

The Impact of Ecology on the Economic Development of Vinnytsia Region

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Abstract:

The problem of nature protection for the Vinnytsia region, most of the territory of which is experiencing almost uncontrolled intensive economic activity, is very relevant. Natural conditions and resources of Vinnytsia region are diverse and unique, the issue of their rational use is still insufficiently studied. Preservation of modern nature, increase of its riches, is impossible without research of available resources in the territory. Diagnosing minerals, the presence of rare plants, all available resources will help us to better understand the current situation and predict the future state of nature in the region, the possibility of its reconstruction not only by preserving but also creating new environmental facilities. Modern development of human activity is often harmful to the environment due to the growth of urban planning, industrial production, traffic. Therefore, there is pollution of water, air, soil, which negatively affects the health of the population, poses a threat to the environment, exacerbates environmental problems. Environmental pollution by industrial waste has a negative impact on the quality of natural resources, reducing their productivity or making them unusable, which reduces the economic potential of the region and the enterprise. The influence of the ecological factor on the production potential is manifested in the action of environmental pollution on the economic resources of the enterprise, reducing the efficiency of their reproduction and use. Such an impact is observed mainly at the stage of use and during the reproduction and development of production potential. The economic resources of the enterprise are exposed to the polluted environment in the form of industrial waste. As a result, the number of functioning resources decreases, their qualitative characteristics change. Reducing the number of resources and their quality indicators leads to a shortage of resources over time and to a change (decrease) in overall productivity. Thus, the real fund of time of equipment use decreases, labor productivity, equipment capacity, return of material and raw materials decreases (Lukyanikhin 2018)

Keywords: ecology; soil condition; industrial waste; minerals.

JEL Classification: Q15; Q23; Q24; Q25.

Introduction

The prospects for regional development are influenced by dynamically changing processes and factors that are innovative for the management of the region and amend the existing development trends. Such changes are environmental, social and economic in nature. Their impact is manifested in the constraints and threats, as well as in the preconditions and opportunities for the development of the region, changing the processes, mechanisms and tools for managing regional development. Today, special attention should be paid to social and ecological-economic imperatives that reflect the interaction of the ecological environment and the economic sphere, largely determine the high variability of the situation and require the ability to adapt to innovation. No less important is the aspect of the reverse impact of socio-economic development processes on resource, economic and environmental opportunities. Therefore, in the conditions of variability of ecological, social and economic processes the question of maintenance and development of social and economic attractiveness is actual. Despite the territorial and natural preferences of such regions, the issue of ensuring a decent standard and quality of life is acute. Ensuring the sustainability and stability of regional development is not only a national task, but also at the regional level has a specific and innovative nature, which determines the need to find mechanisms and tools

to regulate social, economic and environmental development in the context of increasing change (Kryshtal, Chechetova and Goncharuk 2018).

The region is located in the forest-steppe zone of the right-bank part of Ukraine, and makes up 4.4% of the territory of Ukraine. The land area is 2606.4 thousand hectares, or 98.4% of the total area, 1.6% of the region is occupied by inland waters. The rivers of the region belong to the basins of the Southern Bug, Dniester and Dnieper, of which two are large (Southern Bug, Dniester), four medium (Sob, Girsky (Roten), Tikich, Murafa, Ros) and 4,5 thousand small.

In the central part of the region flows the river Southern Bug (with right tributaries Zgar, Riv, Silnitsa, Dokhna; left - Snivoda, Desna, Sob, Udych), in the southwestern part of the region flows the river Dniester (with left tributaries: Lyadova, Nemia, Murafa), in the northern and northeastern regions flow rivers belonging to the Dnieper basin: the river Ros, the river Guyva, the river Gnilypat.

Within the region there are 56 reservoirs - with an area of 11167 hectares, the largest Ladyzhin reservoir reaches 2.2 thousand hectares, ponds in the amount of 5298 - with an area of water mirror 30.0 thousand hectares. Rivers and reservoirs are used for fish farming, industrial and municipal water supply, land irrigation, as well as a source of hydropower. Groundwater plays an important role in the water management of Vinnytsia region as the most reliable source of quality drinking water, groundwater reserves of the region amount to 324.9 million m³ per year, approved operational reserves - 45.7 million m³ per year.

The Southern Bug River divides the region into two parts: the left bank, which belongs to the Dnieper Upland, and the right bank, the Podil Plateau. The surface of Vinnytsia region is an elevated plateau that decreases in the direction from northwest to southeast. Most of the region is located within the Ukrainian Crystal Shield. The modern relief of the region is mainly wavy, sometimes hilly, plain, branched by numerous river valleys, ravines and gullies, especially in the Transnistrian region.

In Vinnytsia region, the raw material base of construction materials is well developed - there are 309 mineral deposits used in construction. Raw materials for the production of building materials are represented by granites (rubble and facing stone), limestone, sandstone, clay and loam, sand and gravel materials.

In the Vinnytsia region, forest-steppe landscapes are widespread, the forest fund in terms of land use is Table 1, the forests are dominated by deciduous tree species: hornbeam, maple, linden, oak, ash. Herbaceous vegetation is characterized by great diversity, only wild plants number about a thousand species, table 1.

Table 1. Forest fund of Vinnytsia region in terms of special purpose lands

№	Ministries, departments (permanent forest users, forest owners), others	Total area, thousand hectares	Forest lands, thousand hectares					Total forest land
			covered with forest vegetation		not covered with forest vegetation			
			Total	including forest crops	open forest crops	others are not covered with forest vegetation	Total not covered with forest vegetation	
I. Lands of forestry purpose								
I.1	Vinnytsia OULMG	219,3	200,5	139,3	9,4	18,8	28,2	219,3
I.2	VOKSLP «Vinoblagroli»	107,9	98,0	54,5	2,2	4,0	6,2	104,3
II. Lands of nature reserves and other nature protection purposes *								
II.1	Vinnytsia OULMG	16,0	15,7	5,8	0,01	0,26	0,27	16,0
II.2	VOKSLP «Vinoblagroli»	3,8	3,4	1,6	0,07	0,16	0,23	3,6
III. Other (recreational and health)								
V.1	Vinnytsia OULMG (recreational and health, protective)	71,1	65,4	45,5	4	1,7	5,7	71,1
V.2	Vinnytsia OULMG (recreational and health, protective)	2,7	2,4	1,5	0,06	0,022	0,028	2,5
	Total	420,8	385,4	248,2	15,74	24,95	40,63	416,8

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

Vinnytsia, like the whole of Ukraine, is in the temperate zone. The climate of the region is moderately continental, it is characterized by long, mild summers with sufficient moisture and relatively short mild winters.

The coldest month of the region is January, the warmest is July. The average amplitude of temperature fluctuations during the year does not exceed 25⁰ C. Under the influence of continental air masses there is sometimes a decrease in temperature to -32... -38⁰ C, in summer - an increase to +37⁰ C, the highest temperature is observed in July-August.

The average annual precipitation on the territory is 440-590 mm. The highest amount of precipitation occurs in the north-west of Vinnytsia region, the maximum amount of precipitation falls in May in the amount of 130 mm, July - 170 mm. The least wet are the winter months, the cold season accounts for 25% of precipitation: in December-February, respectively, falls 65-80 mm.

The climate of Vinnytsia is favorable for agricultural production: long warm and rather humid summers, early spring, dry autumn winters with moderate frosts and significant snow cover - all this has a positive effect on the growth of grain, industrial and horticultural crops.

The presence of various minerals in the region is due to the structural and genetic features of the geological structure. Within the region, the platform and transition to the geosynclinal geosynclinal zone of the earth's crust is widespread. Each of these zones is characterized by specific features of the geological structure and the distribution within its boundaries of characteristic mineral complexes. The geological structure involved rocks of various mineral and chemical composition and genesis, from the most ancient Archean era to the modern Quaternary period. The history of geological development of the territory fully reflects the processes of scattering and concentration of minerals and periods of their accumulation in sedimentary rocks.

During the reporting year 2019, no geological exploration work was carried out, and there are 369 deposits on the state balance of reserves, 62 deposits were developed in 2001. Minerals of Vinnytsia region are mainly raw materials for the construction industry, to a lesser extent for processing, chemical and metallurgical.

Any industrial region of Ukraine has facilities that directly or indirectly affect the environmental situation, and taking into account pollutants on the environment pose a danger in general, Table 2.

Table 2. Ecologically dangerous enterprises of Vinnytsia region

№	Enterprises	Type of economic activity	Departmental affiliation (form of ownership)	Note (according to the results of 2018)
1	Vinnytsia Regional Production and Utility Company of Water Supply and Sewerage "Vinnytsia vodokanal" (Vinnytsia)	Production and distribution of electricity, gas and water	Communal property	Total discharge: 25.9 million m ³ (cleaned and standard clean); 3.9 tons of pollutants
2	Ladyzhynska TPP of OJSC "West energy" (Ladyzhin)	Production and distribution of electricity, gas and water	Communal property	Discarded: 72.3 thousand tons; of which sulfur dioxide 53.5 thousand tons
3	Ash dump of Ladyzhynska TPP of OJSC "West energy" (Ladyzhin)	Hydropower and hydraulic structures	Collective ownership	Accumulated: 28 million tons (hazard class IV)
4	Municipal solid waste landfill in Vinnytsia (village Stadnytsia, Vinnytsia district)	Storage and disposal of industrial and household waste	Communal property	Accumulated waste: 2.5 million tons
5	Dzhurinsky poison burial ground (Dzhurin village, Sharhorod district)	Storage and burial of unusable chemical plant protection products		Approximately 2100 tons are stored
6	Vinnytsia Poultry Factory LLC (Olyanitsa village, Trostyanets district)	Poultry farming	Private property	280 tons of bird droppings data for 2017 *

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

In 2019, the environment of Vinnytsia region received 99.7 thousand tons of pollutants from stationary sources of pollution compared to 2018 by 2.5% more, this is due to poultry breeding and distribution of gaseous fuel through local (local) pipelines.

The share of 73.9% (73.7 thousand tons) of pollutant emissions falls on the city of Ladyzhin. In addition, a high percentage of emissions in the total amount falls on Tulchyn (4.5%), Trostyanets (3.7%) districts and the city of Vinnytsia (2.9%). The amount of emissions of pollutants from stationary sources per 1 km² of the region in 2019 was 3.8 tons. The largest emissions of pollutants per 1 km² are in the city of Ladyzhin - 3349 tons, Vinnytsia - 42 tons, Zmerinka - 17 tons, Khmilnyk - 9.4 tons, Kozyatyn - 7.0 tons and Trostyanets and Tulchyn districts 4,0 tons. On average, 64 kg of waste per capita in the region.

According to the State Administration "Vinnytsia Regional Laboratory Center of the Ministry of Health of Ukraine" in 2019, 6.9% of air samples taken in urban and rural settlements did not meet the requirements for the content of pollutants (in 2018 - 5.3 %, in 2017 - 2.9%). High specific weight of non-standard air samples due to excessive content of dust, carbon monoxide, nitrogen dioxide, phenol and its derivatives, formaldehyde.

There is a tendency to reduce air emissions in the city of Vinnytsia in 2017-2019 of the following substances: cadmium, manganese, copper, chromium, iron, nickel, slightly increased indicators for lead and zinc table 3, table 4.

Table 3. Volumes of emissions of pollutants into the atmosphere in Vinnytsia region for 2017 – 2019

Indexes	2017	2018	2019
The total number (units) of permits for emissions of pollutants into the atmosphere, issued in the current year to the business entity, the object of which belongs to:	510	697	487
the second group	239	280	168
the third group	271	417	319
Emissions of pollutants and greenhouse gases from stationary sources, thousand tons	155,8	97,3	99,7
Emissions of pollutants into the atmosphere from stationary sources per km ² , tons	5,9	3,7	3,8
Emissions of pollutants into the atmosphere from stationary sources per capita, kg	98,4	62,1	64,5

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

But to characterize the air pollution of the city, IZA was calculated taking into account the maximum values of 5 impurities: nitrogen dioxide, dust, formaldehyde, hydrogen fluoride, carbon monoxide and amounted to - 4.78. That is, IZA for 2019 did not increase significantly compared to last year, 2018 (IZA was - 4.47).

Table 4. The content of pollutants in the air of Vinnytsia region in 2019

Contaminant	City	Average annual content, mg / m ³	Average daily maximum concentration limit, mg / m ³	Maximum single MPC, mg / m ³	Maximum content, mg / m ³
Dust	Vinnytsia	0,1	0,7	0,4	0,2
Sulfur dioxide	-"	0,001	0,03	0,08	0,03
Carbon monoxide	-"	1	0,3	0,66	2
Nitrogen dioxide	-"	0,1	2,8	4,0	0,7
Hydrogen fluoride	-"	0,005	1,2	1,5	0,006
Ammonia	-"	0,01	0,3	0,1	0,03
Formaldehyde	-"	0,004	0,3	1,0	0,03
Cadmium	-"	0,00	0,02	1,0	0,0
Iron	-"	0,81	4,30	40,0	1,21
Manganese	-"	0,03	0,05	0,63	0,04
Copper	-"	0,04	0,19	2,0	0,06
Nickel	-"	0,03	0,04	1,0	0,04
Lead	-"	0,03	0,04	0,3	0,05
Chrome	-"	0,03	0,06	0,78	0,05
Zinc	-"	0,11	0,21	50,0	0,178

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

The main air pollutants in the region remained the enterprises of energy industry, agriculture, processing industry and transport, table 5.

Table 5. Atmospheric air pollutants by type of economic activity in 2019

Types of economic activity	Emissions in the region	
	thousand tons	% to total pollution
A- Agriculture, forestry and fisheries	15815,099	15,86
B- Mining and quarrying	200,896	0,20
C- Processing industry	5788,615	5,80
D- Electricity, gas, steam and air conditioning supply	72169,292	72,37
E- Water supply; sewerage, waste management	101,450	0,10
F- Construction	131,868	0,13
G- Wholesale and retail trade; repair of motor vehicles and motorcycles	22,871	0,02
H- Transport, warehousing, postal and courier activities	3276,286	3,29
I- Temporary accommodation and catering	-/-	0,00
J- Information and telecommunications	0,165	0,00
K- Financial and insurance activities	2,616	0,00
L- Real estate transactions	165,406	0,17
M- Professional, scientific and technical activities	0,997	0,001
N- Activities in the field of administrative and support services	29,440	0,03
O- Public administration and defense; compulsory social insurance	1103,496	1,11
P- Education	406,564	0,41
Q- Health care and social assistance	509,068	0,51
Total	99724,129	100,00

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

The analyzed data show the greatest pollution, namely 72.37% of the supply of electricity, gas, steam and air conditioning, and 15.86% of agriculture, forestry and fisheries.

Surface water control is carried out by several monitoring entities: State Department of Ecology and Natural Resources, the regional SES, the Vinnytsia CGM, the South-Bug Basin Water Management Association (according to the monitoring scheme in certain areas), the Vinnytsia vodokanal plant, the OJSC» (In the areas of water intakes of the Southern Bug River: Khmilnyk, Kalynivka, Vinnytsia, Sutysok). According to Vinnytsia vodokanal (the state of the river was monitored daily), the oxygen balance was within normal limits, although there were fluctuations in the oxygen content associated with biogenic processes. The average monthly value of ammonium nitrogen content ranged from 1.06 to 1.66 maximum permissible concentrations established for fishery reservoirs (MPC1), did not exceed the maximum permissible concentrations established for drinking water bodies (MPC2). The most polluted by this ingredient are areas of the river near the village. The most polluted by this ingredient are areas of the river near the town of Sutysok.

On the territory of the region 204 rivers, the length of each reaches more than 10 km, they belong to the basins of the Southern Bug (Zgar, Riv, Dokhna, Sob, Savranka), Dniester (Murafa, Lyadova, Markivka, Rusava, Nemiya) and the Dnieper (Ros, Gnilyat, Guyva). The average density of the river network is 0.38 km / km². Rivers are fed by rain (48%), snow (25%) and groundwater (27%). In the Dniester basin, underground supply is up to 40%. Within the region there are 56 reservoirs, with a total water surface area of 11,167 ha; the largest Ladyzhin Reservoir (2.2 thousand hectares). The average annual runoff of Vinnytsia is 2.0 billion m³. In a low-water year (P = 75%) it is about 1.5 billion m³, in a very low-water year (P = 95%) - 1.05 billion m³. Most of the local runoff of the region, up to 70%, is formed in the basin of the Southern Bug. A larger transit runoff of the Dniester runs along the southern border of the region and is used only for irrigation and hydropower. One inhabitant of Vinnytsia region, excluding transit runoff of the Dniester, has the following annual volumes of local runoff: average annual - 1.5 thousand m³; low water - 1.1 thousand m³; very low water - 0.75 thousand m³.

Table 6. Dynamics of water use 2017-2019

Indexes	Unit	2017	2018	2019
Water was taken from natural sources, in total	million m ³	117,8	118,0	106,9
including: surface	million m ³	101,9	101,7	91,11
underground	million m ³	15,86	16,38	15,79
marine	million m ³			
Water was taken from natural sources per capita	m ³	74,1	75,62	68,84
Used fresh water, total	million m ³	98,08	96,01	87,16
including for needs: economic and drinking	million m ³	29,58	30,34	29,76
production	million m ³	62,29	60,59	26,56
agricultural	million m ³		39,07	3,603
irrigation	million m ³	4,357	3,38	3,323
fishery	million m ³			23,91
Used fresh water per person	m ³	61,7	61,53	56,13
Water was lost during transportation	million m ³	13,82	14,23	14,55
	% to the collected water	11,7	12,1	13,6
Reset water, total	million m ³			64,04
including: in the underground horizons	million m ³	-	-	0,0
in drive *	million m ³			2,082
on the filter fields	million m ³			2,223
in surface water bodies	million m ³	62,54	65,5	59,73
not classified as water bodies	million m ³			4,305
Total return water was discharged into surface water bodies	million m ³	62,54	65,5	59,73
of them: normatively purified, total	million m ³	26,39	27,69	28,14
including: on biological treatment facilities	million m ³			28,1
on physical and chemical treatment facilities	million m ³			0,038
on mechanical treatment facilities	million m ³			0,0
normatively (conditionally) clean without purification	million m ³	34,77	36,43	30,03
contaminated, total	million m ³	0,833	0,988	0,672
including: insufficiently cleaned	million m ³	0,82	0,988	0,672
without cleaning	million m ³	0,013	0,0	0,0
Return water is discharged into surface water bodies per capita	million m ³	39,3	41,98	18,12

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

Groundwater plays an important role in the water management of Vinnytsia region as the most reliable source of good quality drinking water. Estimated groundwater reserves of the region are 324.9 million m³ / year, approved operational reserves - 45.7 million m³ / year.

The projected resources of drinking groundwater within the Vinnytsia region are 885.5 thousand m³ / day. As of January 1, 2019, 27 groundwater deposits have been explored and approved in the region, the reserves of which amount to 151,943 thousand m³ / day.

The dominant water abstraction sectors are utilities and agriculture, which account for 42% (44.4 million m³) and 36% (38.9 million m³), industry - 19% (20.5 million m³), and other industries. - 3% (3.1 million m³).

Water use in 2019 from natural sources alone - 106.9 million m³, including 85% (91.1 million m³) from surface water and 15% (15.8 million m³) from groundwater. Water abstraction decreased by 9% to 11.1 million m³, while utilization decreased by 9% to 8.85 million m³.

A total of 87.2 million m³ was used in the region, including: production needs - 52.4 million m³ (60%); drinking and sanitary needs - 29.8 million m³ (34%); irrigation - 3.3 million m³ (4%); other needs - 1.7 million m³ (2%).

The largest consumers of water resources in Vinnytsia region are: Vinnytsia - 28%, Trostyanets district - 21%, Kalinovka district - 8%, Barsky district - 6%.

The largest consumers of water in the region in terms of enterprises are Municipal Enterprise "Vinnytsia vodokanal" uses 23%, PJSC "DTEK" West energy" Production enterprise Ladyzhynska Thermal power plant

(Ladyzhin) - 13%, Limited liability companies "Vinnytsia Poultry Farm" (village Olyanytsya Trostyanets district) - 6%, table 7.

Table 7. Water use by type of economic activity in 2017-2019

Types of economic activity	2017		2018		2019	
	Total million m ³	% savings of fresh water due to circulating	Total million m ³	% savings of fresh water due to circulating	Total million m ³	% savings of fresh water due to circulating
Industry	26,64	99,1	22,98		19,50	98,78
Agriculture	37,52	-	39,07		34,64	-
Forestry			0,044		0,051	-
Utilities	32,13	1,186	32,26		29,76	0,086
Total	98,08	97,87	96,01	95,56	87,16	96,5

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

About 59.7 million m³ of wastewater was discharged into water bodies of Vinnytsia region, including 27.7 million m³ (46%) by public utilities; agriculture - 26.3 million m³ (44%); industry - 4.8 million m³ (8%), other industries - 0.9 million m³ (2%).

The share of normatively clean without treatment water is the largest in the total volume of drainage - they account for 50% of the total volume of drainage (30.0 million m³). Contaminated wastewater was discharged into surface water bodies 1% of the total drainage volume (0.67 million m³), normatively treated at treatment plants - 47% (28.1 million m³), uncategorized - 2% (0.89 million m³)

Together with water pollution, 0.063 thousand tons of ammonium nitrogen arrived in the region's reservoirs in 2019; 0.099 thousand tons of suspended solids; 0.504 thousand tons of nitrates; 0.030 thousand tons of nitrites; 1,497 thousand tons of sulfates; 11.92 thousand tons of dry residue; 3,818 thousand tons of chlorides; 0.380 thousand tons of HSC; 0.162 tons of aluminum; 0.893 tons of iron; 0.204 tons of oil products, 1.329 tons of SPAR; 0.102 tons of zinc; 0.099 tons of fluorine; 34.48 tons of phosphates, table 8.

Table 8. Discharge of pollutants into surface water bodies

Discharge of pollutants	2017	2018	2019
	volume of pollutants, thousand tons	volume of pollutants, thousand tons	volume of pollutants, thousand tons
BSK 5	0,159	0,161	0,181
XSK	0,362	0,312	0,380
Suspended substances	0,085	0,096	0,099
Dry residue	10,16	10,72	11,92
Sulfates	0,766	1,328	1,497
Chlorides	3,194	3,507	3,818
Ammonium nitrogen	0,047	0,051	0,063
Nitrates	0,642	0,499	0,504
Nitrites	0,034	0,042	0,030
Petroleum products	0,184	0,229	0,2
SPAR	0,447	0,730	1,3
Zinc	0,119	0,082	0,1
Phosphates	28,94	42,54	34,5
Iron	1,204	1,006	0,9

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

The territory of the region as of January 1, 2019 is 2649.2 thousand hectares or 4.4% of the area of Ukraine (60354.9 thousand hectares). Most of the territory - 2064.0 thousand hectares (77.9% of the total area of the region) is occupied by agricultural land, of which: agricultural land 2014.2 thousand hectares (76.0% of the total area), including arable land 1725.5 thousand hectares (65.13% of the total area), fallow 1.0 thousand hectares (0.04%), perennial plantations 51.4 thousand hectares (1.94%), hayfields and pastures 263, 3 thousand hectares (8.92%). Forests and other wooded areas make up 380.3 thousand hectares (14.36% of the total area), built-up lands 107.7 (4.07%), wetlands 29.1 (1.10%), open lands without vegetation cover or with insignificant vegetation 25.0 thousand hectares (0.94%), inland waters 49.4 thousand hectares (1.86% of the total area) and

other lands (farmyards and roads, sands, ravines, stone shady places, etc.) 49.4 thousand hectares (1.86%). The land area (excluding wetlands and inland waters) is 2605.7 thousand hectares, or 98.3% of the total area (Samborska O. 2020).

According to the classification of soils and lands of Ukraine and their suitability for agricultural production, the soils of Vinnytsia region are located in terms of fertility from the fourth (70-61 points) to the eighth (30-21 points) class. These are soils from high fertility (especially valuable lands) to a group of soils of low quality (low-value lands) according to the general classification of soils and lands of Ukraine.

The main soils of the region are chernozem (50.1% of the area of agricultural lands) and gray forest (almost 33%).

Table 9. Conservation of degraded and unproductive lands in 2019

Types of land	Total land at the beginning of the year		Preservation was carried out		Need conservation		Are in a state of conservation	
	thousand hectares	% to the total area	thousand hectares	% to the total area	thousand hectares	% to the total area	thousand hectares	% to the total area
Agricultural land (arable land)	737,3	27,8	0	0	737,3	27,8	0	0

According to the degree of agricultural development, all districts can be divided into three groups: I - up to 70%; II - 71 - 80% and III - > 80%. The highest degree of development of agricultural lands is in Bershada (81%), Kozyatyn (86%), Lipovets (88%), Orativ (84%), Tepylyk (87%), Pohrebyshche (83%), Tyvriv (80%), Khmilnytsky (82%) and Chernivtsi (84%) districts. Ecological sustainability of land resources is characterized by the degree of plowing of land. In the region it is 65% (% of arable land from the total area). The most environmentally unstable areas are those in which plowed lands significantly outweigh conditionally stable lands, which include hayfields, pastures, lands covered with forests and shrubs and swamps.

The most environmentally sustainable are the land resources of Lityn and Chechelnytsia districts, where the degree of plowing is 55%. The highest percentage of plowed territory is in Bershada (73%), Lipovets (76%), Tepylyk (80%) and Chernivtsi (74%) districts.

Table 10. Irrigated lands

Irrigated lands	2018		2019	
	thousand hectares	% of the total area	thousand hectares	% of the total area
The area of irrigated land on which the proper functioning of the infrastructure of irrigation systems is ensured			3,743	15,7
including drip irrigation systems			1,05	4,4

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

One of the main criteria for assessing the ecological condition of agricultural land is the level of soil fertility, as the basis for the functioning of this category of land. The set of natural factors (surface area, natural vegetation in the past, climate, anthropogenic impact) contributed to the formation of different properties and fertility of soils.

The use of soils for a long time under crops with unbalanced application of fertilizers leads to an acute shortage of a nutrient, reduced fertility. An important indicator of the level of soil fertility is the humus content. The content of humus in the soils of Vinnytsia region is subject to a certain zonation and is due to the peculiarities of soil genesis: type of soil formation, particle size distribution of soils, type of vegetation, etc.

The most common soils in the region are podzolic soils (approximately 1318.6 thousand hectares), of which 351.2 thousand hectares of chernozems are podzolic. Arable land accounts for 82%. The average humus content in light gray and gray podzolic soils is 1.85%, dark gray podzolic soils - 2.77% and chernozems podzolic - 3.39%. Typical chernozems cover an area of approximately 494 thousand hectares, of which 91% are plowed. The average humus content is 4.01%. 36.3 thousand hectares fall on other types of chernozem soils.

On the area of 14.8 thousand hectares there are soid - slightly podzolic soils, the average humus content of which is 0.90%. 9.1 thousand hectares of these lands are occupied by unproductive agricultural lands, of which 59% are plowed. Other types of soils are distributed mainly on small areas and amount to 115.3 thousand hectares.

The average humus content in the soils of the region according to the Vinnytsia branch of the Ukrzemproekt Institute (1982) is 2.94%. The highest content of soils is in Lipovets (3.99%), Khmilnytsky (3.87%), Kalinovsky (3.65%), Kozyatyn (3.87%) districts, the lowest - in Barsky (1.86%), Zhmerynsky (1.94%), Tyrviv (1.92%) and Murovano-Kurylovesky (1.97%) districts.

According to Art. 150 of the Land Code of Ukraine to especially valuable soils in the region include chernozems not eroded loamy in forests, meadow - chernozem loamy, dark gray and chernozems podzolic loamy in forests and their gley deposits, deep and medium-deep drained peatlands. Their total area is 580.9 thousand hectares, of which 550.1 thousand hectares are under arable land. 105.9 thousand hectares of agricultural land are subject to waterlogging, of which arable land - 96.2 thousand hectares, 75.9 thousand hectares - waterlogging, of which arable land 38.9 thousand hectares, 2.2 thousand hectares - rocky, of which arable land 0.4 thousand hectares (Land Code of Ukraine: Information of the Verkhovna Rada of Ukraine from 2002).

Table 11. Soils with humus content

Surveyed area, thousand hectares	Soil area												Weighted average, %
	Very low <1,1		Low 1,1-2,0		Average 2,1-3,0		Increased 3,1-4,0		High 4,1-5,0		Very high > 5,0		
	thousand hectares	%	thousand hectares	%	thousand hectares	%	thousand hectares	%	thousand hectares	%	thousand hectares	%	
1265,5	2,1	0,2	267,1	21,1	510,1	40,3	371,7	29,4	89,6	7,1	6,8	0,5	2,70

Table 12. Prevalence of land degradation processes

Types of degraded lands	Area of affected lands thousand hectares	% of the total area
Deflation-hazardous lands (agricultural lands)		
Land (agricultural land) subject to water erosion		
Land (agricultural land) exposed to the combined action of water and wind erosion		
Land (agricultural land) with acidic soils	556,6	53,5
Land (agricultural land) with saline soils		
Land (agricultural land) with saline soils		
Land (agricultural land) with solonetzic complexes		
Land (agricultural land) sweetened		
Land (agricultural land) is wet		
Lands (agricultural lands) are swampy		
Land (agricultural land) is rocky		
Contaminated land (agricultural land) not used in agricultural production		

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

Wetlands or swamps are natural - anthropogenic in nature. High plowing, saturation of crop rotations with row crops and patterned tillage system are the main reasons that lead to an increase in wetland areas.

In Yampil'sky, Tomashpil'sky, Kryzhopil'sky, Pishchansky, Mohyliv - Podil'sky, Chechelnytsky and Chernivtsi districts on the area of 18,1 thousand hectares, on watersheds and their slopes where soil-forming breeds are dense to quarter quarters or and wetlands.

Wetlands, compared to the surrounding soils, have a heavier particle size distribution and lack of agronomical valuable structure: in the wet state they are viscous, very sticky, in the dry state - very fused, dense, cracked.

The frequency and degree of waterlogging of such soils depends on weather conditions (after dry years they disappear, and after wet, on the contrary, increase).

Frequency in the water mode complicates their use. In places where these soils are located on slopes of more than 7 degrees, in years with excessive rainfall, landslides occur, which cause the destruction of the soil surface. A large area of them is already forested, but up to 200 hectares are under agricultural land (mostly under unproductive pastures).

In Khmel'nitsky, Kalinovsky, Vinnytsia, Kozyatyn'sky and Lityn districts, the terrain is a slightly undulating plain with well-defined micro-depressions of round or oval shape with a flat bottom, several meters in diameter and 0.5 to 2.0 m deep, which in spring - summer period is filled with melt and rain water, which also causes prolonged waterlogging of soils, and sometimes permanent waterlogging, and complicates their use.

In the region, water erosion damaged 851.1 thousand hectares, of which 743.8 thousand hectares of agricultural land or 41.1% of the total area of surveyed land, including arable land 598.3 thousand hectares (80.4% of surveyed agricultural land).

The highest percentage of eroded lands is in Barsky, Kryzhopilsky, Tomashpilsky, Murovano-Kurylovetsky, Chechelnytsky and Shargorodsky districts (60 - 67%), the smallest - in Lypovets, Kalinovsky and Vinnytsia districts (9 - 14%).

Significant damage to agricultural land, mainly arable land, is caused by water erosion of soils. As can be seen, 39% of arable land is to some extent affected by planar erosion.

Since 1961, water erosion has covered more and more areas from year to year. Thus, for the period from 1961 to 1980 the area of eroded soils increased by 67.4 thousand hectares (13%), from 1980 to 1990 - by 58.9 thousand hectares (10%), and from 1991 to 1996, it decreased by 21.9 thousand hectares (4%), which is explained primarily by the transfer of arable land on the slopes of more than 70 to other types of agricultural land (fodder).

The Southern Branch of the Ukrainian Research Institute of Soil Protection against Erosion performed work to determine losses from soil erosion in Vinnytsia region. The results show that the Vinnytsia region has lost 140.6 thousand hectares of conventional agricultural land during the entire history of agriculture, including about 103 thousand hectares of conventional arable land.

To restore the fertility of 1 ha of eroded arable land lost over the years, it is necessary to apply an average of about 1000.0 tons of manure, 9.0 tons of ammonium nitrate, 17.1 tons of simple superphosphate and almost 80.0 tons of potassium salt.

As a result of water erosion, 5.9 million tons of soil are lost annually in the region, which contains 153.5 thousand tons of humus, 8.8 thousand tons of nitrogen, 8.1 thousand tons of phosphorus and 81.9 thousand tons of potassium. In terms of the equivalent amount of fertilizers, these losses are expressed in the loss of 2.3 million tons of manure, 25.2 thousand tons of ammonium nitrate, 43.1 thousand tons of superphosphate and 199.6 thousand tons of potassium salt.

As we can see, water erosion causes huge losses to the region's agricultural production.

There are many reasons for the occurrence and development of erosion processes. One of them is the irrational use of land, which contributes to:

- intensive plowing of sloping lands (more than 30) and cultivation of row crops (especially sugar beets) on them;
- lack of complexes in carrying out anti-erosion measures;
- super saturation of row crops with row crops.

According to the standards for erosion risk assessment: plowing of the territory of the region - 65%, agricultural lands - 86%, including plowing of slopes > 20 - 80%, the ratio of arable land to stable lands (hayfields, pastures, forests, swamps) - 2.7, - class of erosion danger in the region - strong and catastrophic.

To obtain the maximum yield and high quality products, it is necessary to create and maintain an optimal reaction of the soil solution. Most crops require a weakly acidic and near-neutral reaction of the soil solution.

The soils of the region are mainly weakly acidic, close to neutral and neutral reaction of the soil solution (1165.8 thousand hectares - 92.2% of the surveyed area). Only 97.8 thousand hectares require priority liming.

Systematic application of phosphorus fertilizers significantly increases the content of both total phosphorus and its mobile forms. The intensity of accumulation of available phosphates is different on different types of soils 88.2% or 1113.9 thousand hectares of surveyed soils have medium, high, high and even very high content of mobile phosphorus and only 149.7 thousand hectares or 11.8% - low and even very low.

Soil fertility relative to potassium is determined by the dynamic content of its mobile and fixed compounds due to the genetic properties of soils. The increase in mobile potassium content in soils is primarily due to the application of fertilizers. Interacting with the soil, potash fertilizers create compounds of different solubility, mobility and availability to crops.

Within each type of soil, the ability to replenish metabolic potassium reserves as it is assimilated by crops is different. Thus, 879.5 thousand hectares or 69.6% of the region's soils are characterized by high and even very high content of exchangeable potassium, 380.4 thousand hectares (22.5%) - medium and 3.7 thousand hectares (0.3%) - low.

The excess of mineral fertilizers over organic ones can cause significant changes in the absorption complex of chernozem soils. According to stationary experiments, this ratio increases the mobility of humus, calcium is leached from the colloidal complex, and the soil solution is acidified.

The use of high doses of mineral fertilizers can adversely affect the environment: cause acidification of soil solution, contamination of groundwater as a result of filtration of fertilizers (especially nitrogen), accumulation of excess nitrate nitrogen in crop products, contamination of reservoirs as a result of reservoir residues.

As for radioactive contamination, the most contaminated soils of Chechelnytsky, Tulchynsky, Nemyrivsky and Sharhorodsky districts, 190.5 thousand hectares of land are in the zone of enhanced radiation control, which is 7.2% of the total area of the region and in this zone there are 89 settlements items.

To reduce the access of radioactive substances in the Vinnytsia region, the most effective measures are liming of acid soils with full doses of lime, regular application of organic and mineral fertilizers, high-quality tillage with plowing to the full depth of the arable layer.

Irrigation in the region covers 24 thousand hectares, of which 4.8 thousand hectares require an increase in the technical level of irrigation systems. Water from all sources is suitable for irrigation. No saline and saline soils were found in the region.

The area of drained lands is 57.3 thousand hectares, of which 56.4 thousand hectares are agricultural lands, of which 2.8 thousand hectares need to be reconstructed to restore the drainage network.

Modern use of land resources of the region does not meet the requirements of rational nature management. The permissible ratio of arable land, natural forage lands, forests and water areas has been violated, which has led to destructive processes in agro-landscapes, and in some regions to an ecological crisis.

The flora of Vinnytsia region is distinguished by its richness. In various natural complexes in the region there are about 1,200 species of plants. Almost all of them are confined to certain growth conditions, which are distinguished in the Eastern Podolia: forest and coastal-water species are widespread throughout the region. Meadow and swamp species are more typical for the north of Vinnytsia, and steppe - for the south. Scattered throughout the Eastern Podolia are species of limestone and granite outcrops. Extremely many in the field of invasive plant species, which grow mainly in places where the natural vegetation is disturbed or disappeared altogether.

Out of one thousand plants of Vinnytsia region, about 200 are rare - those that are found only in some areas, tracts or reduce their range. Rare species of flora can be divided into several groups according to the degree of their distribution, ecological adaptation, confined to certain natural complexes. Thus, according to the geographical principle, there are: endemic, relict, border-areal, disjunctive-areal. By phytocenotic - forest, meadow, swamp, aquatic and coastal-water, steppe and petrophytic species. By economic - decorative, medicinal, technical. aromatic. Phenological - early spring, spring, summer, ephemeroids. Systematic groups of rare species are singled out: orchids, feather grass, bulbs, table 13.

Table 13. Species of plants and fungi protected by the law of Ukraine, 2017-2019

	2017	2018	2019
Species of plants and fungi in the region, units	600	600	600
% of the total number of species of Ukraine	2,40	2,40	2,40
Species of plants and fungi listed in the Red Book of Ukraine, units	86	86	86
Species of plants and fungi listed in the Annexes to the Convention on the Conservation of European Wildlife and Natural Habitats, units	48	48	48
Species of plants and fungi listed in the Annexes to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	65	65	65

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

The species of individual plants, which are listed in the Red Book of Ukraine, are a great asset for the region and Ukraine. The difficult economic situation of a large part of the population leads to the uncontrolled collection of plants - primroses, medicinal plants, grazing.

The result is a reduction in the range of individual plant species, reducing their numbers. Over the past 2 years, there has been an increase in the amount of harvested medicinal raw materials. The main types of medicinal plants are elder flowers, birch buds, hawthorn and rowan berries, oak bark, yarrow, linden flowers, wormwood, horsetail, celandine, rose hips. However, the limit on the special use of medicinal raw materials was not necessary.

Due to the fact that the population harvests a significant number of different species of medicinal plants for their own needs, the mass of harvested medicinal raw materials is much larger in both quantity and species composition. This indicates insufficient protection of medicinal plants by land users.

Table 14. Species of plants and fungi subject to special protection in the Vinnytsia region

Name of the species (ordinary and scientific)	Red Book of Ukraine	Berne Convention
Coronilla elegans	+	
Cephalanthera rubra	+	
Cephalanthera longifolia	+	
Cephalanthera damasonium	+	
Euonymus nana	+	
Bulbocodium versicolor	+	
Leucojum vernum	+	
Gymnadenia odoratissima	+	
Gymnadenia conopsea	+	
Betula borysthena	+	
Coronilla elegans	+	
Cephalanthera rubra	+	
Carlina onopordifolia	+	+
Trapa natans	+	+
Dianthus hupanicus	+	+
Neottia nidus-avis	+	
Botrychium lunaria	+	
Botrychium matricariifolium		+
Liparis loeselii	+	+
Chmaecytisus albus	+	
Chmaecytisus blockianus	+	
Chmaecytisus podolicus	+	
Dracocephalum austriacum	+	+
Cypripedium calceolus	+	+
Fritillaria Montana	+	+
Salvinia natans	+	+

Source: systematized by the author based on Ecological passport of Vinnytsia region in 2019

The fauna of the region is diverse. However, against the background of a fairly large biodiversity, usually inherent in the forest-steppe, it is still necessary to emphasize a certain trend towards impoverishment of the fauna of terrestrial vertebrates, caused by semi-isolation due to strong fragmentation of natural areas.

In total, there are about 420 species of animals in the region, including fish - 30, amphibians - 11, reptiles - 8, birds - 300, mammals - 70. As of 01.01.2019 in all categories of farms the number of cows was 1926.3 thousand heads, which is 91.5 thousand heads (4.2%) less than in the corresponding period last year. The mass share of cows in households is 75.7%. In 2018, the number of cattle in industrial farms decreased by 1.14 million compared to 2014, in households - by 2.23 million. Thus, the number of cows in homesteads last year decreased by 3.3% and amounted to 1,5 million heads, and the number of industrial cows increased (+0.3%) and amounted to 467.9 thousand cows (Pronko, Kolesnik and Samborska 2020).

Based on the analysis of the distribution of mainly vertebrates by biotopes, it is possible to identify the following faunal complexes.

Forest, which includes animals living in forests of various types. Among mammals, the red vole, the yellow-throated mouse, the European mole, the common shrew, and the forest marten dominate here; among the birds - finch, black-headed shepherd, great tit, blackbird and songbird, variegated woodpeckers large and medium, gray owl; amphibians are represented by the gray toad, and reptiles are represented by the toadstool. The shrub faunal complex includes animals that inhabit shrubs on beams and edges. Shrub stations occur evenly throughout the region. The diversity of animals in these places is quite significant, which is caused by the intermediate nature of shrub stations - there are both representatives of forest and steppe-agrogenic complex. The dominant species of shrub habitats should be considered: among mammals - field and forest mice, voles and ores, European hedgehogs, weasels and ermines, badgers, foxes; among the birds - the shrike, the gray nightingale, the oatmeal, the hoopoe, the lentil, the click, the river mare; among reptiles there is a copperhead and a lizard agile. Bee-eaters nest in the burrows of ravines.

Meadow faunal complex includes animals that live in open and overgrown areas. Common for these places among mammals are the field mouse, the shrew and the common woodpecker, the coot is large, the

European mole, please; among birds - white wagtail, sandpiper, fisherman, shore swallow; among reptiles - the common snake; among amphibians - kvaksha. In addition, it is here that there is a fairly large number of species from the Red Book: ermine, otter, white-tailed eagle and sandpiper.

The swamp faunal complex includes separate areas of coastal zones. The species composition of mammals is not fundamentally different from the meadow complex, and among the birds there are a number of species that are unique to wetland stations. Quite common mallard, waterfowl, coot, great reed warbler. Rarer are reed oatmeal, meadow reed warbler and nightingale mare. The lake frog is also found in large enough numbers in the coastal strips.

The stepoagrogenic faunal complex includes species that live in fairly large steppe areas, as well as in fields, pastures and fallow lands, which are more or less evenly distributed. These stations are also characterized by the Podolsk blind, the hare, the white-toothed white-bellied and the white-bellied. Among the birds here are the common lark and the yellow wagtail. Less common - crested lark, partridge, quail and chaff.

The synanthropic faunal complex includes species whose life is closely connected with human habitation and settlements. It is here that species that can be considered synanthropes are: house mouse, gray rat, stone marten, black ferret, late bat, house and field sparrows, village swallow.

The results of the research are a large number of plants and fungi found in the Vinnytsia region, which are subject to special protection not only by Ukrainian legislation, but also by international conventions on environmental protection. This is especially attractive for the preservation of the surrounding environment and care for the environment. The development of regional environmental programs has contributed to the development and preservation of the region's environment, which in turn has led to an increase in the flow of tourists from other countries. And the development of the tourism industry of Vinnytsia region opens opportunities for attracting additional revenues to the budget, which will contribute to a good foundation for economic growth in the region. Reducing the share of environmental pollution in the region will contribute to the cultivation of more medicinal plants supplied to other regions of Ukraine.

Conclusion

Detailed deposits of construction raw materials fully meet the needs of the construction industry. It should be noted some granite deposits that can be used as facing stone and porous - limestone suitable for sawing on wall blocks.

It is necessary to develop the direction of using the properties of medicinal radon waters of the Khmelnytsky radon water deposit, mineral waters with soda mineralization, which were discovered and studied in the Transnistrian region. Significant prospects are revealed in the development of natural table waters, of which there are about 50 in the region directions for subsoil development.

The main and promising areas for improving the environmental situation of Vinnytsia region should be the following:

1. Ensuring the harmonization of interaction between society and the natural environment, raising the level of public environmental awareness:
 - reduction of pollution of natural water with organic substances, nitrogen compounds and phosphates;
 - land reclamation and restoration;
 - reduction of the area of low quality soils (low-value lands)
2. Improving programs of national importance for regional environmental policy:
 - promoting the development of the regional Aarhus Ecological Information Center, involving the public in the process of environmental education for sustainable development, environmental education and upbringing;
 - creation of a network of regional ecological and educational centers on the basis of educational institutions, non-governmental environmental organizations.
3. Improving environmental safety and mitigating the effects of climate change:
 - reducing the negative impact of urbanization processes on the environment, stopping the destruction of the environment within cities by increasing landscaping and expanding areas of public green spaces, reducing air pollution, water bodies, noise and electromagnetic pollution;
 - strengthening the shores of water bodies within settlements;
 - cleaning of the region's rivers for domestic use;
 - creation of a system of separate collection / sorting and processing of solid household waste, their use as alternative energy sources;
 - monitoring of soils in the territories adjacent to chemical warehouses and development of projects for their reclamation;

- creation of a system of safe handling of electrical waste and spent chemical power sources, medical waste;
 - increase of the afforestation area to 15% of the oblast territory by reforestation and afforestation on forest land plots, creation of protective forest plantations on non-agricultural lands and lands allocated for afforestation, restoration and creation of new field protective forest belts;
 - introduction of a system of environmental measures to preserve bio- and landscape diversity and expand the area of nature reserves to 5% of the total area.
4. The formation of a holistic tourism product that can best meet the needs of international and domestic tourism:
- development and implementation of new tourist routes taking into account historical and local lore, literary and art history, historical and ethnic spheres;
 - carrying out certification and inventory of tourist resources of the region;
 - attraction of investments in creation of electronic catalogs of museum exhibits, monuments of history and monumental art, architecture, archeology;
 - organization of annual trainings, seminars on tourism development, participation in international, all-Ukrainian, regional tourist exhibitions and fairs;
 - production of advertising and presentation materials (including in audio format for information accessibility for visually impaired people);
 - display and publication through national and local media programs and articles to promote domestic tourism;
 - development of green tourism (conducting trainings, educational seminars for owners of green tourism estates);
 - certification of rural green tourism facilities and their centralized information support (website).

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