosystem type, and soil structure all influence [27,28,29,30]

As an integral component of soil-terrestrial ecosystems, it plays an important role in environmental protection, secure energy supply, and biodiversity conservation. The soil also provides nutrition to the plant ecosystem. [31] Global iqlim o'zgarishlari tuproq ekotizimini zaiflashtirishi va bu esa kelajak avlodlardagi hayvonlar va o'simliklar xavfsizligiga tahdid solishi taxmin qilinmoqda. [32,33]

In desert ecosystems, nitrogen ions (N_2), usually in the post-Water position, are the main factor limiting primary production, so it is very important to control the presence of N_2 factors, so it is very important to understand the factors controlling the presence of N_2. [34,35]

Water resources are considered to be the main indispensable factor for the development of agriculture and ecologically. Due to climate change and population growth, the natural boundaries of many countries and regions are pushed and several environmental and agricultural socio-economic problems such as drought, soil salinity, and food crisis arise. [36]

There is a continuous relationship between the soil and the plant. The effectiveness of nutrients in the soil can significantly affect plant growth, development, and propagation. [37,38,39,40,41,42]

The imbalance of substances in the soil leads to a decrease in soil fertility. The growth of shoots and shoots and the absorption of water and mineral substances from the soil to the roots, the movement of them through the conducting ligaments changes. Also, this condition can further affect soil cytochemistry. If this situation continues for a long time, different soil cytochemistry can significantly affect plant productivity and species composition at the ecosystem level. [43,44,45,46]

Issues such as increasing food demand, declining crop yields, and environmental degradation all pose major challenges to sustainable development in the country. [47]

For example, in Central Asia, the production of agricultural products occupies an important place as the main production sector. Due to the scarcity of natural water resources for the production of agricultural products, a gendered irrigation system is used. Since 1960, the water volume of the Aral Sea has been greatly reduced (about 75% of the area of the Aral Sea has disappeared) as a result of a sharp reduction in the arrival of the Amudarya and Syrdarya waters that supply the Aral Sea with the expansion of irrigation and irrational management of water resources. the decrease in water inflow has led to an increase in environmental problems such as soil salinization, vegetation degradation, and sandstorm formation. The amount of water used in agriculture is about 90% of the total amount of water used.[48]

Therefore, it is important to optimize the rational use of water resources, taking into account soil salinity control, to improve environmental conditions and ensure agricultural sustainability. [49]

Mirzachol's geographical location, topography, and climatic features shape its natural conditions. The combination of natural geographical conditions, especially climatic factors (soil, water, air) affects the health of people living here. Global and regional climate changes in the territory of Uzbekistan show that in 20-30 years the average annual temperature in the republic is expected to increase by 2-3 °C in the northern regions and by 1 °C in the southern regions. Salinity affects more than 20% of irrigated land, and soil salinity is a major problem limiting agricultural development worldwide. [50]

A high concentration of salt can have a negative effect not only on the physical and chemical properties of the soil but also on the growth and productivity of plants. [51]

Recently, the demand for food has been increasing. But for this, there are few opportunities to expand the land and cultivated areas. Uncultivated saline lands are a reserve resource for arable land without destroying the ecology. Many agricultural practices, including plowing, drip irrigation, and fertilization, are used to improve soil quality for these saline land uses. Conversion of uncultivated and uncultivated saline soils to tilled soils alters soil properties and soil microorganisms.[52]

Studying and implementing changes in soil microbial processes can help maintain long-term land-use sustainability in agricultural systems. [53,54]

As an important regulator of soil processes, soil microorganisms participate in the mineralization of nutrients, structure formation, nutrient capture, and transport to plants. Soil microorganisms are sensitive to changing environmental conditions, including salinity. An increase in soil salinity can cause a significant decrease in microbial biomass. [55,56]

When salinity stress was reduced, sensitive species such as fungi [57] or Gram-negative bacteria [58] increased, leading to corresponding shifts in microbial community composition. Even in highly saline soils, the activity and growth of sensitive functional groups can increase rapidly when electrical conductivity decreases and substrate availability increases. [59,60]

These changes in microbial biomass and community structure help to understand the effects of cultivation and may serve as early and sensitive indicators of future changes. [61,62]

The soil microbial community consists of two main functional groups, fungi, and bacteria, with distinct roles in microbial processes. [63]

During the Archaean and Protozoic eras, soil microbial biomass contributes only a small percentage. [64] Molecular biomarkers are mainly derived from cell membrane components such as ergosterol [65] and amino acids [66,67]. The cell wall components fungal glucosamine (GlcN) and bacterial muramic acid (Murein) are highly specific to two major functional microbial groups but accumulate as microbial residues in soil organic matter. [68,69]

Ergosterol is found only in fungi, but not in all, especially in arbuscular mycorrhizal fungi [70], but not in some Zygomycetes. [71]

As the largest reservoir of carbon (C) on Earth, terrestrial soils contain more than 70% of organic C. [72] The amount is greater than the combined mass of living biomass and organic C stored in the atmosphere. [73]

Therefore, C plays an important role in the composition of the soil and the periodic cycle of substances. In general, the decrease in the volume of water bodies on the surface of the earth leads to an increase in the concentration of carbon dioxide (CO_2) in the atmosphere and a decrease in the quality of the soil. These are the main driving forces of global warming and land degradation respectively. [74,75]

In contrast, water sequestration is a promising way to mitigate global warming and achieve sustainable agriculture. [76]

Water dynamics and its drivers are well-studied, and therefore widely used to simultaneously mitigate and manage the crisis of climate change and food insecurity. [77,78]

Land-use change can lead to changes in plant species and land management practices, both of which determine and determine the balance between gains and losses of soil organic matter. [79,80]

Hence, the watershed can be significantly affected by land use change. [81,82] So far, much attention has been paid to water dynamics in the topsoil (30 cm), mainly because the topsoil stores large amounts of water that can be easily affected by external influences. [83]

More than 27% of the world's water is stored in arid and semi-arid regions, which cover a third of the entire earth's surface and support more than 40% of humanity. [84] Empirical evidence has shown that ecosystems in these regions are important sinks for atmospheric CO_2.

Material and methods

An average sample is prepared from the soil brought from the field for analysis. That is, the soil sample is spread on a flat surface and divided into certain pieces. A total of 400 grams of soil samples will be taken from each plot. 100 grams of the obtained sample is placed in a drying cabinet for moisture determination, 100 grams is used to determine humus, and 100 grams is used to prepare an aqueous extract to determine the chemical composition.

When analyzing the soil samples, a technical balance (OHAUS» Evrope GmbH Model: SKX6201, max 6200 g) was used to weigh the sample.

First of all, to determine soil moisture, 100 grams of soil is taken and dried in a drying oven at 106 degrees, and its moisture content is determined. It is assumed that the effect of the amount of moisture on the obtained result is taken into account.

For analysis using a spectrophotometer, 100 grams of soil and 990 ml of distilled water are taken in a ratio of 10:1 and a solution is prepared.

Soil acidity and alkalinity were measured based on water absorption pH (PHS-3E pH meter Shanghai, China) and electrical conductivity ES (PHS-3E pH meter Shanghai, China). For this purpose, after 1 hour of this prepared solution, the pN index and electrical conductivity ES of the soil in the sample are determined.

Then, 10 mm of 5 molar formic acids is poured into this solution (after determining rN and electrical conductivity ES). The solution is left for an hour. The required amount is taken from the prepared watery syrup using filter paper. A certain amount is taken from the prepared aqueous extract through the necessary test cuvettes, and chemical analysis of the content of the extract is carried out in a DR-3900 (Germany) brand spectrophotometer in terms of quality and quantity. -2, Russia), the humidity of the room was controlled in % (Hygrometer psikhrometrichesky (oS) VIT-2, Russia) measuring device. Test cuvettes are used in the process of determining the chemical elements in the soil.

Spectrophotometric determination of macro and microelements in the soil.

To determine the moisture content of soil samples, we first take 100 grams of the soil sample on a scale ("OHAUS" Model: SKX6201 Switzerland) and dry it in a thermostat (VWR Germany) until it reaches a constant mass at 105 0C. It is determined by the following formula:

The weight of the soil container is determined (g)

the net weight of the soil is found (d)

The difference between the weight of wet soil (c) and absolute dry soil sample (d), that is, the amount of evaporated water, indicates the amount of soil moisture;

e=c-d

The amount of soil moisture is determined as a percentage from the following ratio:

d ---------100 %

ISSN: 2776-0979, Volume 4, Issue 7, July, 2023

e ---------x %

x ---$\frac{e \times 100}{d}$

When determining the organic content of soil samples, 10 grams of the soil sample is burned in a muffle furnace (Nabertherm GmbH, Germany) at 5500C. It is determined by the following formula:

Soil moisture content (f)

The weight of an earthenware pot is determined (g)

the net weight of the soil is found (d)

Depending on the difference between the weight of wet soil (c) and absolute dry burnt soil sample weight (d), the amount of burned soil is determined;

e=c-d

The amount of soil humus is determined as a percentage from the following proportion:

e---------100%

x---------f

x=$\frac{e \times f}{100}$

As a result =e-x

To prepare an aqueous solution (in a ratio of 1:10), take 100 g of the soil sample, dissolve it in 990 ml of distilled water (BIOSAN, Latvia), and leave it for 1 hour. conductivity values are determined, then 10 ml of 5 M formic acid is added to the aqueous solution and left for another 1 hour. After that, the aqueous extract is filtered and the water passed through the filter paper is analyzed.

Chemical analysis of the soil composition in terms of quality and quantity was carried out using the reagents shown in Table 1 in the spectrophotometer (DR-3900 Germany) by taking a certain amount of the prepared aqueous extract and using appropriate test cuvettes.

The experiment was conducted at a room temperature of 230C and humidity of 74% (psychrometric hygrometer VIT-2, Russia).

Results and Discussion

Table 1. Analysis of the chemical composition of soils (in terms of mg per 100 g)

Chemical substances	Boyovut district	Yangiyer city	Khovos district
NH^{4+}-N	1,62	0	2,13
P_2O_5	34,15	6,21	3,96
Mo^{6+}	10,93	6,48	6,73
K_2O	12,44	17,75	10,55
Zn	0,44	0,39	0,37
Cl-	40	40	338,92
Cu	0,28	0,18	0,12
SO_4^{2-}	61,59	402,5	414,37
Mn	1,06	0,72	1,76
Ca	42,07	45,5	53,05
Mg^{2+}	293,9	338,75	293,41

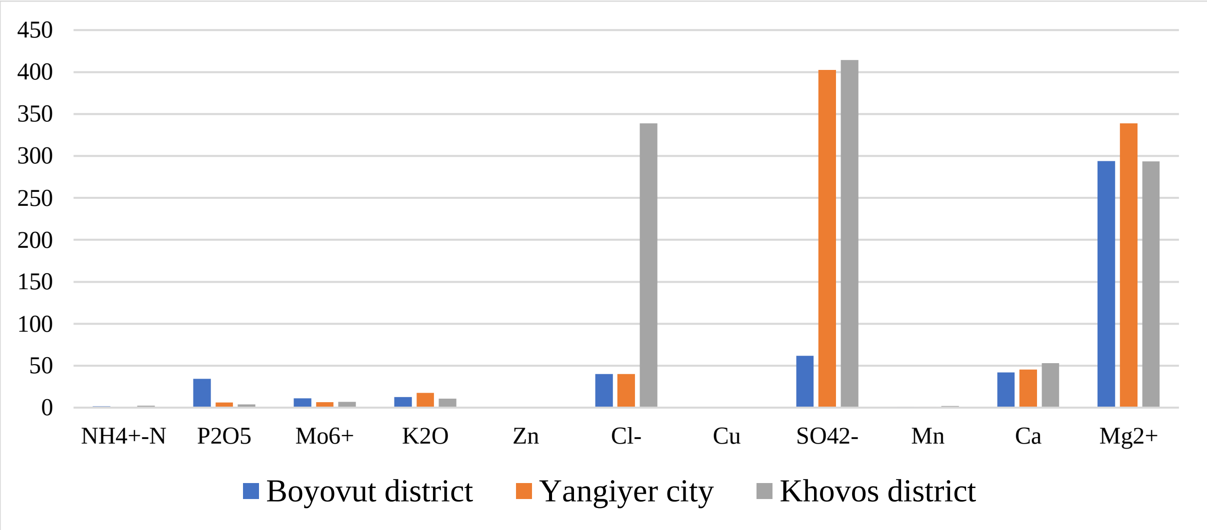

Diagram 1. Chemical composition (mg)

According to the soil samples of the Boyovut district, the following results were obtained. NH_4+N (mg/100 gr) 1.62 mg, P_2O_5 (mg/100 gr) 34.15 mg, Mo^{6+} (mg/100 gr) 10.93 mg, K_2O (mg/100 gr) 12.44 mg, Zn (mg/100 gr) 0.44 mg , Cl^- (mg/100 gr) 40 mg, Cu (mg/100 gr) 0.28 mg, SO_4^{2-} (mg/100 gr) 61.59 mg, Mn (mg/l) 1.06 mg, Ca (mg/100 gr) 42.07 mg, Mg^{2+} (mg/100 g) 293.90 mg.

The following results were obtained according to soil samples in the city of Tangier. NH_4+N (mg/100 gr) 0 mg, P_2O_5 (mg/100 gr) 6.21 mg, Mo^{6+} (mg/100 gr) 6.48 mg, K_2O (mg/100 gr) 17.75 mg, Zn (mg/100 gr) 0.39 mg , Cl^- (mg/100 gr) 40 mg, Cu (mg/100 gr) 0.18 mg, SO_4^{2-} (mg/100 gr) 402.50 mg, Mn (mg/l) 0.72 mg, Ca (mg/100 gr) 45.50 mg, Mg^{2+} (mg/100 g) 338.75 mg.

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 7, July, 2023

The following results were obtained according to soil samples in the Khavos district. NH_4+N (mg/100 gr) 2.13 mg, P_2O_5 (mg/100 gr) 3.96 mg, Mo^{6+} (mg/100 gr) 6.73 mg, K_2O (mg/100 gr) 10.55 mg, Zn (mg/100 gr) 0.37 mg , Cl^- (mg/100 gr) 338.92 mg, Cu (mg/100 gr) 0.12 mg, SO_4^{2-} (mg/100 gr) 414.37 mg, Mn (mg/l) 1.76 mg, Ca (mg/100 gr) 53.05 mg, Mg^{2+} (mg/100 g) 293.41 mg.

Table 2. Analysis of the chemical composition of soils (in mg per 1 l)

Address name	B (mg/l)	CO_2 (mg/l)	$NO^{-3}N^-$ (mg/l)	Fe (mg/l)
Boyovut district	0,23	276,83	42,07	5,17
Yangiyer city	0,18	175	0	3,525
Khovos district	0,17	285,03	29,1	2,43

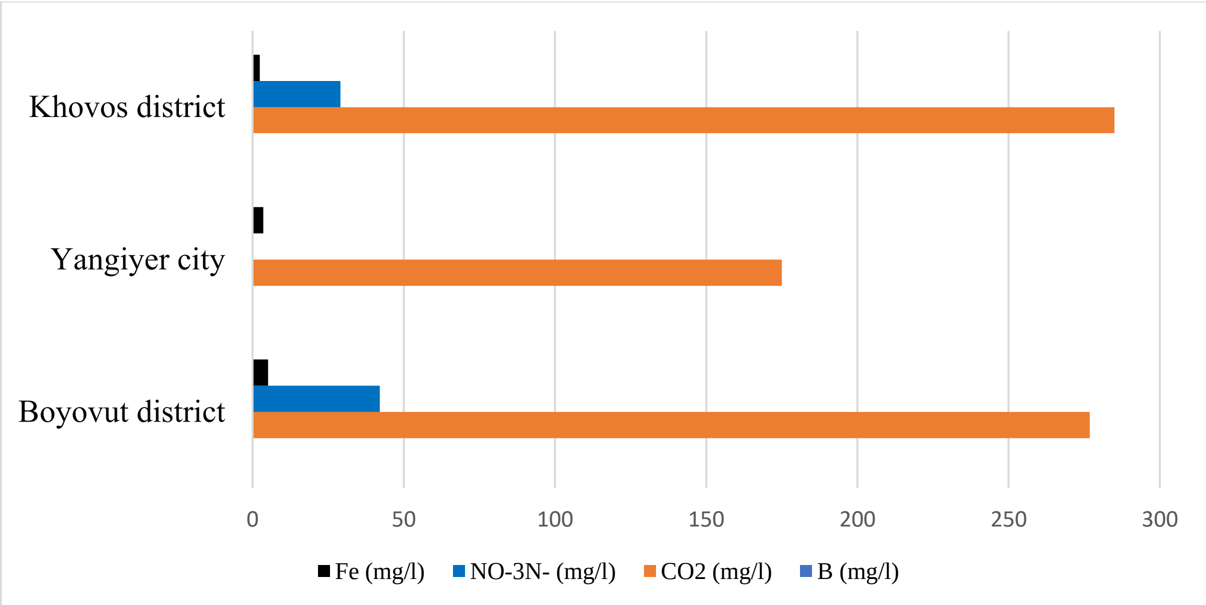

Diagram 2. Analysis of the chemical composition of soils

According to the soil samples of the Boyovut district, the following results were obtained. B (mg/l) 0.23 mg, NO_3-N (mg/l) 42.07 mg, Fe (mg/l) 5.17 mg, CO_2 (mg/l) 276.83 mg.

The following results were obtained according to soil samples in the city of Yangiyer. CO (mg/l) 175 mg, B (mg/l) 0.18 mg, NO_3-N - (mg/l) 0 mg, Fe (mg/l) 3.525 mg.

The following results were obtained according to soil samples in Khavos district. CO_2 (mg/l) 285.03 mg, B (mg/l) 0.17 mg, NO_3-N- (mg/l) 29.10 mg, Fe (mg/l) 2.43 mg

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 7, July, 2023

Table 3. Soil pH indicators

Address name	pH
Boyovut district	7,91
Yangiyer city	7,53
Khovos district	7,15

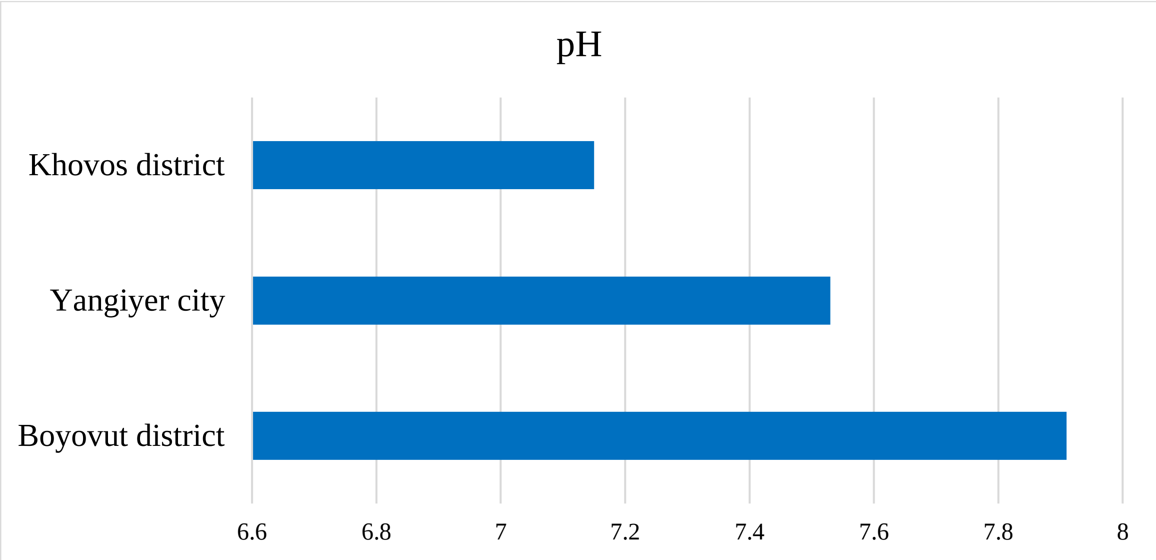

Diagram 3. Soil pH indicators

The soil pH of Boyovut district is pH 7.91.
The pH indicator of the soil of the city of Yangiyer is pH 7.53.
The pH indicator of the soil of Khovos district is pH 7.15.

Table 4. Electrical conductivity (mS/cm)

Address name	Electrical conductivity
Boyovut district	0,134
Yangiyer city	0,9
Khovos district	1,72

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 7, July, 2023

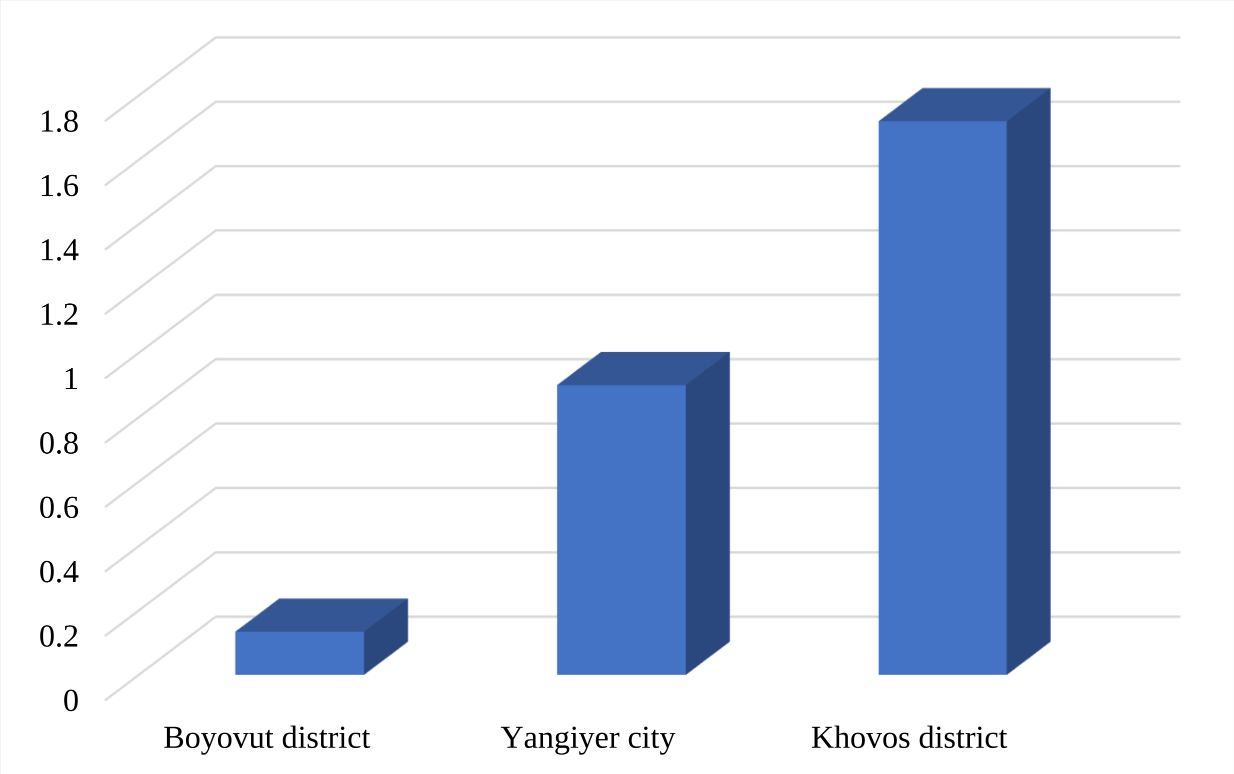

Diagram 4. Electrical conductivity (mS/cm)

Electrical conductivity of Boyovut district soil (mS/cm) 0.134 mS
The electrical conductivity of the soil of Yangiye city (mS/cm) is 0.9 mS
Electrical conductivity of the soil of Khavos district (mS/cm) 1.72 mS

Table 5. Analysis of soil organic content and moisture content (in % per 100 g)

Address name	**Hummus (Organic Content) % in 100 gr**	**Moisture % in 100 gr**
Boyovut district	0,9	18
Yangiyer city	0,8	20
Khovos district	0,8	16,5

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 7, July, 2023

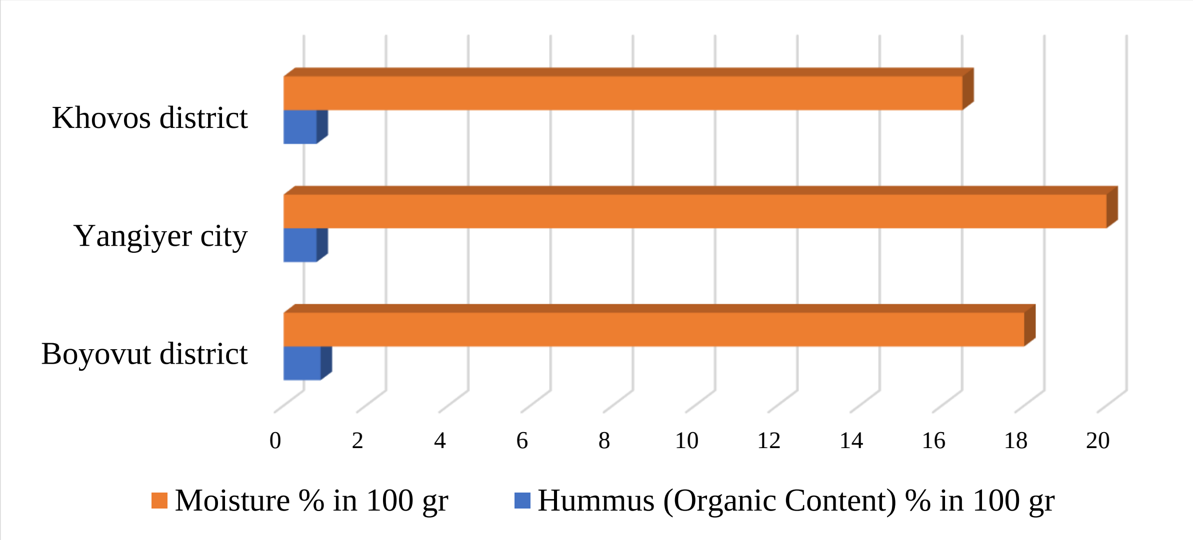

Diagram 5. Analysis of soil organic content and moisture content

Analysis of organic composition and moisture content of the soil of Boyovut district (in % per 100 g) Humus 0.9%, moisture 18%.
Analysis of the organic composition and moisture content of the soil of the city of Yangiyer (in % per 100 g) Humus 0.8%, moisture 20%.
Analysis of the organic composition and moisture content of the soil of Boyovut district (in % per 100 g) Humus 0.8%, moisture 16.50%.

Conclusion

Based on the soils taken from 3 zones of the Mirzachol region (Boyovut, Khovos districts, and the city of Yangiyer), we can make a conclusion about the electrical conductivity of the soils taken for analysis: Boyovut district is saline soil, Yangiyer city is weakly saline. soil, the moderately saline soil of Khovos district was determined. The Humus content of the regions is 0.8% on average in 10 grams of soil. According to the amount of moisture, the soil with a high level of moisture is the soil of the city of Yangiyer (18% per 100 g of soil), and the soil with a low level of moisture in the soil of Khovos district (16.5% per 100 g of soil). The pH indicator of soils was determined in a weak alkaline environment (average pH 7.53).

Acknowledgements

The results of the experiments presented in the article were obtained from plants planted according to the planting scheme on the experimental plot of the Yangiyer branch of the Tashkent Institute of Chemical Technology. For this we express our gratitude to the leadership of the Yangiyer branch of the Tashkent Institute of Chemical Technology.

WEB OF SCIENTIST: INTERNATIONAL SCIENTIFIC RESEARCH JOURNAL
ISSN: 2776-0979, Volume 4, Issue 7, July, 2023

REFERENCES

1. D'Odorico, P., Bhattachan, A., Davis, K.F., Ravi, S., Runyan, C.W., 2013. Global desertification: drivers and feedbacks. Adv. Water Res. 51, 326–344.

2. Mooney, H., Larigauderie, A., Cesario, M., Elmquist, T., Hoegh-Guldberg, O., Lavorel, S., et al., 2009. Biodiversity, climate change, and ecosystem services. Curr. Opin.Environ. Sustain. 1, 46–54.

3. (Hu, Z., Zhang, C., Hu, Q., Tian, H., 2014. Temperature changes in Central Asia from 1979 to 2011 based on multiple datasets. J. Clim. 27, 1143–1167.

4. Whitford, W.G., 2002. Ecology of Desert Systems. Academic Press, London, UK. Ward, D., 2009. The Biology of Deserts. Oxford University Press, London, UK.).

5. Sun, X., Ning, Z., Yang, H., Zhang, Z., Li, Y., 2018. The stoichiometry of carbon, nitrogen, and phosphorus in soil in typical desertified regions, north China. J. Desert Res. 38,1210–1218.

6. Whitford, W.G., 2002. Ecology of Desert Systems. Academic Press, London, UK.; Zhang, C., Lu, D., Chen, X., Zhang, Y., Maisupova, B., Tao, Y., 2016. The spatiotemporal patterns of vegetation coverage and biomass of the temperate deserts in Central Asia and their relationships with climate controls. Remote Sens. Environ. 175, 271–281.

7. Wasson va boshWasson, R.J., Fitchett, K., Mackey, B., Hyde, R., 1988. Large-scale patterns of dune type, spacing, and orientation in the Australian continental dunefield. Aust. Geogr. 19, 89–104.

8. Hesse, P.P., Simpson, R.L., 2006. Variable vegetation covers episodic sand movement longitudinal desert dunes. Geomorphology 81, 2765–3291.

9. Kidron, G.J., Vonshak, A., Dor, I., Barinova, S., Abeliovich, A., 2010. Properties and spatial distribution of macrobiotic crusts in the Negev Desert, Israel. Catena 82, 92–101.

10. Kidron, G.J., 2019. The dual effect of sand-covered biocrusts on annual plants: increasing cover but reducing individual plant biomass and fecundity. Catena 182, 104120.https://doi.org/10.1016/j.catena.2019.104120.**)**.

11. Bao, S., 2000. Soil and agricultural chemistry analysis, first ed. China Agriculture Press, Beijing, China.

12. Seibert, J., Stendahl, J., Srensen, R., 2007. Topographical influences on soil properties in boreal forests. Geoderma 141, 139–148.

13. Gilliam, F.S., Dick, D.A., 2010. Spatial heterogeneity of soil nutrients and plant species in herb-dominated communities of contrasting land use. Plant Ecol. 209, 83–94.

14. Bui, E.N., Henderson, B.L., 2013. C:N: P stoichiometry in Australian soils with respect to vegetation and environmental factors. Plant Soil 373, 553–568.
15. Feng, D., Bao, W., 2017. Review of the temporal and spatial patterns of soil C:N: Pstoichiometry and its driving factors. Chin. J. Appl. Environ. Biol. 23 (2), 400–408.
16. Cui, Y.X., Fang, L.C., Guo, X.B., Wang, X., Zhang, Y.J., Li, P.F., Zhang, X.C., 2018. Ecoenzymatic stoichiometry and microbial nutrient limitation in rhizosphere soil in the arid area of the northern Loess Plateau, China. Soil Biol. Biochem. 116, 11–21.
17. Li, Y., Wu, J.S., Liu, S.L., Shen, J.L., Huang, D.Y., Su, Y.R., Wei, W.X., Syers, J.K., 2012. Is the C:N: P stoichiometry in soil and soil microbial biomass related to the landscape and land use in southern subtropical China? Glob Biogeochem. Cycles 26 (4), 4002
18. Suo, Y., Yuan, Z., Lin, F., Wang, X., Ye, J., Bai, E., Hao, Z., 2016. Local-scale determinants of the elemental stoichiometry of soil in an old-growth temperate forest. Plant Soil 408 (1–2), 1–14.
19. Feng, D., Bao, W., 2017. Review of the temporal and spatial patterns of soil C:N: Pstoichiometry and its driving factors. Chin. J. Appl. Environ. Biol. 23 (2), 400–408.
20. Zeng, Q.C., Lal, R., Chen, Y.N., An, S.S., 2017. Soil, leaf, and root ecological stoichiometry of Caragana korshinskii on the Loess Plateau of China about plantation age. PLoS ONE 12, e0168890.
21. Feng, D., Bao, W., 2017. Review of the temporal and spatial patterns of soil C:N: Pstoichiometry and its driving factors. Chin. J. Appl. Environ. Biol. 23 (2), 400–408.
22. Tao, Y., Wu, G.L., Liu, Y.B., Zhang, Y.M., 2017a. Soil stoichiometry and their influencing factors in typical shrub communities in the Gurbantunggut Desert, China. J. Desert Res. 37 (2), 305–314.**);**
23. Seibert, J., Stendahl, J., Srensen, R., 2007. Topographical influences on soil properties in boreal forests. Geoderma 141, 139–148.
24. Li, C., Lei, J., Xu, X., Gao, Pei, Qiu, Y., Xu, B., Zhong, X., Wang, Y., Yan, J., Wang, G.,2014. Spatial pattern for soil water and chemical properties in Gurbantunggut Desert. Acta Ecol. Sin. 34, 4381–4389.
25. Suo, Y., Yuan, Z., Lin, F., Wang, X., Ye, J., Bai, E., Hao, Z., 2016. Local-scale determinants of elemental stoichiometry of soil in an old-growth temperate forest. Plant Soil 408 (1–2), 1–14.
26. **L**iu, X., Zhang, S., 2019. Nitrogen addition shapes soil enzyme activity patterns by changing pH rather than the composition of the plant and microbial communities in an alpine meadow soil. Plant Soil 440, 11.

27. Bui, E.N., Henderson, B.L., 2013. C:N: P stoichiometry in Australian soils with respect to vegetation and environmental factors. Plant Soil 373, 553–568.

28. Feng, C., Ma, Y., Fu, S., Chen, H.Y.H., 2017. Soil carbon and nutrient dynamics following cessation of anthropogenic disturbances in degraded subtropical forests. Land Degrad. Dev. https://doi.org/10.1002/ldr.2781.

29. Tao, Y., Wu, G.L., Liu, Y.B., Zhang, Y.M., 2017a. Soil stoichiometry and their influencing factors in typical shrub communities in the Gurbantunggut Desert, China. J. Desert Res. 37 (2), 305–314.

30. Wang, B.R., Yang, J.J., An, S.S., Zhang, H.X., Bai, X.J., 2018. Effects of vegetation and topography features on ecological stoichiometry of soil and soil microbial biomass in the hilly-gully region of the Loess Plateau, China. Chin. J. Appl. Ecol. 29 (1), 247–259.

31. Pereira, P., Bogunovic, I., Muñoz-Rojas, M., Brevik, E.C., 2018. Soil ecosystem services, sustainability, valuation and management. Curr. Opin. Environ. Sci. Health 5, 7–13

32. Mooney, H., Larigauderie, A., Cesario, M., Elmquist, T., Hoegh-Guldberg, O., Lavorel, S., et al., 2009. Biodiversity, climate change, and ecosystem services. Curr. Opin. Environ. Sustain. 1, 46–54.

33. Nelson, E.J., Kareiva, P., Ruckelshaus, M., Arkema, K., Geller, G., Girvetz, E., et al., 2013. Climate change's impact on key ecosystem services and the human well-being they support in the US. Front. Ecol. Environ. 11, 483–893

34. Hooper, D.U., Johnson, L., 1999. Nitrogen limitation in dryland ecosystems: responses togeographical and temporal variation in precipitation. Biogeochemistry 46, 247–293

35. Noy-Meir, I., 1973. Desert ecosystems: environment and producers. Annu. Rev. Ecol. Syst. 4, 25–51.

36. Djumaeva, D., Lamers, J. P. A., Khamzina, A., and Vlek, P. L. G., 2013, The benefits of phosphorus fertilization of trees grown on salinized croplands in the lower reaches of Amu Darya, Uzbekistan. Agroforestry Systems 87(3):555-569.

37. Bui, E.N., Henderson, B.L., 2013. C:N: P stoichiometry in Australian soils with respect to vegetation and environmental factors. Plant Soil 373, 553–568.

38. Wang, M., Moore, T.R., 2014. Carbon, nitrogen, phosphorus, and potassium stoichiometry in an Ombrotrophic peatland reflects plant functional type. Ecosystems 17 (4),673–684.

39. Fan, H., Wu, J., Liu, W., Yuan, Y., Hu, L., Cai, Q., 2015. Linkages of plant and soil C:N: P stoichiometry and their relationships to forest growth in subtropical plantations. Plant Soil 392, 127–138.

40. Di Palo, F., Fornara, D.A., 2017. Plant and soil nutrient stoichiometry along primary ecological successions: is there any link? PLoS ONE 12 (8), e0182569.
41. Zeng, Q.C., Lal, R., Chen, Y.N., An, S.S., 2017. Soil, leaf and root ecological stoichiometry of Caragana korshinskii on the Loess Plateau of China in relation to plantation age. PLoS ONE 12, e0168890.
42. Zeng, Q.C., Lal, R., Chen, Y.N., An, S.S., 2017. Soil, leaf and root ecological stoichiometry of Caragana korshinskii on the Loess Plateau of China in relation to plantation age. PLoS ONE 12, e0168890.
43. Ru, H.L., Zhang, H.D., Jiao, F., Guo, M.L., Xue, C.Y., 2016. Plant and soil C, N, P stoichiometric characteristics in relation to micro-topography in the hilly Loess Plateau region, China. J. Nat. Resour. 31 (10), 1572–1583.
44. Liu, X., Ma, J., Ma, Z.W., Li, L.H., 2017. Soil nutrient contents and stoichiometry as affected by land-use in an agro-pastoral region of northwest China. Catena 150, 146–153.
45. Wang, B.R., Yang, J.J., An, S.S., Zhang, H.X., Bai, X.J., 2018. Effects of vegetation and topography features on ecological stoichiometry of soil and soil microbial biomass in the hilly-gully region of the Loess Plateau, China. Chin. J. Appl. Ecol. 29 (1), 247–259.
46. Yang, Y., Liu, B.R., An, S.S., 2018. Ecological stoichiometry in leaves, roots, litters and soil among different plant communities in a desertified region of northern China. Catena 166, 328–338.
47. Nouri, H., Stokvis, B., Galindo, A., Blatchford, M., and Hoekstra, A. Y., 2019, Water scarcity alleviation through water footprint reduction in agriculture: The effect of soil mulching and drip irrigation. Science of The Total Environment 653:241-252.
48. Djanibekov, U., and Finger, R., 2018, Agricultural risks and farmland consolidation process in transition countries: The case of cotton production in Uzbekistan. Agricultural Systems 164:223-235.
49. Yao L., Xu Z., Chen X., 2019, Sustainable Water Allocation Strategies under Various Climate Scenarios: A Case Study in China. Journal of Hydrology 574:529-543.
50. Qadir, M., Ghafoor, A., Murtaza, G., 2000. Amelioration strategies for saline soils: a review. Land Degrad. Dev. 11, 501–521
51. Keren, R., 2000. Salinity. In: Summer, M.E. (Ed.), Handbook of Soil Science. CRC Press,Boca Raton, pp. 3–25.
52. Yuan, B.C., Li, Z.Z., Liu, H., Gao, M., Zhang, Y.Y., 2007. Microbial biomass and activity in salt affected soils under arid conditions. Appl. Soil Ecol. 35, 319–328.

53. Yao, H., He, Z., Wilson, M., Campbell, C., 2000. Microbial biomass and community structure in a sequence of soils with increasing fertility and changing land use. Microb. Ecol. 40, 223–237

54. de Vries, F.T., Liiri, M.E., Bjørnlund, L., Bowker, M.A., Christensen, S., Setälä, H.M., Bardgett, R.D., 2012. Land use alters the resistance and resilience of soil food webs to drought. Nat. Clim. Change 2, 276–280.

55. Batra, L., Manna, M., 1997. Dehydrogenase activity and microbial biomass carbon in salt-affected soils of semiarid and arid regions. Arid Land Res. Manag. 11, 295–303;

56. Rietz, D.N., Haynes, R.J., 2003. Effects of irrigation-induced salinity and sodicity on soil microbial activity. Soil Biol. Biochem. 35, 845–854.

57. Sardinha, M., Müller, T., Schmeisky, H., Joergensen, R.G., 2003. Microbial performance in soils along a salinity gradient under acidic conditions. Appl. Soil Ecol. 23, 237–244.

58. Schimel, J.P., Balser, T.C., Wallenstein, M., 2007. Microbial stress response physiology and its implications for ecosystem function. Ecology 88, 1386–1394.

59. Muhammad, S., Müller, T., Joergensen, R.G., 2006. Decomposition of pea and maize straw in Pakistani soils along a gradient in salinity. Biol. Fertil. Soils 43, 93–101;

60. Wichern, J., Wichern, F., Joergensen, R.G., 2006. Impact of increased salinity on soil microbial communities and decomposition of maize in acidic soils. Geoderma 137, 100–108.

61. Powlson, D.S., Brookes, P.C., Christensen, B.T., 1987. Measurement of soil microbial biomass provides an early indication of changes in total soil organic matter due to straw incorporation. Soil Biol. Biochem. 19, 159–164.

62. Joergensen, R.G., Emmerling, C., 2006. Methods for evaluating human impact on soil microorganisms based on their activity, biomass, and diversity in agricultural soils. J. Plant Nutr. Soil Sci. 169, 295–309.

63. de Vries, F.T., Hoffland, E., Eekeren, N., Brussaard, L., Bloem, J., 2006. Fungal/bacterial atios in grasslands with contrasting nitrogen management. Soil Biol. Biochem. 38, 2092–2103

64. Joergensen, R.G., Emmerling, C., 2006. Methods for evaluating human impact on soil microorganisms based on their activity, biomass, and diversity in agricultural soils. J. Plant Nutr. Soil Sci. 169, 295–309.

65. Djajakirana, G., Joergensen, R.G., Meyer, B., 1996. Ergosterol and microbial biomass relationship in soil. Biol. Fertil. Soils 22, 299–304

66. Frostegård, Å., Bååth, E., Tunlid, Å., 1993. Shifts in the structure of soil microbial communities in limed forests as revealed by phospholipid fatty acid analysis. Soil Biol. Biochem. 25, 723–730

67. Amelung, W., 2001. Methods using amino sugars as markers for microbial residues in soil. In: Lal, J.M., Follett, R.F., Stewart, B.A. (Eds.), Assessment Methods for Soil Carbon. Lewis Publishers, Boca Raton, pp. 233–272.

68. Amelung, W., 2001. Methods using amino sugars as markers for microbial residues in soil. In: Lal, J.M., Follett, R.F., Stewart, B.A. (Eds.), Assessment Methods for Soil Carbon. Lewis Publishers, Boca Raton, pp. 233–272.

69. Appuhn, A., Joergensen, R.G., 2006. Microbial colonisation of roots as a function of plant species. Soil Biol. Biochem. 38, 1040–1051.

70. Olsson, P.A., Larsson, L., Bago, B., Wallander, H., van Aarle, I.M., 2003. Ergosterol and fatty acids for biomass estimation of mycorrhizal fungi. New Phytol. 159, 1–10.

71. Weete, J.D., Gandhi, S.R., 1999. Sterols and fatty acids of the Mortierellaceae: taxonomic implications. Mycologia 91, 642–649.

72. Parras-Alcántara, L., Lozano-García, B., Brevik, E.C., Cerdá, A., 2015. Soil organic carbon stocks assessment in Mediterranean natural areas: a comparison of entire soil profiles and soil control sections. J. Environ. Manage. 155, 219–228.

73. Köchy, M., Hiederer, R., Freibauer, A., 2015. Global distribution of soil organic carbon–Part 1: masses and frequency distributions of SOC stocks for the tropics, permafrost regions, wetlands, and the world. Soil 1, 351–365.

74. Lal, R., 2010. Managing soils and ecosystems for mitigating anthropogenic carbon emissions and advancing global food security. Bioscience 60, 708–721.

75. Schuur, E.A.G., McGuire, A.D., Schädel, C., Grosse, G., Harden, J.W., Hayes, D.J., Hugelius, G., Koven, C.D., Kuhry, P., Lawrence, D.M., Natali, S.M., Olefeldt, D., Romanovsky, V.E., Schaefer, K., Turetsky, M.R., Treat, C.C., Vonk, J.E., 2015. Climate change and the permafrost carbon feedback. Nature 520, 171.

76. Stockmann, U., Adams, M.A., Crawford, J.W., Field, D.J., Henakaarchchi, N., Jenkins, M., Minasny, B., McBratney, A.B., de Remy de Courcells, V., Singh, K., Wheeler, I., Abbott, L., Angers, D.A., Baldock, J., Bird, M., Brookes, P.C., Chenu, C., Jastrow, J.D., Lal, R., Lehmann, J., O'Donnell, A.G., Parton, W.J., Whitehead, D., Zimmermann, M., 2013. The knowns, known unknowns and unknowns of sequestration of soil organic carbon. Agr. Ecosyst. Environ. 164, 80–99.

77. Lal, R., 2010. Managing soils and ecosystems for mitigating anthropogenic carbon emissions and advancing global food security. Bioscience 60, 708–721.;

78. Stockmann, U., Adams, M.A., Crawford, J.W., Field, D.J., Henakaarchchi, N., Jenkins, M., Minasny, B., McBratney, A.B., de Remy de Courcells, V., Singh, K., Wheeler, I.,Abbott, L., Angers, D.A., Baldock, J., Bird, M., Brookes, P.C., Chenu, C., Jastrow, J.D., Lal, R., Lehmann, J., O'Donnell, A.G., Parton, W.J., Whitehead, D., Zimmermann, M., 2013. The knowns, known unknowns and unknowns of sequestration of soil organic carbon. Agr. Ecosyst. Environ. 164, 80–99

79. Muñoz-Rojas, M., Jordán, A., Zavala, L.M., Rosa, D.D.L., Abd-Elmabod, S.K., AnayaRomero, M., 2015. Impact of land use and land cover changes on organic carbon stocks in Mediterranean soils (1956–2007). Land Degrad. Dev. 26, 168–179;

80. Liu, X., Li, L., Qi, Z., Han, J., Zhu, Y., 2017. Land-use impacts on profile distribution of labile and recalcitrant carbon in the Ili River Valley, northwest China. Sci.TotalEnviron. 586, 1038–1045.

81. Deng, L., Liu, G., Shangguan, Z., 2014. Land-use conversion and changing soil carbon stocks in China's 'Grain-for-Green' Program: a synthesis. Glob. Chang. Biol. 20, 3544–3556

82. Yu, P., Han, K., Li, Q., Zhou, D., 2017. Soil organic carbon fractions are affected by different land uses in an agro-pastoral transitional zone in Northeastern China. Ecol. Indic. 73, 331–337.

83. Jiang, X., Cao, L., Zhang, R., 2014. Changes of labile and recalcitrant carbon pools under nitrogen addition in a city lawn soil. J. Soils Sediments 14, 515–524.

84. Han, Q., Luo, G., Li, C., Shakir, A., Wu, M., Saidov, A., 2016. Simulated grazing effects on carbon emission in Central Asia. Agric. For. Meteorol. 216, 203–214.