Scientific Bulletin of Mukachevo State University

Series

Economics

Volume 9, No. 4, 9-15
Journal homepage: https://economics-msu.com.ua/en

UDC: 332:631.4:504.53
DOI: 10.52566/msu-econ.9(4).2022.9-15

Economics of Soil Carbon and its Specifics in Ukraine

Maria Hnatyshyn*

PhD in Economics, Associate Professor, Department of Analytical Economy and International Economics, ORCID: https://orcid.org/0000-0002-0854-0568

Ivan Franko National University of Lviv, 79000, 1 Universytetska Str., Lviv, Ukraine

Abstract. Anthropogenic emissions are one of the main causes of global warming. Carbon dioxide is the most commonly produced greenhouse gas. Sequestration is one of the options to decrease the amount of atmospheric carbon dioxide. One of the main types of carbon sequestration is the biological carbon sequestration method of soil carbon sequestration. There are various estimates of the SCS potential of soils since the knowledge of soil carbon conservation processes is still limited. However, it is evident that degraded soils have more potential to sequester carbon. The aim of the paper is to analyze the social cost of soil organic carbon in soils of Ukraine, discuss different ways used to estimate the price of soil organic carbon and the carbon sequestration potential of different soils. The social cost of carbon was used to estimate the value of soil organic carbon stocks in Ukraine because it shows the avoided social cost of carbon emissions. The social cost of carbon represents the net present value of the climate change impact of additional carbon released into the atmosphere (marginal global damage costs). Estimation of the social cost of SOC stock in different types of soils in Ukraine makes it possible to compare alternative land use options and to make right policy choices. The results depict the high importance of Ukrainian soils in preventing global climate changes through carbon storage. Czornozem soils are especially rich in SOC, and therefore more valuable in terms of the ecosystem services they provide. The sequestration potential of most types of Ukrainian soils exceeds the sequestration potential of forests. The article proposes measures and practices for soil carbon sequestration and SOC protection. The implementation of the measures to preserve and accumulate SOC will contribute to the increase in biological productivity of agricultural soils and, consequently, boost the yield of cultivated crops, which will have a positive effect on food security

Keywords: climate change, soil organic carbon, carbon sequestration, carbon price, social cost of carbon

Received: 27.09.2022, Revised: 15.11.2022, Accepted: 29.11.2022

Suggested Citation: Hnatyshyn, M. (2022). Economics of soil carbon and its specifics in Ukraine. *Scientific Bulletin of Mukachevo State University. Series "Economics"*, 9(4), 9-15.

*Corresponding author

Introduction

Global climate change is one of the main threats for the humanity. It is 95% possible that anthropogenic emissions since the 1950s are the main cause of global warming [1]. The process can be slowed down or even stopped if humanity manages to mitigate emissions sufficiently. CO_2 is the most commonly produced greenhouse gas so researches often focus on it. The amount of CO_2 in the atmosphere increased from approximately 280 ppm in 1850 to 411.44 ppm in 2019 according to the Intergovernmental Panel on Climate Change data [2]. Except mitigation, there is one more option to decrease the amount of atmospheric carbon dioxide – to sequester it, which means capture and store it. There are two main types of carbon sequestration: geological and biological. The focus of the research is on the biological carbon sequestration method of soil carbon sequestration (SCS). Estimates of SCS potential differ. In general, the best solution is to increase carbon stocks in degraded soils to recover the historical losses.

A number of international organizations explore the possibilities of sustainable land use as a means of adapting to and mitigating climate change. The main of them are the International Initiative "4 per 1000", the International Federation of Organic Agricultural Movements (IFOAM), the Intergovernmental Panel on Climate Change (IPCC), the non-profit environmental law organization Earthjustice, etc. National Scientific Center "O.N. Sokolovsky Institute for Soil Science and Agrochemistry Research", The Institute of Bioenergy Crops and Sugar Beet (IBC&SB) NAAS, Institute of Agroecology and Environmental Management of NAAS and others study the problem in Ukraine.

Restoration of the level of organic matter in the soil requires an understanding of environmental processes important for its preservation. Soil organic matter is composed of soil microbes including bacteria and fungi, decaying material from plants, animals and other organisms and products of their decomposition. Highly decomposed material is called humus. Those organic compounds of soil contain carbon, which is called soil organic carbon (SOC). The higher the amount of organic matter in soil is, the higher is the SOC. SOC is stored in soil through photosynthesis – transformation of atmospheric CO_2 into plant biomass. Only small part of the original carbon from biomass is retained in the soil through the formation of humus, larger share of it is lost as CO_2 due to microbial respiration during the process of decomposition. Compared to biomass, humus is highly resistant to decomposition and can be stored in soil for a long time. Biomass has a much shorter residence time in soil. Carbon can be also lost from soil through soil erosion and leaching of dissolved carbon into groundwater. When the inputs and outputs of carbon are equal, the SOC level remains stable. In other cases, the SOC level may decrease if carbon loss exceeds its inputs, or increase, when carbon inputs from photosynthesis exceed its losses [3]. SOC is highly important for agriculture. It improves soil quality through increased retention of water and nutrients, which makes the soil more productive, improves soil structure and reduces erosion, which improves water quality. Therefore, it increases food security and decreased negative impacts to ecosystems.

The purpose of the study is to analyze the social cost of SOC in soils of Ukraine, to discuss the sequestration potential of Ukrainian soils and to propose measures and practices for SOC protection.

Problems of climate change, greenhouse gas emissions, soil productivity and carbon sequestration have been studied by R. Lal [4]; T. Ontl & L. Schulte [3]; T. Ligthart & L. van Harmelen [5]; J. Berazneva et al. [6]; M. Sperow [7]; E.A. Mikhailova et al. [8] and others. T. Ontl & L. Schulte analyze the process of soil carbon storage as a vital ecosystem service [3]. T. Ligthart & L. van Harmelen [5] estimate abatement-based and damage-based shadow prices for SOC depletion. E.A. Mikhailova et al. [8] use the avoided social cost of CO_2 to assess the value of SOC stocks. R. Lal [4] discusses strategies to increase the soil carbon pool and possibilities of enhancing food security through carbon sequestration. J. Berazneva et al. [6] also analyze soil carbon management practices and investigate their efficiency. M. Sperrow [7] estimates biophysical potential for SOC accumulation and narrows his attention to no-till method and finds it cost-effective. Problems of greenhouse gas reduction and SCS in the soils of Ukraine are presented in the works of S. Balyuk & A. Kucher [9]; A. Kucher [10]; S. Balyuk, B. Nosko & L. Vorotintseva [11]; V. Medvedev [12]; O. Tarariko et al. [13]; S. Pozniak [14] and others. S. Balyuk, B. Nosko & L. Vorotintseva [11] pay much attention to the assessment of SOC stocks in Ukrainian soils and sustainable soil management in Ukraine. They show the leading role of Ukraine in global food security provision and stress the importance of soils of Ukraine in dealing with the global problem of carbon sequestration. A. Kucher [10] assesses the economic value of soil carbon sequestration and the necessary financial support for low-carbon land use implementation in Ukraine. O. Tarariko et al. [13] promote balanced land use and soil protection from erosive degradation in their study, give recommendations on the national agricultural land resources management improvement. S. Pozniak & M. Hnatyshyn [14] pay more attention to international aspects of soil carbon sequestration and analyze the prospects of implementation of the international initiative "4 per 1000" in Ukraine. The need to ensure sustainable development brings together scientists from various fields.

Materials and Methods

The study is based on interdisciplinary approach. The screening and content analysis of scientific journals and publications in environmental economics, agricultural economics and soil studies has been conducted. A number of websites of international organizations were used concerning the possibilities of sustainable land use and how those sustainable practices can help to mitigate climate change and to adapt to it. The following methods were used in the study: calculation-constructive, statistical and graphic methods, analysis and synthesis, comparative analysis, economic analysis. Abstract-logical method was used for conclusions and recommendations formulation.

To estimate the value of soil organic carbon stocks in Ukraine the social cost of carbon was used. The data used in the study was obtained from international agencies and scientific papers. The study is based on the calculated humus reserves in the main Ukrainian soils conducted by Baliuk et al. [15]. The main sources of data used by them for the calculation of SOC were the data of soil surveys of the National Scientific Center "O.N. Sokolovsky Institute for Soil Science and Agrochemistry Research", scientific institutions of the National Academy of Agrarian Sciences of Ukraine, higher educational institutions and the laboratory of forest soil science of the G.M. Vysotsky Research Institute of Forestry and Forest Melioration. The economic assessment of SOC reserves in Ukrainian soils was conducted through social cost of SOC in Ukrainian soils estimation. Social cost represents the net present value of the climate change impact of additional carbon released into the atmosphere (marginal global damage costs). For the estimation of social cost of SOC the social cost of CO_2 was used as provided by the U.S. Environmental Protection Agency (EPA) [16]. The social cost of CO_2 is measured by the EPA in USD. It represents the money value of damage caused by 1 ton of CO_2 emissions. It includes changes in net agricultural productivity, human health, damages from different climate change risks, changes in energy system costs etc. Therefore, it is designed to include all negative and, if there are such, positive consequences of CO_2 emissions. However, it is not always possible to cover all consequences that might occur because of the lack of precise information. The value of emissions depends on the time span taken into account (the last year included in the forecast), and on the year in which CO_2 is emitted. The large the time span is and the more years are left to emit the higher will be the damage. So, the value is different for each year. Besides, discount rate should be taken into account. The EPA proposes calculations for 5%, 3% and 2.5% discount rates from which the 3% discount rate was chosen for this study. The social cost of CO_2 evaluated by the EPA was transformed into the cost of SOC based on the amount of carbon. It enabled the estimation of social cost of SOC in soils of Ukraine.

Results and Discussion

According to the overview performed by Ontl and Schulte, approximately 3170 GT of C (organic and inorganic) are stored in total in terrestrial ecosystems. 2500 GT of carbon is found in soil, 1550 GT of which is organic C. For comparison, the amount of carbon found in living plants and animals is only 560 GT and the amount of carbon found in atmosphere is 800 GT [3].

Approximately twenty-four billion tons of fertile topsoil is lost every year. It is 10 to 40 times faster than the rate of soil formation. Therefore, approximately 50-70% of soil carbon stocks have been lost in cultivated soil and it is called soil degradation. 25% of the earth's surface has already become degraded [17]. Plowed land ratio in Ukraine reaches 53.8%, which is high compared to European countries, plowed land of which make up 30-32% of the total area [9]. Besides, Ukraine is currently experiencing soil degradation caused by the war. According to preliminary estimates of the Ministry of Ecology and Natural Resources of Ukraine, published on the website of the "EcoTreat" project, the estimated amount of damages caused to the environment of Ukraine as of Aug 1st, 2022 is 204 billion UAH. The number includes soil pollution – the spillage of 5.589 tons of petroleum products. The estimated cost of the damage is 3.385 million UAH [18].

It is not an easy task to estimate the price of SOC. It is necessary to distinguish different evaluation methods of carbon price in agriculture. The first one is based on the cost of pollution removal. In this case, it is the value of SCS for the farmer. How much do farmers have to invest to sequester certain value of carbon, how much will they need to invest in future to preserve the carbon in soil, and opportunity cost – the profit that could be earned using carbon-intensive technologies. In certain cases, carbon sequestering and carbon preserving technologies may be even more productive than carbon emitting ones. The second carbon price that can be touched upon is the market price of carbon. It is formed under the emission trading schemes (like EU Emissions Trading Scheme). The cost of emission permits on the EU market in May 2021 for the first time crossed the limit of 50 USD/t CO_2e [19]. The third one is the social cost of SOC, which is based on damage, caused by CO_2 emissions. It is a marginal cost of the damage caused by emission of additional ton of CO_2 into the atmosphere.

There are different estimations of the shadow price of SOC. According to Ligthart and Harmelen, the shadow price of SOC based on the cost of pollution removal is 100 EUR/t SOC and the shadow price based on the damage is 28.6 EUR/t SOC [5]. Another study estimates the shadow price of the steady state of the soil carbon in the range from 95 USD/t to 168 USD/t [6]. According to the findings of the High-Level Commission on CO_2 Emissions, the price to achieve the goals of the Paris Agreement which will ensure an increase in temperature by no more than 2 C by 2030 is 50-100 USD/t CO_2 [20].

Based on the calculated humus reserves in the main Ukrainian soils of 100-720 t/ha, and, accordingly, SOC – 58-418 t/ha, A.V. Kucher [10] made an economic assessment of SOC reserves in Ukrainian soils, which is 14.4-103.7 thousand USD/ha. That means the price of SOC he considers is approximately 248 USD/t SOC.

Sperrow [7] has calculated the cost of no-till method on U.S. cropland and found out that almost 95% of the biophysical potential of SCS on U.S. cropland could be captured for less than \$100 per ton of CO_2. And he states that this method is cheaper than geologic storage.

In contrast to emissions mitigation technologies sequestration methods usually involve annual spending on keeping C sequestered, i.e., if CO_2 was sequestered due to no-till method the tillage will eliminate all the efforts. Therefore, SCS is not a one-time action. The market carbon price should be modified to get the actual price of carbon sequestration in agriculture to cover the risks of reemissions. As agriculture is also a large emitter of greenhouse gases, it can be talked of the carbon tax which will stimulate farmers to sequester carbon or the carbon subsidy for farmers sequestering carbon. That is, policy options and the cost of SCS for the state. Some scientist proposes to valuate soil organic carbon stocks based on the avoided social cost of carbon emissions [8]. It is also possible to use this evaluation for newly sequestered carbon which adds to overall SOC.

Using the assessment of SOC stock in profile of Baliuk et al. [15] the social cost of SOC in Ukrainian soils was estimated. For that purpose, the estimation of CO_2 social cost of the EPA was used. It has calculated the social cost of carbon as $46 per metric ton of CO_2 emissions in the year 2025 (2007 USD) at 3% discount rate [16]. NSC ISSAR experts estimate total SOC stocks in soils in Ukraine as 7 Gt [15]. Based on that data and estimations the cost of SOC in soils of Ukraine was calculated using the following equation:

$$Cost\ of\ SOC\ stock\ =\ SOC\ stock\ \times \frac{11}{3} \times cost\ of\ CO2\ \times inflation \quad (1)$$

To count the overall value of SOC in Ukrainian soils total SOC stocks in soils in Ukraine were multiplied by the social cost of carbon. The price of CO_2 was converted into the price of SOC. The proportion is 11/3 [8]. The social cost of SOC was obtained in 2007 USD. To get the result in 2020 USD amendments for inflation had to be made. Inflation since 2007 was 31.67% according to the World Bank data. Therefore, the cost of SOC stock in Ukrainian soils was counted according to the equation 1 as follows:

$$Cost\ of\ SOC\ stock\ =\ 7\ \times\ 109\ (SOC) \times \frac{11}{3}\left(\frac{CO2}{SOC}\right) \times\ 46\ \left(\frac{USD}{CO2}\right) \times\ 1.3167 \quad (2)$$

The cost of SOC stock equals 1.554.5838 bln USD. The social cost of SOC per hectare of Ukrainian soil is 1.554.5838 bln USD / 60 362 800 ha = 257.540 USD/ha.

However, this indicator is much aggregated, as soils differ considerably by their SOC content. Further, the SOC social cost for different kinds of soil was calculated. The social cost of SOC is 84.2688 USD/t. So, the average price per ha of the main types of soils in Ukraine and the social cost of those soils in 2020 USD was calculated (Table 1, Fig. 1).

Table 1. Social cost of SOC in Ukrainian soils

Soil type	Average SOC stocks in profile, t/ha	Total stocks of SOC (average values), Mt	Social cost per hectare, USD/ha	Social cost by type of soil, million USD
Chornozems ordinary	217.5	2 283.75	24133.09	253397.43
Chornozems typical	261.0	1 513.80	28959.71	167966.30
Chornozems southern	130.5	469.80	14479.85	52127.47
Chornozems podzolized	165.5	562.70	18363.34	62435.35
Chornozem-meadow soils	313.5	627.00	34784.93	69569.87
Gray forest soils	95.5	410.65	10596.37	45564.38
Sod-podzolic soils	124.5	485.55	13814.11	53875.04

Source: [14-16], own calculations

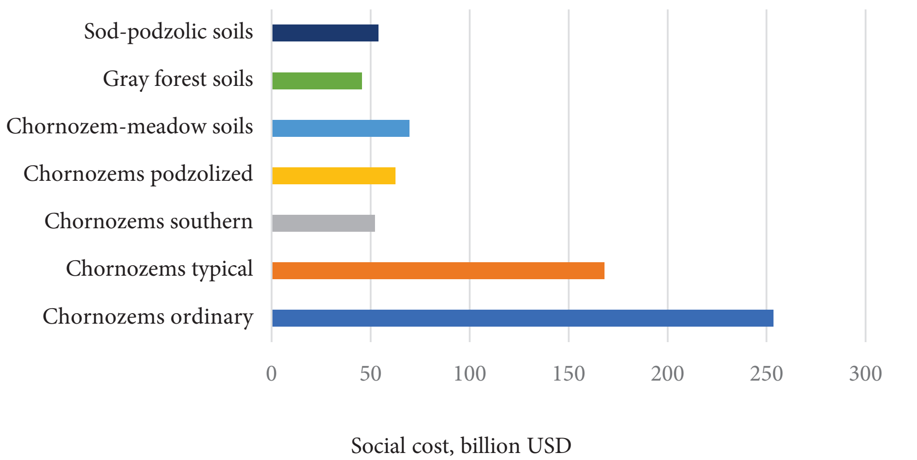

Figure 1. Social cost of the main types of soils in Ukraine

Source: [14-16], own calculations

This means the ecosystem services which soil provides through C storage is very valuable. The sequestration potential of most types of Ukrainian soils exceeds the sequestration potential of forests. For example, the amount of C in forest biomass in Malaysia is 153.14 t/ha [21]. SOC depletion diminishes the amount of C sequestered in soil and therefore decreases its value, while SCS can increase the value of soils.

There are various estimates of soil carbon sequestration potential since carbon removal practices differ significantly and the knowledge of soil carbon conservation processes is still limited. UNEP Foresight Brief cites theoretical estimates of carbon sequestration potential of 0.8 up to 8 Gt C annually (some studies include afforestation or re-forestation practices) and the agricultural land potential up to 10 Gt C annually [17]. Practically achievable sequestration is in the range of 1.5 to 2.5 Gt C annually [17]. The problem is that SCS is potentially reversible and has natural limits. The same soils can emit or sequester carbon depending on the methods of cultivation. Degraded soils have more potential to sequester carbon. Therefore, the process of SCS has to be wisely managed and include social and economic caveats.

By applying the right methods, the functions of terrestrial ecosystems can be largely restored, the amount of SOC and soil productivity can be increased and the greenhouse gas emissions can be reduced. A number of SOC conservation and accumulation measures are proposed by the 4 per 1000 Initiative, Earthjustice, the International Federation of Organic Agricultural Movements (IFOAM), and a number of scientists: R. Lal [4]; S. Balyuk & A. Kucher [9]; S. Balyuk, B. Nosko & L. Vorotintseva [11]; V. Medvedev [12]; O. Tarariko et al. [13]; D. Suleiman & T. Westhof [22]; Simionescu et al. [23] etc. First of all, the relevant crops that have the highest yields in certain soil and climatic conditions should be cultivated; this will create the largest number of food with the lowest consumption of fuel, fertilizers and pesticides. It is advised to use crop rotations, which increase the accumulation of soil organic matter and reduce soil erosion, and to reduce tillage, as greenhouse gas is emitted from soil disturbance. Moreover, less tillage will reduce energy consumption. However, the no-till method may require the use of larger amounts of herbicides.

Concerning fertilizers, organic fertilizers are preferable because they increase the amount of soil organic carbon, intensify the soil-forming process and reduce soil contamination with synthetic fertilizers. The methods and techniques of mineral fertilizers application should be improved to reduce the amounts of fertilizers used.

Forest protection strips between crop fields should be planted and preserved to reduce wind erosion of the soil, in particular in the steppe regions where they will contribute to the preservation of moisture. Cover crops or green manures should be used. They increase the accumulation of C in the soil, reduce surface runoff and, consequently, the removal of nutrients, as well as reduce the use of agricultural machinery. Alley cropping is highly recommended – to grow food, fodder or special crops between rows of trees or shrubs, which will increase C sequestration in trees and shrubs and reduce runoff and erosion conserving the disturbed and degraded soils. Moderate grazing will help to avoid excessive soil compaction and biodiversity reduction, increase pasture bio-productivity and prevent soil degradation. Forest grazing – planting forests or shrubs in forage lands, will increase the sequestration of C in plants. Organic agriculture should be promoted as a production system that allows maintaining the health of soils, ecosystems and people. Complying with legislation on the conservation of coastal buffer zones will contribute to the preservation of C in plants and soils, reduce surface runoff, thereby preserve nutrients in the soil and improve water quality. It is advised to reduce the volumes and influences of industrial agriculture and to form the agro-landscapes according to the principles and provisions of the contour-ameliorative organization of agricultural lands.

Many of these measures have a synergistic effect, so their combined implementation is particularly important.

Conclusions

The potential of carbon sequestration includes preservation of the present carbon reserves in the soils that are in equilibrium and cannot further increase SOC stocks, restoration of the pre-degradation amount of SOC in degraded soils and further SCS stimulation. The soils in equilibrium should be guarded against degradation through sustainable agricultural practices, climate-optimized agricultural technologies, introduction of an effective system of legal protection of soils. Carbon sequestration should be promoted in degraded soils.

The social cost of SOC stock in Ukraine for the year 2025 will be 1.554.5838 bln USD. This large number indicates the economic importance of Ukrainian soils for the humanity. The social cost of carbon, which was used in the estimations is even a little lower than the market price of CO_2 emission permits on the EU market (50 USD/t CO_2e). This would be a sufficient stimulus for SCS in Ukrainian soils, provided the right policy mechanisms will be introduced.

Soil productivity is closely related to the amount of SOC, so the depletion of its reserves has a large-scale impact on the entire ecological and economic system. Soil restoration will contribute to the improvement of the ecological and economic situation in Ukraine. With the increase in the biological productivity of agricultural soils, the yield of cultivated crops will increase, therefore, the food provision and the well-being of people will improve, and the employment of the rural population will rise.

References

[1] Global Warming vs. Climate Change. NASA. (2022). Retrieved from https://climate.nasa.gov/resources/global-warming-vs-climate-change.

[2] Climate Change and Land. IPCC Special Report. (2022). Retrieved from https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM_Approved_Microsite_FINAL.pdf.

[3] Ontl, T.A., & Schulte, L.A. (2012). Soil carbon storage. *Nature Education Knowledge*, 3(10), article number 35.
[4] Lal, R. (2004). Soil carbon sequestration impact on global climate change and food security. *Science*, 304(5677), 1623-1627.
[5] Ligthart, T.N., & van Harmelen, T. (2019). Estimation of shadow prices of soil organic carbon depletion and freshwater depletion for use in LCA. *The International Journal of Life Cycle Assessment*, 24(9), 1602-1619.
[6] Berazneva, J., Conrad, J., Güereña, D., Lehmann, J., & Woolf, D. (2019). Agricultural productivity and soil carbon dynamics: A bioeconomic model. *American Journal of Agricultural Economics*, 101(4), 1021-1046.
[7] Sperow, M. (2020). What might it cost to increase soil organic carbon using no-till on U.S. cropland? *Carbon Balance Manage,* 15, article number 26.
[8] Mikhailova, E.A., Groshans, G.R., Post, C.J., Schlautman, M.A., & Post, G.C. (2019). Valuation of soil organic carbon stocks in the contiguous united states based on the avoided social cost of carbon emissions. *Resources*, 8(3), article number 153.
[9] Baliuk, S.A., & Kucher, A.V. (2019). Spatial features of the soil cover as the basis for sustainable soil management. *Ukrainian Geographical Journal*, 3, 3-14.
[10] Kucher, A.V. (2020). Economics of soil carbon sequestration and development of low-carbon land use. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 20(1), 301-308.
[11] Baliuk, S.A., Nosko, B.S., & Vorotyntseva, L.I. (2018). Regulation of fertility of soils and efficiency of fertilizers in conditions of climate fluctuations. *Bulletin of Agricultural Science*, 4, 5-12.
[12] Medvedev, V.V. (2015). *Soil agronomic and environmental physics*. Kharkiv: Striped typography.
[13] Tarariko, O.H., Ilienko, T.V., & Kuchma, T.L. (2016). Sustainable land use management and soil conservation: Urgency and challenges in modern conditions. *Ukrainian Geographical Journal*, 3, 56-60.
[14] Pozniak, S., & Hnatyshyn, M. (2021). Global initiative "4 per 1000" and possibilities of its implementation in Ukraine. *Ukrainian Geographical Journal*, 2, 11-19.
[15] Baliuk, S.A., Medvediev, V.V., Kucher, A.V., Solovej, V.B., Levin, A.Ja., & Kolmaz, Ju.T. (2017). Control over organic carbon of soil in a context of food safety and climate fluctuation. *Bulletin of Agricultural Science*, 9, 11-18.
[16] Social cost of carbon. EPA fact sheet. (2022). Retrieved from https://www.epa.gov/sites/default/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf.
[17] Schwarzer, S. (2019). Putting carbon back where it belongs – the potential of carbon sequestration in the soil. *Foresight Brief*, 013, 1-12.
[18] Eco Threat. Official Resource of the Ministry of Ecology and Natural Resources of Ukraine. (2022). Retrieved from https://ecozagroza.gov.ua/.
[19] Daily carbon prices. (2022). Retrieved from https://ember-climate.org/data/carbon-price-viewer/.
[20] Report of the High-Level Commission on Carbon Pricing (2017). Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/32419/141917.pdf?sequence=4&isAllowed=y.
[21] Raihan, A., Begum, R.A., Mohd Said, M.N., & Pereira, J.J. (2021). Assessment of carbon stock in forest biomass and emission reduction potential in Malaysia. *Forests*, 12(10), article number 1294.
[22] Sulaeman, D., & Westhoff, T. (2020). *The causes and effects of soil erosion, and how to prevent it.* Retrieved from https://www.wri.org/blog/2020/01/causes-effects-how-to-prevent-soil-erosion
[23] Shpychak, O., Varchenko, O., Svynous, N., Semysal, A., Ostapenko, S., & Prystemskyi, O. (2022). Foreign economic priorities for the development of agro-food enterprises in European integration business partnership. S*cientific Horizons,* 25(4), 75-88. doi: 10.48077/scihor.25(4).2022.75-88.

Економіка ґрунтового карбону та її специфіка в Україні

Марія Андріївна Гнатишин

Кандидат економічних наук, доцент кафедри аналітичної економії та міжнародної економіки, ORCID: https://orcid.org/0000-0002-0854-0568

Львівський національний університет імені Івана Франка, 79000, вул. Університетська 1, м. Львів, Україна

Анотація. Антропогенні викиди є однією з головних причин глобального потепління. Діоксид карбону є найбільш поширеним парниковим газом. Секвестрація є одним із варіантів зменшення кількості діоксиду карбону в атмосфері. Одним із основних видів секвестрації карбону є біологічний метод секвестрації карбону ґрунтом. Існують різні оцінки секвестраційного потенціалу ґрунтів, оскільки процеси секвестрації карбону ґрунтом остаточно не з'ясовані. Однак очевидно, що деградовані ґрунти мають більший потенціал для поглинання карбону. Метою статті є аналіз соціальної вартості органічного карбону у ґрунтах України, аналіз різних способів визначення ціни SOC та потенціалу його секвестрації різними типами ґрунтів. Соціальна вартість карбону використана для оцінки вартості запасів органічного карбону в ґрунтах України, оскільки вона відображає уникнені соціальні втрати від викидів карбону. Соціальна вартість вуглецю є чистою теперішньою вартістю впливу додаткового викиду карбону в атмосферу на зміну клімату (гранична вартість глобальної шкоди). Оцінка соціальної вартості запасів SOC у різних типах ґрунтів в Україні дає змогу порівняти альтернативні варіанти землекористування та вибрати правильні політичні інструменти. Результати оцінки свідчать про важливість українських ґрунтів у запобіганні глобальним змінам клімату шляхом утримання карбону. Чорноземні ґрунти особливо багаті на SOC і тому більш цінні з погляду екосистемних послуг, які вони надають. Секвестраційний потенціал більшості типів ґрунтів України перевищує секвестраційний потенціал лісів. У статті запропоновано заходи та методи збереження існуючого SOC та збільшення секвестрації карбону ґрунтом. Реалізація заходів щодо збереження та накопичення SOC сприятиме підвищенню біологічної продуктивності сільськогосподарських ґрунтів і, як наслідок, урожайності вирощуваних культур, що позитивно вплине на продовольчу безпеку та подолання глобальної проблеми нестачі продуктів харчування

Ключові слова: зміна клімату, ґрунтовий органічний карбон, секвестрація карбону, ціна карбону, соціальна вартість карбону