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Agroecological Bases of Sustainable Development Strategy for the Rural United Territorial Communities of the Western Polissya Region

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Abstract. The article considers the influence of agroecological indicators on the sustainable development of the rural united territorial communities of the Western Polissya region (Ukraine) based on the current state analysis of crop production. To study the state of crop production and determine its role in the development of rural areas of the Western Polissya region, the authors used their field research, as well as data from the Main Departments of Statistics in Rivne and Volyn regions, the State Statistics Service of Ukraine, statistical collection "Crop Production of Ukraine" (2018). The following methods were applied throughout the research process: system analysis, comparison, graphical and statistical methods. The development of crop production was assessed taking into account the dynamics of the following indicators: sown areas of crops (thousand hectares), production volume (gross harvest) of crops (thousand centners), crop yields (thousand hectares^{-1}), sown areas of crops in enterprises and households on the territory of the Western Polissya region in terms of Rivne and Volyn regions for the period from 1995 to 2019. During the study period, changes in the ratio of areas between different crops were discovered: a decrease in the sown area of sugar beet, fruit and berry crops, cereals and legumes, and an increase in sunflower, vegetable crops, etc. An increase in crop yields and a slight decrease in gross harvest were established only for sugar beet in the two regions and fruit and berry crops in the Volyn region. In the region, 51.6% of the sown area of crops is accounted for by households that supply the market with products included in the consumer basket of ordinary citizens: roots and tubers, vegetables, and melons. Enterprises are focused on growing profitable crops (technical, grain, and legumes) for export

Keywords: agroecological indicators, anthropogenic impact, sustainable development, rural united territorial communities, Western Polissya region

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INTRODUCTION

The authors observe the formation of a new worldview paradigm based on a political and practical model of development of all countries, which fulfills the current generation's needs without compromising the ability of future ones to fulfill theirs. This model is focused on achieving the optimal balance between the three development components – economic, social, and environmental. The transition to sustainable development is becoming an important objective for Ukraine as well, given the goals based on political, economic, social, environmental, moral, religious, ethnic, cultural, and sociological values inherent in Ukrainian society [1-3]. Therefore, to move towards sustainable development in Ukraine, the question of certain social transformations arose, one of which is the decentralization reform of the administrative-territorial organization.

In 2014 the implementation of decentralization reform was launched. The main objectives of this reform are the achievement of optimal distribution of powers between local governments and executive authorities on a subsidiarity basis, and creating viable territorial communities as a foundation for the new administrative-territorial organization. As part of the reform, the fundamentally new processes of cooperation and voluntary unification of territorial communities should take place. The purpose of such optimization is to create an effective system of public authority in administrative-territorial units. Such a system should be able to provide favorable conditions for human life and opportunities for sustainable socio-economic development of all regions via the rational use of their natural resource potential [4; 5].

At the time of writing, the united territorial communities are entering a new stage of their existence. They received authority, ability to distribute their own and obtain external resources. Created communities are responsible to their residents for creating a comfortable and safe living environment. This requires predictable and motivated development; its initial stage is in the development of strategic directions for sustainable development. It has become quite a challenge for the communities, whose population has been declining significantly in recent years.

An important factor in the sustainable development of rural territorial communities is the development of the agricultural sector, capable to ensure the food independence of Ukraine and provide a significant number of jobs for the population. As there are two main and closely interconnected branches in agricultural production – crop production and animal husbandry, their development becomes a strategic goal of agriculture. Thus, crop production is the basis for feed manufacturing and directly affects the development of animal husbandry. Furthermore, the waste generated in animal husbandry is an organic fertilizer, the introduction of which helps to increase soil fertility, the content of nutrients and stimulate the development of microorganisms, which makes it possible to increase plant yields [5; 6].

Under the strategic directions of agricultural development of Ukraine for the period up to 2020, the goal of the crop development strategy was to ensure a stable increase in production for the needs of the domestic and foreign markets and increase the efficiency of the industry. The main goals of crop development for this period were identified as follows: 1. Increasing crop production; 2. Creating a balanced feed base for livestock; 3. Creating a raw material base for bioenergy; 4. Increasing exports of crop products and products of its processing; 5. Increasing the productivity of crops [7].

The key issues considered in the study of the state and prospects of crop production include the impact of tillage and fertilization on yields, the formation of scientifically sound crop rotations, the introduction of innovations in crop production, breeding new varieties, protection of crops from weeds and pests, diseases, viruses, etc. Increasing crop yields makes it possible to obtain more products without changing the sown area, which is one of the priority goals of crop development, so many scientific works are devoted to solving this problem.

The main factors influencing crop yields, including natural factors of cosmic origin (solar activity and lunar cycles) are cited in the works of P. Pisarenko and Ya. Khlebnikova [8], G. Mühlbachová et al. [9], N. Lialina [10], and M. Mayerová et al. [11], who investigated the influence of chemical weed control agents on crop yields in different crop rotations. According to their data, crop losses in the uncontrolled area (control) increased in the following order: spring barley < winter wheat < peas < oilseed rape <potatoes.

Particularly relevant today is the impact of climate change on crop yields, that depend on climatic indicators, extreme temperatures, and carbon dioxide concentrations, which are expected to increase in the next century. D. Angelova [12], L. Petersen [13] proposed a model of approximate yield at the enterprise level in the context of climate change, which combines economic and agronomic concepts of crop production. L. Yu et al. investigated the impact of drought on crop water use efficiency [14]. O. Fraier emphasizes the need to strengthen agricultural diversification, i.e., by forming a balanced crop rotation portfolio with the addition of different crops [15].

It is now believed that any modern agricultural technology should be soil-protective – to ensure efficient use of land, as well as the restoration and increase of its fertility. The effectiveness of various agricultural technologies for growing crops is reflected in the studies by scientists from different countries. For example, V. Dnes et al., as a result of comparing the economic efficiency

of different technologies, have found that the use of no-till farming saves money almost two times, compared with differentiated technology [16]. The influence of different tillage systems on agrophysical parameters is provided by Y. Grechishkina et al. [17]. In recent years, the development of nanotechnologies, which are also used in agricultural production, has become more widespread. The production of nanoparticles attracted the attention of chemists and biologists, who want to use them to develop a new generation of nanofertilizers and nanopesticides. For example, M. Bayat et al. investigated the use of products based on agro-nanoparticles and their use to combat fungal diseases of strawberries [18].

An alternative management model, which involves the efficiency of agricultural production while reducing the anthropogenic load on the environment and natural resources, is the transition to organic agricultural production [19]. Organic agricultural production is consistent with the generally accepted concept of sustainable development in the world, as it provides stabilization and restoration of quality parameters of land resources. In addition, it guarantees the diversification of food types in the country and provides the population with quality food, opening the prospect of social and economic growth in rural areas through the export of certified products to world markets at much higher prices. T. Epule in his work compares the impact of organic and inorganic agriculture on global food security, where he points out that organic farming alone cannot support sufficient production [20]. According to him, a reasonable combination of organic and inorganic types of agriculture provides the best effect.

Thus, studies aimed at the development of the crop industry are actively continuing, and their introduction and use in enterprises, farms, and individual farms require funding and government support programs. Therefore, constant monitoring of crop production, which depends on many indicators that may change each year, does not lose relevance. This allows to identify strengths and weaknesses at the regional level, identify and work to reduce the main threats to its sustainable development to ensure a favorable investment environment. In addition, the development of agriculture is one of the priority goals of the Strategies of socio-economic development of rural and urban territorial communities that are currently in the final stages of formation (by the end of 2020) as a result of administrative reform launched in Ukraine in 2014.

The purpose of the study was to assess the impact of agri-environmental indicators on the sustainable development of rural integrated territorial communities of the Western Polissya region (Ukraine) based on the analysis of the current state of crop production.

MATERIALS AND METHODS

To study the state of crop production in the Western Polissya region, the dynamics of sown areas of the crops (sugar beet, sunflower, potato, cereals and legumes, vegetables, fruits, and berries), their production (gross harvest), and yield were analyzed. The data were analyzed for the period from 1995 to 2019 in terms of the Rivne and Volyn regions.

To determine the role of crop production in the development of rural integrated territorial communities, the ratio of sown areas of fodder crops, technical, grain and legumes, roots and tubers, vegetables, and melons in enterprises and farms in the region as of 2019. The study used data from the Main Departments of Statistics in Rivne [21] and Volyn [22] regions, the State Statistics Service of Ukraine [23], and the statistical yearbook "Crop Production of Ukraine" [24].

The article considers the ratio of crops in crop rotations under the approved standards of the optimal ratio of crops in different natural and agricultural regions (Table 1).

Table 1. *Standards for the optimal ratio of crops in crop rotations in different natural and agricultural regions*

Natural agricultural region	Structure of sown areas (in percent)							
	Cereals and legumes	Technical cultures			Vegetables, potatoes, melons	Fodder crops		Autumn fallow
		Total	Including			Total	Including perennial herbs	
			Rapeseed	Sunflower				
Polissya	35-80	3-25	0.5-4	0.5	8-25	20-60	5-20	
Forest-steppe	25-95	5-30	3-5	5-9	3-5	10-75	10-50	
North steppe	45-80	10-30	10	10	< 20	10-60	10-16	5-14
South-steppe (irrigation included)	40-82	5-35	5-10	12-15	< 20	< 60	< 25	18-20
Pre-Carpathian	25-60	5-10	5-7		8-20	25-60	10-40	

Source: *[25]*

The study used the following main methods: systematic analysis (the comprehensive analysis of the relationship between the area of crops and products), comparative (the general and distinctive features in the development of crop production in Rivne and Volyn regions in farms of all categories were determined), graphical method (for visual presentation of results), statistical method (for detection of changes in sown areas of crops, the volume of their production and productivity for the period from 1995 to 2019).

RESULTS AND DISCUSSION

The Western Polissya region, (also known as the North-Western region according to socio-geographical zoning), is located in the extreme North-West of Ukraine. It includes two oblasts, Volyn and Rivne, with a total area of 40.2 thousand km^2, and a population of 2.19 million people (Fig. 1).

In 2019, the share of regional rural residents was 50%. Due to the low level of urbanization, the average population density (54 people per km^2) is much lower than the national average, the lowest among all economic regions. There is a significant surplus of labor resources in the region, especially in rural areas. This leads to significant pendulum migrations and departure of residents for seasonal work both within Ukraine and in other countries.

***Figure 1**. Western Polissya region on the map of Ukraine*

Natural and climatic conditions

According to the climatic zoning, the Western Polissya region is located in the North Atlantic-continental climate region. The climate is temperate continental: mild winters with frequent thaws, warm summers, average annual rainfall – 650-700 mm. Winter comes in late November, and a stable snow cover is formed in the last days of December – the first decade of January. Summer comes in late May and lasts until September. This is the period of the highest air and soil temperatures, precipitation, and ripening of the crop. Clear, cool early autumn weather sets in early September [26]. According to the physical and geographical zoning, the studied region is located on the East European Plain. The central and northern parts of the Western Polissya region are located in the zone of mixed (coniferous-deciduous) forests (Polissya region), Volyn Polissya region. The southern lands belong to the zone of deciduous forests (Western Ukrainian region), the Volyn upland region, and the extreme southern lands fall into the region of Small Polissya [26].

There are two distinct types of landscapes in the region – Polissya and forest-steppe. Polissya landscape areas are characterized by large forest cover, wetlands, spread over large areas of meadows (inter-river and floodplain), the predominance of infertile soils, and the presence of a significant number of floodplain and karst lakes. The main massifs are occupied by pine and pine-oak forests, small areas – hornbeam-pine, hornbeam-oak, and other forests. Bogs and wetlands occupy an average of about 10-20%, and in the northern regions up to 40% of the territory [27; 28].

The valley-ridge terrain complicated by ravine-beam and karst forms is inherent in forest-steppe landscape areas. The forest cover is smaller in comparison with the Polissya landscape, deciduous and mixed forests of oak, hornbeam, and pine predominate. Meadows in the forest-steppe part are almost completely flooded, less often located on the edges of swamps and beam bottoms. Swamps – lowlands, occupying the valleys of small rivers.

According to geobotanical zoning, the region is located in the European deciduous forest area (zone). The center and north are located in the Eastern European (Sarmatian) provinces of coniferous-deciduous

and deciduous forests, namely: Polissya sub-province of coniferous-deciduous forests, districts – Western Polissya oak-pine, pine, hornbeam-oak forests, and Verkhopripyatsky floodplains pine, alder, spruce (fragmentary) forests, floodplain meadows and oligo-, meso-, eutrophic bogs. The southern part of the Western Polissya region is part of the Central European Province of Deciduous Forests, the South Poland-Western Podolsk Subprovince of Deciduous Forests, Meadows, Meadow Steppes and Eutrophic Swamps, and the districts of Lublin-Volyn are hornbeam-oak, and Small Polissya hornbeam-oak, pine forests, floodplain meadows and eutrophic bogs [26].

According to the agro-climatic zoning, the Western Polissya region belongs to the zone of sufficient moisture, which is characterized by the following indicators: hydrothermal coefficient 1.3-1.6, the sum of active temperatures 2400-2800°C, the amount of precipitation for the warm period 360-430 mm, the length of the period active vegetation 160-175 days, duration without frosty period on the soil surface 140-170 days, reserves of productive moisture in a meter layer of soil, mm; a) under the chill in early spring (April 1) 160-220; b) before the cessation of winter vegetation on non-steam predecessors (November 1) 110-220 [26].

According to agro-soil zoning, the central and northern parts of the Western Polissya region are located in the zone of Ukrainian Polissya with sod-podzolic and swamp soils on ancient alluvial, water-glacial deposits, and moraines, a Western province with sod-podzolic, podzolic-podzolic, swamps, c. incl. peat soils. In the east, a small part of the region entered the Right Bank Province with sod-podzolic, mostly gleyed, swampy, including peat soils. The southern part of the region is located in the Forest-Steppe zone with typical chernozems, podzolic and degraded soils mainly on forest rocks, a Western province with podzolic in some places gley soils and typical chernozems. The extreme southern territory of the region (namely the Rivne region) is also part of the Ukrainian Polissya zone [26].

According to the agricultural zoning, the north of the Western Polissya region belongs to the intensive livestock area, characterized by meat and dairy cattle breeding, flax growing, potato growing, and the south of the region belongs to the intensive livestock farming area, which is dominated by beet growing, grain farming, m. meat and dairy cattle breeding, pig breeding [26]. In the structure of the land fund of the Western Polissya region, the total area of agricultural lands is 1974.2 thousand hectares, of which 1329.1 thousand hectares are arable land, 1176.2 thousand hectares are sown areas of crops (Table 2).

***Table 2**. Area of agricultural land in the Western Polissya region, thousand hectares*

	Total land area	Agricultural land	Arable	Sown areas of crops
Rivne	2005.1	926.2	656.8	587.6
Volyn	2014.4	1048.0	672.3	588.6
Western Polissya region	4019.5	1974.2	1329.1	1176.2

***Source**: calculated according to the State Statistics Service of Ukraine [23]*

According to the Main Department of the State Geocadastre in the Rivne region, the total area of its lands is 2005.1 thousand hectares. Agricultural lands occupy 926.2 thousand hectares (46.2%), of which 656.8 thousand hectares (32.8%) are arable land [27]. The land fund of the Volyn region as of 01.01.2019 is 2014.4 thousand hectares, of which 1048 thousand hectares (52%) are agricultural lands, which indicates a high level of agricultural land development. Arable land is 672.3 thousand hectares (33% of the total area) [28]. According to the State Statistics Service of Ukraine, the sown area of crops in these areas is 587.6 thousand hectares in Rivne and 588.6 thousand hectares in Volyn.

The state of crop production in the West Polissya region

Included in the strategy of socio-economic development of the united territorial communities of the Western Polissya region, the development of crop production as one of the key goals of sustainable development was analyzed taking into account the dynamics of the following indicators:

– sown areas of crops, thousand hectares;
– the volume of production (gross harvest) of crops, thousand centners;
– crop yields, $c \cdot ha^{-1}$;
– sown areas of crops in enterprises and households.

In 2019, 587.8 thousand hectares (50.0% of the total sown area) prevailed among the sown areas of crops, the industrial crops accounted for 255.3 thousand hectares), roots and tubers, vegetable and melon crops – 173.5 thousand hectares (14.8%), fodder crops – 159.6 thousand hectares (13.6%) (Fig. 2).

The dynamics of sown areas of some crops in the Western Polissya region in terms of regions for the period from 1995 to 2019 are shown in Table 2. The data given in Table 3 shows that for the period from 1995 to 2019 the sown areas allocated for crops in the regions underwent certain changes. For example, in the period from 2005 to 2019 the area for sunflower in the Volyn region has increased from 0.1 to 29.9 thousand hectares (approximately 290 times), and in the Rivne region in the same period it increased from 0.2 to 27.0 thousand hectares.

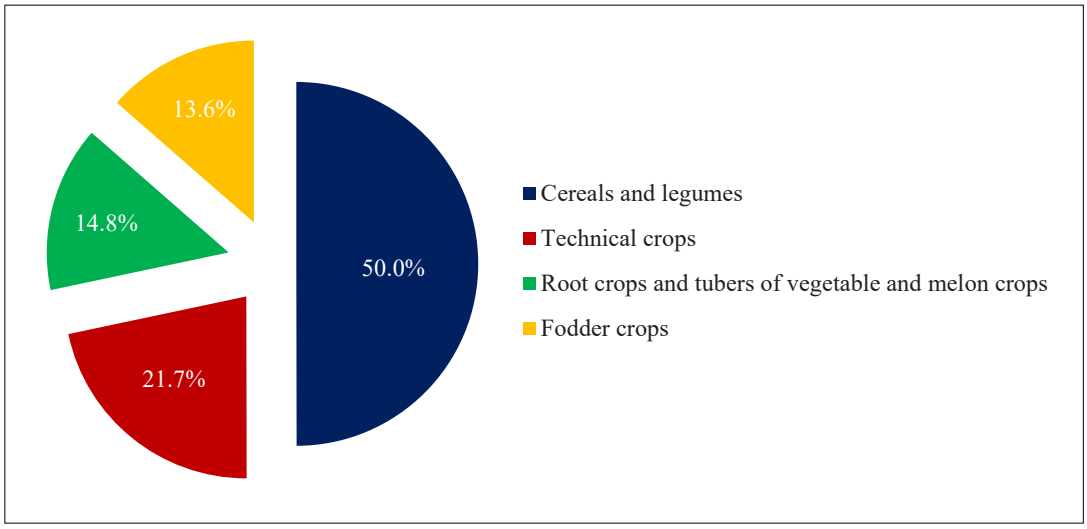

***Figure 2**. The ratio of sown areas of crops in the Western Polissya region in 2019, %*
***Source**: calculated according to the State Statistics Service of Ukraine [23]*

***Table 3**. Dynamics of sown areas of crops (updated) in the Western Polissya region in terms of regions for the period from 1995 to 2019, thousand hectares*

	Rivne region						Volyn region					
Years	Cereals and legumes	Sugar beet factory	Sun-flower	Potato	Vegetable crops	Fruit and berry crops (general)	Cereals and legumes	Sugar beet factory	Sun-flower	Potato	Vegetable crops	Fruit and berry crops (general)
1995	292.7	41.4	0.1	65.9	9.2	13.3	313.7	34.0	0.0	67.4	8.0	15.5
2000	270.8	24.9	0.1	74.0	10.1	9.0	271.8	29.4	0.0	79.3	10.5	5.4
2005	271.5	33.4	0.2	66.6	9.7	7.9	283.8	29.4	0.1	69.4	10.6	4.0
2010	244.2	30.8	2.7	68.7	10.9	7.6	242.1	16.3	0.2	65.9	11.7	4.1
2015	244.8	10.6	4.2	68.8	11.7	7.4	271.3	11.3	2.5	68.3	12.9	4.9
2016	270.0	11.9	15.1	69.9	12.0	7.0	295.5	13.5	6.4	72.0	13.1	4.9
2017	266.2	14.3	24.7	71.1	12.6	7.4	291.5	14.1	16.2	72.8	13.6	4.9
2018	262.1	13.7	24.2	70.9	12.6	7.4	293.8	12.2	23.6	76.5	12.9	4.7
2019	291.1	11.7	27.0	71.0	12.3	7.3	296.7	9.2	29.9	77.4	12.8	4.7

***Source**: formed according to the State Statistics Service of Ukraine [23; 24] and the Main Departments of Statistics in Rivne [21] and Volyn [22] oblasts*

Sown areas for potatoes and vegetables slightly increased in the regions. In the Rivne region in the period from 1995 to 2019, the area occupied by potatoes changed from 65.9 (1995) to 74.0 thousand hectares (2000), in 2019 this figure was 71.0 thousand ha. In the Volyn region in the same period, the area for potatoes almost did not differ from such of Rivne region and was in the range from 65.9 (2010) to 79.3 thousand hectares (2000), in 2019 – 77.4 thousand ha. Areas for vegetable crops increased in the Rivne region from 9.2 to 12.3 thousand hectares, in the Volyn region – from 8.0 to 12.8 thousand hectares, respectively.

As for the areas for cereals and legumes, fruits and berry crops, and sugar beet, there is a negative dynamic. For example, the area for cereals and legumes decreased by only 1.6 thousand hectares in the Rivne region and by

17 thousand hectares in the Volyn region, for beets from 41.4 to 11.7 thousand hectares (3.5) in the Rivne region and from 34.0 to 9.2 thousand hectares (3.7 times) in Volyn region respectively, for fruit and berry crops from 13.3 to 7.3 thousand hectares (1.8) in Rivne region and from 15.5 to 4, 7 thousand hectares (3.3 times) in Volyn region.

The change in the area for crops in the period from 1995 to 2019 in the region also affected the dynamics of their production (gross harvest), as shown in Table 4. The data in Table 4 shows, however, that the decrease in sown areas for cereals and legumes, sugar beet, fruit, and berry plantations had a negligible impact on production in the Western Polissya region for the period from 1995 to 2019, which associated with an increase in their yield (Table 4). The reduction of the gross harvest is observed only for sugar beet in the territory of two oblasts and fruit and berry crops in the territory of Volyn oblast. Thus, as a result of reducing the sown area for beets by 3.5-3.7 times, there was a decrease in gross harvest from 7629.5 thousand centners (1995) to 5600.8 (2019) in the Rivne region and Volyn – from 5966.7 thousand centners (1995) to 4117.3 thousand centners (2019). Reducing the area of fruit and berry crops in the Rivne region by 1.8 times did not affect the volume of production, but on the contrary in 2019, compared to 1995, the amount of gross harvest increased by 2.1 times. In the Volyn region, as a result of a 3.3-fold decrease in the area for these crops, a 1.4-fold decrease in production was detected.

***Table 4**. Dynamics of production (gross harvest) of crops in the Western Polissya region in terms of regions for the period from 1995 to 2019, thousand tons*

	Rivne region						Volyn region					
Years	Cereals and legumes[1]	Sugar beet factory	Sunflower[1]	Potato	Vegetable crops	Fruit and berry crops[2]	Cereals and legumes[1]	Sugar beet factory	Sunflower[1]	Potato	Vegetable crops	Fruit and berry crops[2]
1995	7552.6	7629.5	1.0	6483.6	1041.4	409.7	8189.0	5966.7	0.1	6215.5	1166.9	563.1
2000	4947.6	4313.8	0.6	8755.0	1336.5	346.8	5030.9	4862.8	0.1	11942.4	1105.5	386.2
2005	5991.6	5819.6	4.5	9120.3	1714.5	515.8	6770.5	7111.4	2.1	9752.0	2152.0	275.6
2010	6357.8	10105.1	29.8	10644.0	2164.7	859.1	5794.0	4736.4	2.2	9864.1	2486.6	342.4
2015	11015.4	4544.0	95.6	12275.8	2135.7	992.5	10622.8	4201.9	52.1	10988.1	2764.4	378.6
2016	13004.6	5438.8	370.4	12494.2	2362.3	776.9	11096.5	5803.9	155.8	11324.0	2887.4	370.4
2017	12087.2	6426.4	670.5	13109.1	2681.5	809.0	11652.0	6205.4	395.3	11394.6	3026.2	368.8
2018	12595.2	7239.0	584.2	13108.2	2651.0	871.8	12372.0	5283.3	695.2	11644.8	2802.2	428.7
2019	14930.1	5600.8	778.4	12847.0	2688.7	900.8	12926.3	4117.3	944.7	11741.7	2819.1	396.2

***Note**: 1 – in the mass after finishing, 2 – of the total area of plantings*
***Source**: formed according to the Main Departments of Statistics in Rivne [21] and Volyn [22] oblasts*

With a slight decrease in the area of grains and legumes, there is an increase in their gross harvest by 2.0 times in the Rivne region and 1.6 times – in the Volyn region. For other types of crops, the area of which in the region has been increased, there is an increase in production by two or more times. This is especially true for sunflower since the sown areas for it in the period from 1995 to 2019 increased and therefore its production also increased from 1.0 to 778.4 thousand centners in Rivne region, and from 0.1 to 944.7 thousand centners – in Volyn. The increase in crop production in the Western Polissya region is associated with an increase in their yield, the dynamics of which for the period from 1995 to 2019 is shown in Table 4. The data in Table 5 shows that over the last 24 years there has been an increase in yields of all these crops. Yields (centners per hectare) of fruit and berry crops increased 3.7 times in the Rivne region and 2.1 times – in the Volyn region, sunflower – 2.8 and 3.3 times respectively, sugar beet – 2.5 times in both regions. Slightly lesser results in the dynamics of crop yields can be observed in the potatoes, vegetables, grains, and legumes – around 1.6-2.0 times increase.

***Table 5**. Dynamics of crop yields in the Western Polissya region in terms of regions for the period from 1995 to 2019, thousands ha[-1]*

	Rivne region						Volyn region					
Years	Cereals and legumes[1]	Sugar beet factory	Sunflower[1]	Potato	Vegetable crops	Fruit and Berry crops[2]	Cereals and legumes[1]	Sugar beet factory	Sunflower[1]	Potato	Vegetable crops	Fruit and berry crops[2]
1995	26.0	191	10.1	99	116	35.6	26.5	182	9.0	93	150	44.6
2000	21.1	206	4.8	119	138	41.3	19.4	183	9.0	151	108	75.3
2005	22.6	176	25.7	137	176	69.8	24.1	246	13.7	141	203	76.8
2010	26.6	329	11.3	155	198	121.5	24.1	294	10.4	150	213	92.1
2015	45.0	429	22.8	178	183	145.4	39.4	371	20.6	161	215	87.6
2016	48.2	457	28.0	179	197	114.5	37.7	429	24.3	157	219	80.5
2017	45.7	449	27.3	184	212	119.0	40.1	442	24.7	157	221	81.4
2018	48.1	537	24.1	185	210	128.0	42.2	435	29.4	152	217	98.6
2019	51.2	479	28.1	181	213	133.3	43.4	446	30.1	152	218	95.03

***Note**: 1 – in the mass after finishing, 2 – from the area of plantations at fruiting age*
***Source**: formed according to the Main Departments of Statistics in Rivne [21] and Volyn [22] oblasts*

To determine the role of different types of farms in the development of agricultural production in the Western Polissya region as of 2019, the ratio of sown areas of crops for harvest in enterprises and households was analyzed. As a result of the analysis, it was revealed that 51.6% (606.9 thousand hectares) of sown areas of their total number (1176.2 thousand hectares) are located in households. The ratio of areas of different types of crops in the region in different types of farms is shown in Figure 3.

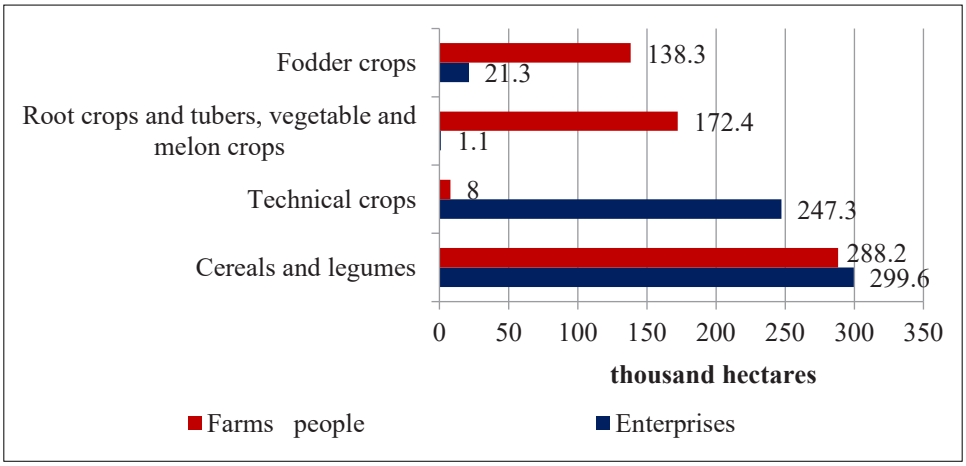

***Figure 3**. The ratio of sown areas of crops in enterprises and households in the Western Polissya region in 2019, thousand hectares*
***Source**: calculated according to the State Statistics Service of Ukraine [23]*

The data provided above leads to a conclusion that 49% (288.2 thousand hectares) of sown areas of cereals and legumes are in households, 51% (299.6 thousand hectares) – in enterprises, under industrial crops, respectively – 3 and 97%, roots and tubers, vegetables and melons – 99 and 1%, fodder – 87 and 13%.

During the research period in the Western Polissya region, changes in the ratio of areas between different crops as a result of a decrease in some (sugar beet, fruit and berry crops, cereals and legumes) and an increase in others (sunflower, vegetables, etc.) have been found. In general, the structure of sown areas of the region as of 2019 was dominated by areas occupied by cereals and legumes 50.0% (of the total sown area), industrial crops accounted for 21.7%, roots, tubers, vegetables, and melons – 14.8%, fodder crops – 13.6%. These rates are within the norms of the optimal ratio of crops in crop rotations of Polissya natural and agricultural region, except for fodder, according to which the percentage of cereals and legumes can be 35-80%, technical 3-25% (including rapeseed 0.5-4, sunflower – 0.5%), potatoes and melons 8-25%, fodder crops 20-60% (13.6% in the region) Figure 2 [29]. This ratio can be attributed to the profitability of growing various agricultural products.

According to O. Fraier [15], in recent years in Ukraine, there has been an increase in sown areas of four key commercially attractive crops (corn, sunflower, soybeans, rapeseed), while the share of other crops in the structure of sown areas of the corporate sector is rapidly declining. Thus, the most profitable types of agricultural production include the cultivation of sunflower, which can explain the significant increase in its area since 1995 in the Rivne region (270 times) and the Volyn region. Yields also increased by 2.8-3.3 times from 1995 to 2019. The area of its sowing in the structure of industrial crops was 22%, which indicates non-compliance with the norms of the optimal ratio of crops in crop rotations of Polissya natural-agricultural region, according to which the percentage of sunflower among industrial crops should be 0.5%.

Currently, this problem is quite common in Ukraine. According to V. Puzik et al. it is especially acute in Zaporizhia, Luhansk, Dnipropetrovsk, Donetsk, Mykolaiv, Kirovohrad, Kherson and Kharkiv regions [30]. The obtained products of the oil subcomplex are more export-oriented, which is the reason for the extensive growth factor of sown areas. The key concern of further development of oilseeds production is to increase and stabilize production volumes by optimizing sown areas. In addition, some farmers grow sunflower for several years on the same land plots to make more profit, although the allowable frequency of its cultivation according to current regulations in Ukraine is not less than seven years [15; 31]. Profitable crops include cereals, for which most of the sown area of the region is allocated. During the study period from 1995 to 2019, the area under cereals and legumes just slightly decreased, which did not affect the volume of production (gross harvest), but on the contrary, due to the increase in their yield from 26.0 to 51.2 c/ha the figure increased by 1.6-2.0 times. This indicates a transition to intensive technologies for growing these crops with increasing mechanization, chemicalization, and use of high-yielding and resistant to adverse environmental factors varieties and hybrids [32-34].

In recent years, the areas set aside for vegetable crops are quite stable, which from 1995 to 2019 increased by 7.9 thousand hectares (Rivne region – 3.1 thousand hectares, Volyn – 4.8 thousand hectares), yields increased 1.8-1.5 times. This indicates that the vegetable market in the region is developing. According to L. Galat and L. Yatsyshina, vegetable growing in Ukraine has remained a profitable industry for many years, because with the right approach to production, marketing, logistics, you can earn income even in conditions of overproduction and market decline [35; 36]. Therefore, the vegetable market, despite various negative factors, is developing, improving, and gradually showing signs of moving towards a civilized global market. It should be noted that the improvement of vegetable growing requires certain measures like breeding and seed production. This is because the variety and high-quality seeds are the main elements of modern zonal technologies for growing crops [37].

One of the most widely consumed foods on the daily basis is potatoes. In the region, potato growth is not developing rapidly. The sown area for potatoes in 2019 compared to 1995 increased slightly, but the production (gross harvest) significantly increased from 6215.5 to 12874.0 thousand centners in the Rivne region and from 6215.5 to 11741.7 thousand. c – in Volyn, which is due to an increase in yield from 93 g/ha to 181 (1.6-1.8 times). It should be noted that the potato market has certain features: the entrance is quite capital-intensive (there is a need for specific vehicles), and yield depends on climatic conditions, use of regional varieties, seed productivity, fertilizer systems, etc. [38-40].

The area for sugar beets in the West Polissya region decreased significantly by 3.5-3.7 times, which led to a decrease in the gross harvest from 7629.5 thousand centners (1995) to 5600.8 (2019) in the territory Rivne region and Volyn – from 5966.7 thousand centners (1995) to 4117.3 thousand centners (2019). It should be noted that the yield has increased 2.5 times over the past 24 years. The production and sale of sugar beets is the only industry that periodically, with an interval of one or two years, brings losses [10]. Long-term research and analysis of information on sugar beet productivity in retrospect according to V. Hlevasky et al. show that the dynamics of yield and sugar content of root crops is influenced by a set of conditions, some of which are uncontrolled at a high level of agrobiological and technical capabilities of human society [41]. Therefore, when growing sugar beets, it is necessary to focus on hybrids and seeds, cultivation technologies, sowing density, the presence of weeds, pests, diseases, and weather conditions of the growing season. High productivity can be obtained only when sowing high-quality seeds [42; 43].

During the research period in the Western Polissya region area for fruit and berry crops decreased by 1.8 (Rivne region.) and 3.3 times (Volyn region). As for the above-mentioned crops, the yield growth from 35.6 to 133.3 c/ha was observed during the study period.

As a result, the volume of their production (gross collection) increased in the Rivne region from 409.7 to 900.8 thousand centners but decreased from 563.1 to 396.2 thousand centners. due to the reduction of the area – in Volyn.

In the region, work has begun on the development of organic farming, in particular in the Volyn region 18 certified operators are specializing in the cultivation of crop products, berries, mushrooms, etc., the quality of which is confirmed by the recognition in the European Union and Switzerland certificate "Organic Standard". In this region, organic products are grown on an area of 2.1 thousand hectares, which is 0.2% of agricultural land in the region. In the Rivne region, businesses have certified organic agricultural products in most crops such as soybeans, buckwheat, corn, oats, wheat, sunflowers, vegetables, berries, and others. The area on which organic products and raw materials are produced is 4.2 thousand hectares, 0.5% of the total area of the region. Thus, the West Polissya region has significant potential for the development of organic farming, favorable natural and climatic conditions, so the Strategy of socio-economic development of rural integrated territorial communities includes the allocation of relevant areas of agricultural land.

The sown areas of crops in Ukraine are divided between enterprises and households. This is due to the land reform of 1991, according to which the lands of collective farms and state farms were privatized with their subsequent unbundling, the issuance of state acts on the right of private ownership of land (shares), and the right to withdraw from agricultural formations with shares. In the study region, 51.6% of the sown area of crops falls on households. In terms of different types of crops, the following ratio was found: 49% of the sown area of cereals and legumes is in households, 51% – in enterprises, under industrial crops, respectively – 3 and 97%, roots and tubers, vegetables and melons – 99 and 1%, fodder – 87 and 13%. This distribution shows, however, that companies are focused on growing profitable crops (technical, grain, and legumes) that are exported. Households supply the market with a set of products that are included in the consumer basket of ordinary citizens.

CONCLUSIONS

As a result of the analysis of the impact of agroecological indicators on the sustainable development of rural united territorial communities of the Western Polissya region, on the example of the study of crop production, the authors discovered both the formation of threats to their development and some promising opportunities. Agroecological threats to development include changes in the structure of sown areas of crops (reduction of areas and exclusion from crop rotation of crops typical for this region), excessive intensification of production, violation of standards for optimal crop rotation.

The promising opportunities of the region include:

– increasing the area of agricultural land for organic products, with favorable natural and climatic conditions, being a prerequisite for that;

– supporting the development of individual farms that largely meet the demand of the population in many goods and services. Encouraging the population to process their agricultural products for sale and create a market for it;

– forming of cluster models of development of newly created communities to increase the efficiency of use of production, trade, labor, innovation, investment, and information potential of the territorial community. One of the priority areas in the region of clustering in crop production can be considered the grain sector;

– developing and implementing short-term and long-term local and regional programs of the revival of components of agrolandscapes, to allocate "ecologically pure" raw material zones;

– taking into account the requirements of the EU Water Framework Directive to build water and soil protection engineering and landscape complexes at water intakes with the addition of forest, shrub, and meadow-swamp phytocenoses, creating in river basins (basin management principle) the optimal ratio between water lands and nature reserve fund;

– carrying out renaturalization of disturbed lands and their conservation to create meadows and forests for water protection, and include them in the structural elements of the regional ecological network based on an agro-environmental approach.

It should be noted that to implement the opportunities for agricultural development in rural UTCs it is important to create a favorable financial and credit environment that will allow introducing innovative technologies to agricultural production based on rational land use; to promote and support the manufacture of environmentally "friendly" products.

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Агроекологічні основи стратегії сталого розвитку сільських об'єднаних територіальних громад Західно-поліського регіону

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Анотація. У статті розглянуто вплив агроекологічних показників на сталий розвиток сільських об'єднаних територіальних громад Західно-поліського регіону (Україна) на основі аналізу сучасного стану рослинництва. Для дослідження стану рослинництва та визначення його ролі у розвитку сільських територій Західно-поліського регіону використано дані Головних управлінь статистики у Рівненській і Волинській областях, Державної служби статистики України, статистичного збірника «Рослинництво України» (2018). У процесі дослідження використовувалися такі основні методи: системний аналіз, порівняння, графічний і статистичний методи. Проаналізовано динаміку таких показників: посівні площі сільськогосподарських культур (тис. га), обсяг виробництва (валового збору) сільськогосподарських культур (тис. ц), урожайність сільськогосподарських культур (ц·га$^{-1}$), посівні площі сільськогосподарських культур у підприємствах та господарствах населення на території Західно-поліського регіону у розрізі Рівненської та Волинської областей за період з 1995 року по 2019 рік. За досліджуваний період виявлено зміни у співвідношенні площ між різними сільськогосподарськими культурами: зменшення посівних площ буряка цукрового фабричного, плодових і ягідних культур, зернових і зернобобових та збільшення – соняшника, овочевих культур тощо. Встановлено зростання урожайності сільськогосподарських культур та незначне зменшення валового збору лише для буряка цукрового фабричного на території двох областей та плодових і ягідних культур на території Волинської області. У регіоні 51,6 % посівної площі сільськогосподарських культур припадає саме на господарства населення, що постачають на ринок набір продуктів, які входить до споживчого кошика простого громадянина: коренеплоди та бульбоплоди, культури овочеві та баштанні. Підприємства зорієнтовані на вирощування рентабельних культур (технічних, зернових та зернобобових), що ідуть на експорт

Ключові слова: агроекологічні показники, антропогенний вплив, сталий розвиток, сільські об'єднані територіальні громади, Західно-Поліський регіон