

Melniychuk Michaylo Michaylovich, Melnik Oleg Volodymirovich, Smilii Pavlo Mikolayovich. Geographical analysis of transformation of water and land resources under the influence of drainage reclamation in Volyn region. Journal of Education, Health and Sport. 2021;11(6):240-248. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2021.11.06.026>  
<https://apcz.umk.pl/czasopisma/index.php/JEHS/article/view/JEHS.2021.11.06.026>  
<https://zenodo.org/record/5119363>

The journal has had 5 points in Ministry of Science and Higher Education parametric evaluation. § 8. 2) and § 12. 1. 2) 22.02.2019.  
© The Authors 2021;

This article is published with open access at Licensee Open Journal Systems of Nicolaus Copernicus University in Torun, Poland  
Open Access. This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which  
permits any noncommercial use, distribution, and reproduction in any medium,  
provided the original author (s) and source are credited. This is an open access article licensed under the terms of the Creative  
Commons Attribution Non commercial license Share alike.

(<http://creativecommons.org/licenses/by-nc-sa/4.0/>) which permits unrestricted, non commercial use, distribution and reproduction  
in any medium, provided the work is properly cited.

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 21.05.2021. Revised: 03.06.2021. Accepted: 30.06.2021.

## GEOGRAPHICAL ANALYSIS OF TRANSFORMATION OF WATER AND LAND RESOURCES UNDER THE INFLUENCE OF DRAINAGE RECLAMATION IN VOLYN REGION

Melniychuk Michaylo Michaylovich (ORCID: 0000-0002-7258-2869)<sup>1</sup>

Melnik Oleg Volodymirovich (ORCID: 0000-0002-1584-2943)<sup>2</sup>

Smilii Pavlo Mikolayovich (ORCID: 0000-0001-9199-1417)<sup>3</sup>

Lesya Ukrainka Volyn National University, Luck, Ukraine

<sup>1</sup>candidate of geographical sciences, associate professor Department of  
Physical Geography

<sup>2</sup>graduate student Department of Physical Geography

<sup>3</sup>graduate student Department of Physical Geography

### Abstract

**Aim.** The purpose of this study is to develop a methodology that takes into account the levels of anthropogenic transformation of various components of the environment.

**Method.** In scientific work to take into account the impact of qualitative indicators on the process of transformation of landscapes of Volyn region under the influence of drainage reclamation was used P. Shishchenko's method with the following additions: the coefficient of anthropogenic transformation of landscapes was calculated separately for: relief and soils and water regime.

**Results.** Understanding the state of lands transformed in the process of drainage reclamation provides an opportunity to understand the effects of a complex of factors on land and agricultural needs and encourages scientific study of various components of the environment. During drainage reclamation there is an intensive mineralization of the organic part of the soil with a significant increase in greenhouse gas emissions and the processes of peat mineralization are actively developing. The total coefficient of anthropogenic

transformation of landscapes was defined as the average value between these coefficients. The results obtained by an improved method allow a more differentiated assessment of the state of transformation of the landscapes of the Volyn region, taking into account the impact of drainage reclamation. These results are adequate, as there is a connection with the industrial development of territories and the level of agricultural development.

**The scientific novelty** lies in the constructive-geographical analysis of the impact of drainage reclamation in the Volyn region on different types of environment.

**Practical significance.** The results of the research can be used in the educational process of VSU named after Lesya Ukrainka and other educational institutions in teaching geographical, economic and tourism disciplines. The results will find their application in the legislative and executive work of local governments in the development of programs of socio-economic development of territorial communities. The materials of the research will promote the rational use of anthropogenic resources and objects of social and household services in Volyn, which will allow to qualitatively influence the course of administrative reform. A number of provisions can be used in similar studies of the regions of Ukraine.

**Key words:** reclamation, drainage, transformation, soil, environment.

**Formulation of the problem.** Dehumidical melioration is an active anthropogenic factor that causes changes in geocomplexes [1]. The state of the drained land reflects the effects of the influence on factors complexes that characterize the specifics of the land fund and the needs of the agricultural economy [2, 3].

The structure of the land fund Volyn region indicates that half of the territory are occupied by agricultural lands are 1080.8 thousand hectares (general land fund is 2014.4 thousand hectares). Under forests and forestry areas are 697.7 thousand hectares, built lands occupy 60,1 thousand hectares, swamps are 115,9 thousand hectares, open lands without vegetation are 14,5 thousand hectares, water is 45,4 thousand hectares [3]. In the area of dehumidical melioration, 416.6 thousand hectares covered by 20.7% of the land fund, the area of agricultural land is 346.96 thousand hectares. Today, the melioration is not covered by 34.2 thousand hectares of swamped lands [4].

Swamp soils are distributed in Volynia, especially within the field of polyvatus, in the valleys of Pripyat, Turia, Standry. Their total area is 374 thousand hectares. In drainage melioration there is an intense mineralization of the organic part of the soil. After draining and conducting agro-mechanical events, in the first decades marsh soils are transformed into high-performance agricultural land. They are suitable for growing high harvest of vegetables, potatoes, perennial grasses, hemp and other crops [2].

**Analysis of recent research and publications.** A number of leading scientists (V. Aleksievsky, S. Voznyuk worked on solving the problem of highly effective use of drained lands (V. Aleksievsky, S. Voznyuk, S. Squarpanov, M. Shevchenko, P. Shishchenko, F. Zuzuk, etc.). A number of anthropogenic techniques transformation of landscapes proposed by scientists. The most widespread score of P. Shishchenko [6] which is convenient for the rapid quantitative estimation of anthropogenic landscapes transformation, taking into account rank and the depth index the transformation of a certain landscape type. However, the index of the anthropogenic depth transformation in the method is a common value and cannot be used to analyze the transformation of the environment components.

The method of estimating anthropogenic transformation of landscapes I. Koinova [7] is partially converted by the method of P. Shishchenko, taking into account the features of the landscapes Volyn region, but there are no fabrics of the various transformation components for the natural environment, in particular a water regime of territories. The method of assessing the ecological state of soils Volyn region proposed by S. Polyansky [8], takes into account both quantitative and qualitative indicators of soils and surrounding natural environment by scoring. However, the quantitative and qualitative indicators considered in the work are not agreed upon. Method of using an index of anthropogenic transformation on the territory of M. Prihidka [9] provides the determination of the particle anthropogenic disturbed territories. The influence of high-quality fabrics are not taken into account.

**The allocation of unresolved parts for the general problem.** An important task for mastering arrays of agricultural crops is to regulate the stocks of organic matter, especially its mineralization. This is carried out by bilateral regulation of the water-air regime and the choice of an optimal structure sown areas. If the process of intensive mineralization of peat do not stop, the peatlands of medium power (1 m) are mineralized after 50-60 years [5].

**Formulation of the article goals.** The purpose of this study develop a method for assessing the level of anthropogenic land and water regime as components of the natural environment.

**Presenting main material.** After the analysis of literary sources, we have carried out such calculations.

1. The coefficient of anthropogenic landscapes transformation of relief, soils and aqueous regime was calculated according to the formula P. Shishchenko, converted

$$\text{to: } K_n = \frac{\sum_{i=1}^n p_i s_i}{100}, \quad (1)$$

де  $s_i$  – the degree of anthropogenic territory transformation;  $p_i$  – area of the territory (y %);  $n$  – number of nature types management within the contour of the region.

2. The degree of anthropogenic transformation of the territory relief and soils which is well correlated with the method of P. Shishchenko was determined by the formula:

$$s_i = r_i q_i, \quad (2)$$

де  $r_i$  – the rank of anthropogenic territory transformation;  $q_i$  - depth index of landscapes transformation;  $n$  – number of species within the contour of the region.

The indexes of the transformation depth landscapes were taken according to the method of P. Shishchenko to calculate the transformation coefficient of relief and soils. In separate groups, forests, meadows and pastures and arable lands on drained-by-rhythiers with an anthropogenic transformation index 1.40; erodized land with an anthropogenic transformation depth index 1.55. So for drained lands, the index of the depth of anthropogenic transformation was taken as well as for artificial reservoirs and for eroded lands was the same as land for industrial use. The value of the degree of anthropogenic territory transformationcalculated for (2) amounted to 1 to 19.2. For convenience the scale has been changed in proportion to the value of the calculated stabs from 1 to 20 (Table 1). To calculate the transformation coefficient of the aqueous mode, the degree of anthropogenic transformation was taken from 1 to 20. Six categories were selected where the level of changes in surface and soil waters were taken into account.

The calculated degrees of anthropogenic transformation of relief, soils and water regimes for different types of territories were reduced to table 2-4. The proposed methodology allows to take into account the transformation of the aqueous re-alignment of the territory which significantly changes under the influence of drainage melioration.

Table 1. Indexes of the anthropogenic depth of water balance transformation

| №,<br>3/II | Characteristics of a water regime superficial and groundwater  | The value of the<br>degree transformation<br>for the water balance |
|------------|--|--|
| 1          | Surface and groundwater regime has not changed (natural protected areas)   | 1  |
| 2          | Surface water mode has undergone minor changes. Natural watercourses are not changed. Soil waters are not changed (forests, swamps, waterlogged areas, pastures)   | 4  |
| 3          | Surface water mode has changed. Natural watercourses can vary. Groundwater regime is not significantly (arable land, perennial plantings)  | 8  |
| 4          | Surface water mode is changed. The channels of natural watercourses are changing under the influence of anthropogenic influence. Partially available channels and drainage. Mode of groundwater is changed not significantly (rural settlements, transport highways) | 12   |
| 5          | Surface water mode is significantly changed. The channels of natural watercourses are mainly natural. Available channels and drains. Mode of groundwater changed (city settlements, industrial lands and land which minerals are extracted)                          | 16   |
| 6          | Surface and groundwater regime has undergone systemic changes under anthropogenic influence. Available drainage networks, water supply and channels. Significantly changed groundwater (drained land, artificial reservoirs and channels)                            | 20   |

Table 2. Degrees of transformation landscapes by various types of land use

| №   | Species<br>land use                          | Degree<br>transformation<br>relief and soils | Degree<br>aqueous<br>transformation<br>mode |
|-----|--|--|---|
| 1   | natural protected areas                      | 1  | 1   |
| 2   | forests                                      | 2,15   | 4   |
| 3   | swamps and waterlogged areas                 | 3,40   | 4   |
| 4.1 | grass and pastures                           | 4,76   | 4   |
| 4.2 | grass and pastures on drained territories    | 5,80   | 20  |
| 5   | perennial planting                           | 6,22   | 8   |
| 6.1 | arable land                                  | 7,79   | 8   |
| 6.2 | arable land in drained territories           | 8,73   | 20  |
| 6.3 | eruded land                                  | 9,66   | 8   |
| 7   | rural building                               | 9,46   | 12  |
| 8   | urban building                               | 11,23  | 16  |
| 9   | reservoirs, channels                         | 13,11  | 20  |
| 10  | transport highways                           | 15,62  | 12  |
| 11  | the land of industrial use                   | 17,76  | 16  |
| 12  | land broken by extraction of minerals (peat) | 20,00  | 16  |

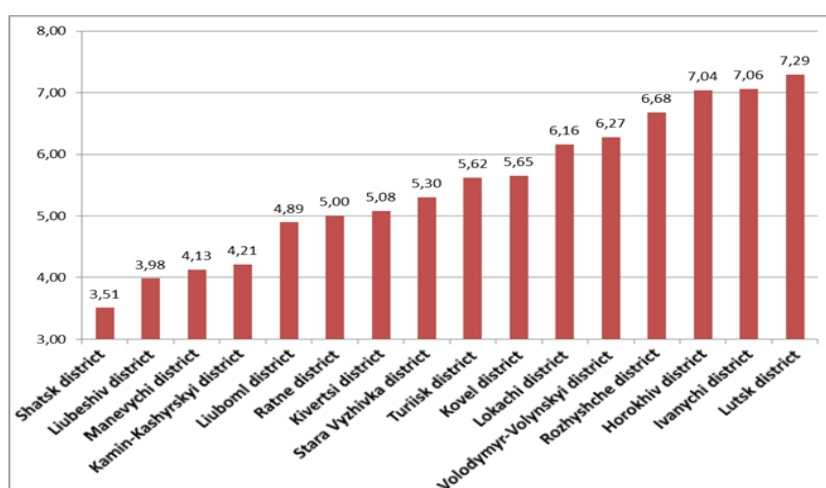
According to the results of calculations, the histograms are constructed. 1, 2 and isolated zones with a weak, medium, high and excessive converted pictures 3, 4.

Table 3. The coefficients of anthropogenic landscapes transformation in the areas of Volyn Oblast

| №  | The coefficient of transformation depth | Relief and soils | Water balance |
|----|---|------------------|---------------|
| 1  | Volodymyr-Volynskyi district            | 6,27             | 9,76          |
| 2  | Gorokhiv district                       | 7,04             | 8,09          |
| 3  | Ivanychiv district                      | 7,06             | 9,29          |
| 4  | Kamin-Kashira district                  | 4,21             | 7,26          |
| 5  | Kivertsy district                       | 5,08             | 7,79          |
| 6  | Kovel district                          | 5,65             | 10,23         |
| 7  | Lokachinsky district                    | 6,16             | 7,36          |
| 8  | Lutsk district                          | 7,29             | 8,36          |
| 9  | Lyubeshiv district                      | 3,98             | 7,40          |
| 10 | Lyuboml district                        | 4,89             | 8,10          |
| 11 | Manevychi district                      | 4,13             | 6,88          |
| 12 | Ratniv district                         | 5,00             | 10,60         |
| 13 | Rozhysche district                      | 6,68             | 10,28         |
| 14 | Starovyzhiv district                    | 5,30             | 9,38          |
| 15 | Turiya district                         | 5,62             | 8,09          |
| 16 | Shatsky district                        | 3,51             | 6,14          |
|    | Volyn region                            | 5,30             | 8,39          |

Table 4. Scale of landscape transformation coefficients according to the level of anthropogenic impact

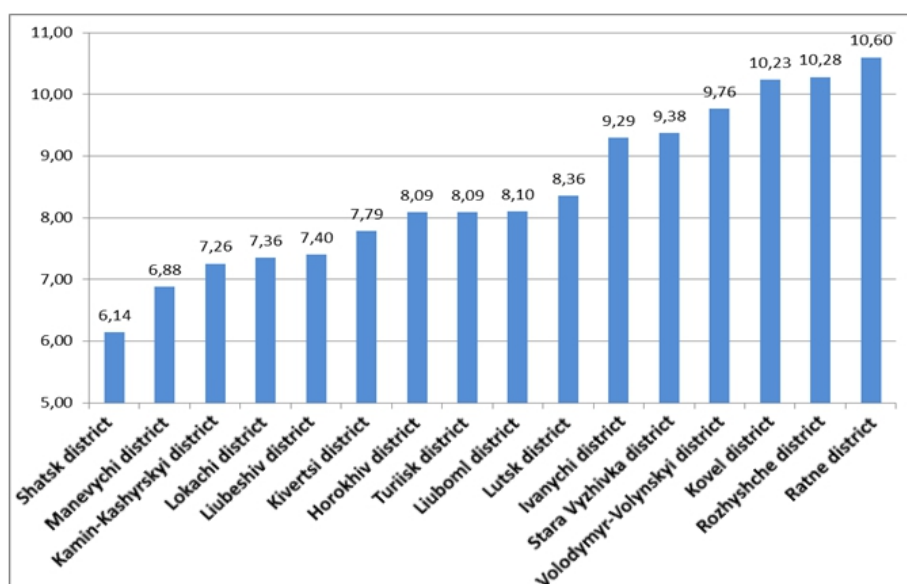
| № | Level of transformation | Relief and soils | Water balance |
|---|-------------------------|------------------|---------------|
| 1 | Weakly transformed      | <4               | <7            |
| 2 | Moderately converted    | 4–5              | 7–8           |
| 3 | Strongly transformed    | 5–6              | 8–9           |
| 4 | Excessively transformed | >6               | >9            |



Picture 1. Values of the coefficients depth transformation of relief and soils

According to the calculations of the coefficients depth transformation of relief and soils, are excessively converted to the southern regions of the Volyn region, characterized by the

largest agricultural and industrial development of the territory, the presence of large citiesrelatively high density of the population and the small protected background.



Picture 2. The value of the coefficients water balance transformation



Picture 3. Map of the anthropogenic transformation of relief and soils Volyn region

The largest proportion of arable land together with drained in the Lutsk region 63.73%, the smallest in Volodymyr-Volynsky is 45.08% that is very high-resolution of the territory. The share of drained lands is the smallest in Locaminsky Paradise 7.66% and the largest in Rozhyshechesky is 30.23% (along with meadows). The protected fund of this group of districts

is relatively low in the range of 3.0-4.5% exceptions are Rozhyshe district where the protected fund is only 0.76% and Lokechinsky where the protected fund is the highest 7.24%. The territory's lines are within 6, 21-21,61%.

On the territory of areas with excessive conversion of relief and soils three of the four largest cities in the Volyn region: Lutsk, Volodymyr-Volynsky and Novovolynsk. The most developed agriculture are food, fuel industry and mechanical engineering. The density population is high enough: from 24.3 people / km<sup>2</sup> in Volodymyr-Volyn district (excluding the population of Vladimir-Volynsky) to 65.6 people / km<sup>2</sup> in Lutsk district. On average, this group of areas population is the largest within the region.



Picture 4. Map of anthropogenic transformation of water balance Volyn region

The strip of heavily transformed districts of the Volyn region extends along its center from the north to south (with the exception of the Kiveretsky District) to excessive transform areas. This group of districts includes Ratnovsky, Antovyzhsky, Kovelsky, Turi and Kivertsy districts. The share of arable lands in this group of districts is slightly lower than the previous one. Located from 23.21% in the Ratnovsky district to 39.03% in the Turi district.

The share of drained land together with meadows and pastures ranges from 14.74% in the Kiversky district to 29.66% in the Kovel region. The protected fund of the glass is from 6.19% in Kivertsy district to 9.37% in Tural district. The exception is Kovel district with a share of the reserve fund 3.70%. However, this is relatively large number of forests 28.65% of the territory. The fermentation of the territory these areas is within 19,88-37,25%. The population density is 21.7-45.2 people / km<sup>2</sup>. In the territory of this group districts is located in Kovel which is a large railway node.

According to the values of the transformation relief and soils, medium-transformed are stone-Kashirsky, manevitsky and Lyubomsky districts. This group of districts are characterized by a relatively small part of the territory occupied by a reserved fund of 4.00-



7.36%, high labeliness of the territory 37,65-53,79% and a relatively low rose of soils 16,39-22,91%. Density population 22,1-36,7 people / km<sup>2</sup>.

To weakly transformed areas are included Shatsky and Lubeshivsky districts which are characterized by a large share of lands occupied by a reserved background-house 17.62% in Lubeshivsky district and 38.19% are in Shatsky district, ironiness 25.83-30.12%, dilution 13,43-14,58 %. The population density is relatively small is 22,2-24,8 people / km<sup>2</sup>.

Based on the analysis, the proposed method allows adequate to evaluate anthropogenic transformation of landscapes, namely the relief and soil soils.

The most significant in the transformation of the water balance Volyn region is affected by dehumidive melioration. The most transformed is the water balance of the centrifugal, western and southern parts of the region. The total share of drained lands on the territories of these areas is from 22.17% to 38.16%. The group with a strongly converted water balance belongs to Lyubomsky, Turkish, Lutsky and Gorokhivsky districts. The share of drained land in these areas is 3.95-18.63%. Gorokhovsky and Lutsk districts, although have small areas of drained areas, it is compensated by large areas of arable lands more than 60%.

Average converted water balance in Lubeshivsky, Kamin-Kashirsky, Kivertsky and Locachinsky districts. The share of drained land in these areas is 14.74-20.35%. The rose of land ranges from 17.7% to 29.67% by the exception of Loccinsky district with 4.80% of drained land. This low share is compensated by the high distribution of land in the area 57.17%.

Manevitsky and Shatsky districts are part of a group with a weakly converted water balance. Although the proportion of drained lands in these areas is 13.09 and 16.71% but relatively low dilution which does not exceed 16.39%.

**Conclusions.** It has been established that the most drained land is located in the northern and central parts of the Volyn region. Prolonged economic use of reclaimed lands as well as a connection with the change in the form of a land ownership and the deterioration of the environmental state these territories, most previously developed methods of agricultural production on drainage lands require significant revision. For the rational use of reclaimed soils it is necessary to develop a modern system of crop rotation, increase fertility due to the introduction of mineral and organic fertilizers, to identify varieties and cultures of agricultural plants that are most appropriate in this territory.

## References

1. Ryzhuk S. M., Slyusar I. T., Vergunov V. A. Agroecological features of highly efficient use of drained peat soils of polissya and forest-steppe: monograph. K.: Agricultural science, 2002. 137 c.
2. Gerenchuk K. I. Nature of the Volyn region. Lviv: Higher school. 1981. 147 p.
3. Uevych S. D. Features of reclamation works in Ratnivshchyna. Young science of Volyn: priorities and prospects of research: materials of the VII International scientific-practical conference of students and graduate students (May, 2013): in 2 volumes. SNU Lesya Ukrainka, 2013. P. 121–122.
4. Zuzuk F. V., Koloshko L. K., Karpyuk Z. K. Drained lands of Volyn region and their protection: monograph. Lutsk: University Lesya Ukrainka, 2012. 294 p.
5. Shevchuk M. Y., Zinchuk P. Y., Koloshko L. K. Soils of the Volyn region. Lutsk: RVV "Vezha" VSU Lesya Ukrainka, 1999. 160 p.
6. Shishchenko P. G. Applied physical geography. K.: Higher school, 1988. 192 p.
7. Koinova I. B. Anthropogenic transformation of landscape systems of the western part of Volyn Polissya: author's ref. dis ... cand. geogr. Sciences: 11.00.11 / I. B. Koinova; Lviv. state Univ. I. Franko. L., 1999. 19 p.
8. Polyansky S. V. Constructive-geographical analysis and assessment of the state of



reclaimed agro-landscapes of Volyn region: author's ref. dis ... cand. geogr. Sciences:  
11.00.11 / Sergey Vladimirovich Polyansky. Lviv, 2013. 20 p.  
9. Prihodko M. M. Ecological safety of natural and anthropogenically modified geosystems:  
monograph. Ivano-Frankivsk: Foliant, 2013. 330 p.