ANALYSIS OF AGRI-ENVIRONMENTAL INDICATORS IN THE WEST DEVELOPMENT REGION OF ROMANIA

TODORESCU PETRONELA-MANUELA[1], JIVAN ROXANA-SELENA[1], IAȚENTIUC ANDREEA-DENISA[1], MĂNESCU CAMELIA[*1], SICOE-MURG OANA MARIA[1]
[1]University of Life Sciences "King Michael I " from Timisoara, Faculty of Management and Rural Tourism, Romania
*Corresponding author's e-mail: cameliamanescu@usvt.ro

Abstract: *The Western Development Region presents a significant pedoclimatic diversity, which influences the structure and application of agri-environmental measures. In this context, land improvement and soil protection indicators play an essential role in ensuring the sustainability of regional agriculture. In the studied area, the share of land with land improvement works is moderate, and irrigation systems are below potential, due to outdated infrastructure and high maintenance costs. Drainage works have also a major importance for maintaining the quality of agricultural land, reducing the risk of waterlogging and loss of fertility. The analysis of agri-environmental indicators in the West Region indicates gradual progress in the implementation of agricultural land protection and improvement works, but the need to modernize irrigation infrastructure and strengthen erosion prevention measures persists.*

Key words*: Western Region, environment, irrigation, drainage, erosion control*

INTRODUCTION

Agri-environmental indicators are analytical tools used to assess the interactions between agriculture and the environment, tracking the impact of agricultural activities on natural resources and biodiversity. They provide a comprehensive picture of the sustainability of agricultural systems and contribute to the formulation and monitoring of public environmental and rural development policies [1,7].

Agriculture is one of the main economic sectors with a direct impact on the environment, through the way in which natural resources are used and through the influence exerted on ecosystems. In the context of the transition to a green economy and the application of the principles of sustainable development, monitoring agri-environmental indicators becomes essential for assessing the environmental performance of agricultural activities [4].

In the context of the Western Region, these indicators are essential for assessing how agricultural practices influence soil, water, air quality and the conservation of natural habitats.

The Western development region, consisting of the counties of Arad, Timiș, Hunedoara and Caraș-Severin, represents one of the most dynamic and diversified economic areas of the country, presenting a significant agro-ecological diversity, which directly influences the values and trends of agri-environmental indicators [6, 13].

With a varied relief, from the fertile plains of Banat to mountainous areas rich in natural resources - the region offers considerable agricultural and ecological potential. Agriculture and environmental protection are increasingly intertwined here, shaping an emerging field: "agri-environmental" investments, oriented towards sustainable agricultural practices, pollution reduction and efficient use of natural resources [2, 3].

The analysis of these indicators provides a complex picture of the interaction between agriculture and the environment, highlighting both the pressures exerted by intensive agricultural practices and the progress made towards sustainability.

Figure 1. West Region - location on the map

Source: Adapted from Wikipedia [15]

The purpose of this paper is to analyze the main agri-environmental indicators in the Western Region, in order to assess the evolution trends, environmental pressures and the level of compliance with the sustainability objectives established at national and European level.

MATERIALS AND METHODS

The study on agri-environmental indicators in the Western Region of Romania was carried out through a descriptive-analytical approach, based on the processing and interpretation of official statistical data and information from relevant institutional sources [14, 16].

Primary data were collected from the databases of the National Institute of Statistics (INS), the Agency for Financing Rural Investments (AFIR), and the Ministry of Agriculture and Rural Development (MADR) for the period 2015–2024. These targeted representative indicators for sustainable agricultural practices, the state of the environment, and the use of natural resources. The selection of agri-environmental indicators, with a focus on land improvement works (irrigation, drainage and soil erosion control), was considered appropriate for assessing the sustainability of agriculture at the level of the West Region. The Western Region was selected due to its agro-ecological diversity and the high share of agricultural land in the total regional area [10, 11,12].

RESEARCH RESULTS

Agri-environmental indicators provide integrated information on the interaction between agriculture and the environment, allowing the assessment of the degree of sustainability of agricultural systems, the pressures on soil, water and biodiversity, as well as the efficiency of public policies. The West Region presents significant agro-ecological particularities, due to the diversity of the relief, the pedoclimatic conditions and the structure of agricultural holdings. In this region, areas with intensive agriculture, oriented towards productivity, coexist with areas with high ecological potential, favorable to sustainable practices and organic agriculture [17].

The utilized agricultural area has remained relatively constant, representing approximately 65–68% of the total regional area. A slight expansion of the land designated for organic farming is observed, from 2.8% in 2015 to over 6% in 2024, especially in Arad and Hunedoara counties. This increase reflects the increased interest in sustainable practices and access to agri-environmental support schemes [5, 13].

Next, we will analyze aspects of land improvement: areas arranged for irrigation, agricultural areas effectively irrigated with at least one watering, the area of land arranged

with drainage works, areas on which erosion control and land improvement works have been carried out.

Land improvements represent the totality of the complex of hydrotechnical works that are carried out to improve the land, ensure soil fertility by improving its qualities in order to capitalize on unproductive land for agriculture or improve the conditions for the development of agricultural crops on some poorly productive lands [2, 8].

The area arranged for irrigation represents the set of works carried out to ensure the controlled supply of water to agricultural crops in order to increase agricultural production and ensure its independence from meteorological conditions [4, 13].

The effectively irrigated area and the density of the irrigation network are the main indicators. In the last decade, they have experienced a partial revitalization, especially in agricultural areas with intensive crops. Thus, the following figures (Figure 2 and 3) highlight the situation of the land areas arranged with irrigation works [4, 16].

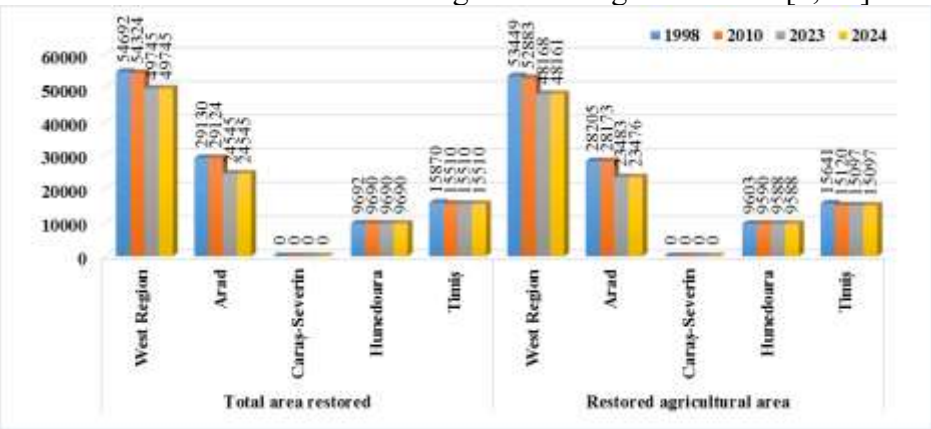

Figure 2. Total area of land restored with irrigation works and irrigated agricultural area (ha)

Source: Processing based on Tempo online data [9,10]

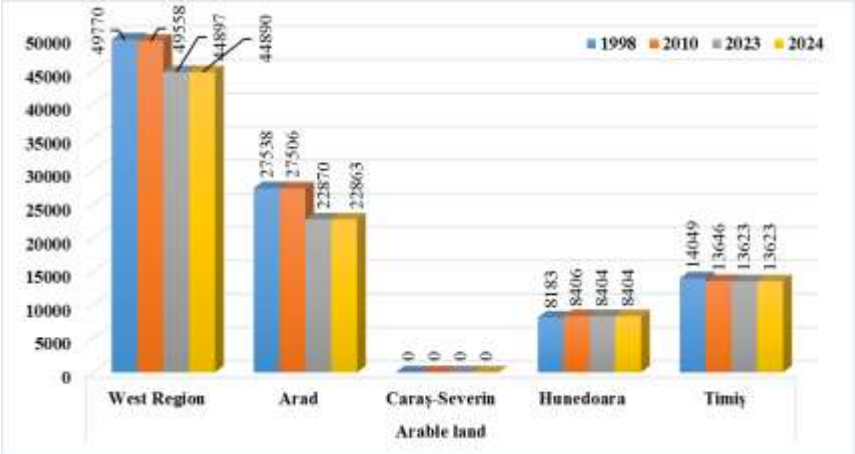

Figure 3. Area of arable land with irrigation (ha)

Source: Processing based on Tempo online data [9,10]

The analysis of data on the area of land developed with irrigation works and the irrigated agricultural area in the region highlights a general trend of reduction during the analyzed interval. The total developed area decreases from 54692 ha in 1998 to 49745 ha in 2024, and the developed agricultural area registers a similar decrease. This contraction,

of approximately 9–10%, suggests a gradual withdrawal of the irrigation infrastructure from active use.

At the county level, Arad has the largest share of developed land, but also registers the largest absolute reduction. Hunedoara and Timiș maintain relatively constant values, reflecting the stability of the existing systems, while Caraș-Severin continues to lack irrigated land, which indicates the absence of specific investments in this county [10, 16].

The downward trend is also visible in the case of arable land, which decreases from 49,770 ha in 1998 to 44,890 ha in 2024, a reduction that can be correlated with changes in land use, fragmentation of agricultural holdings and the decrease in economic interest in irrigation in certain areas.

Figure 4 highlights the situation of the effective agricultural area with at least one irrigation in the region we are analyzing.

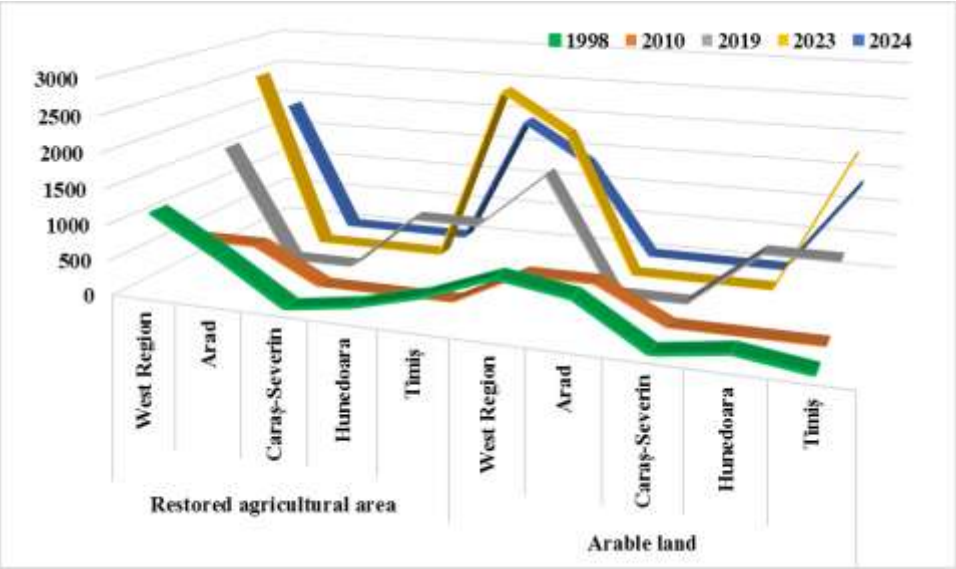

Figure 4. Agricultural area irrigated with at least one watering (ha)

Source: Processing based on Tempo online data [9,10]

The data analysis highlights a fluctuating evolution of the effectively irrigated agricultural area in the region during the period 1998–2024, with a general trend of partial recovery after 2010. The total irrigated area increases from 1134 ha in 1998 to a maximum of 2534 ha in 2023, followed by a slight reduction.

At the county level, Arad records irrigated areas only until 2010, after which the values become zero, indicating the abandonment of the existing irrigation systems. In Hunedoara, irrigated areas appear sporadically (810 ha in 2019), but are not maintained thereafter.

The most consistent and stable irrigation activity is observed in Timiș County, where the irrigated area increases significantly after 2019, reaching regional maximum values. Caraș-Severin does not record irrigated areas during the entire analyzed period.

Drainage works are concentrated in lowland areas, aiming to reduce excess soil moisture and prevent rainwater stagnation. These interventions contribute to improving agricultural production capacity, but, in the absence of complementary measures to restore the natural water regime, they can lead to a decrease in organic matter content and soil compaction [3, 8].

Following the centralized data, we can highlight the situation of lands developed with drainage works for the region under study. As in the case of May, the total area of the region, the agricultural area, respectively the arable area, is analyzed. (Figure 5, 6)

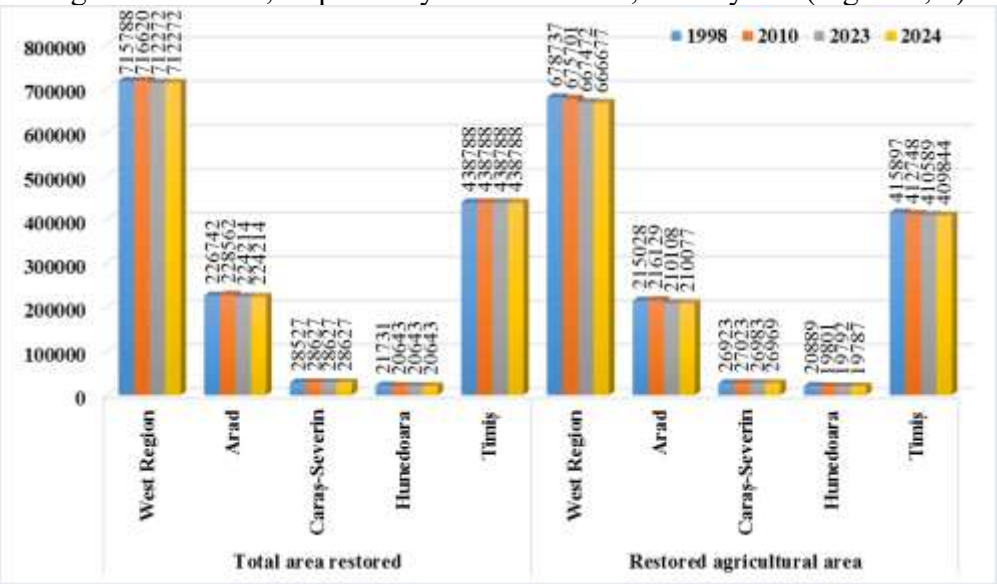

Figure 5. Surface area of land developed with drainage works (total, agricultural, ha)
Source: Processing based on Tempo online data [9,10]

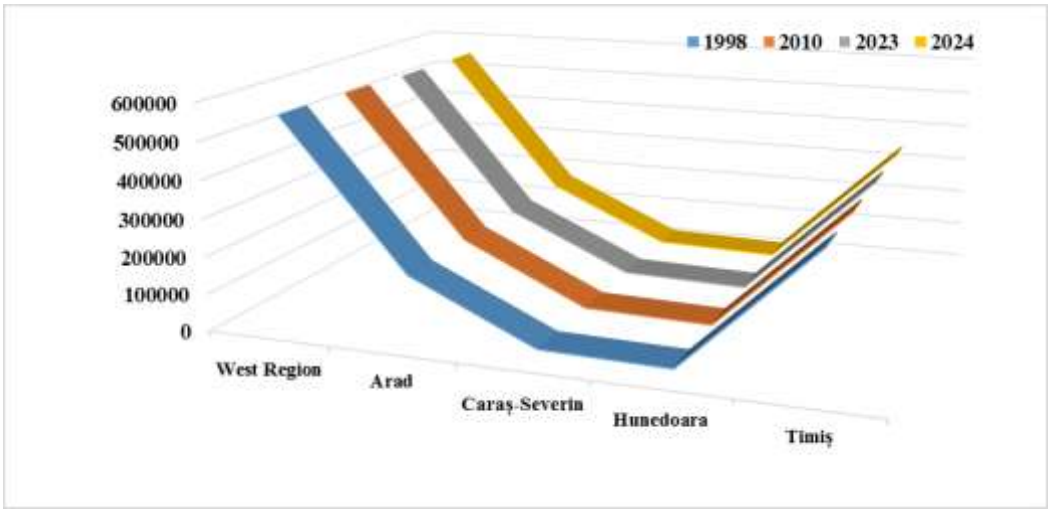

Figure 6. Area of arable land with drainage works (ha)
Source: Processing based on Tempo online data [9,10]

The analyzed area highlights a relative stability of the areas developed with drainage works. The total developed area remains around 715–712 thousand ha, indicating a consolidated infrastructure, but with small negative adjustments in recent years (−0.5%).

From a county perspective, Timiș concentrates the largest part of the lands developed for drainage (over 60% of the regional total), reflecting the major agricultural importance of this county and the extension of plain lands prone to excess humidity.

Arad is in second place, with a slight decrease in the developed area after 2010, while Hunedoara and Caraș-Severin register low, stable values, corresponding to their predominantly hilly and mountainous specificities.

The developed agricultural area follows the same trend, with a slight decrease from 678737 ha in 1998 to 666677 ha in 2024, which suggests the maintenance of the

functionality of the drainage systems to a large extent, but also possible marginal losses through non-use or conversion of land. In the case of arable land, a similar decrease is observed (−1.2%), maintaining however high shares of drained areas, essential for intensive agricultural practices.

The area designed to combat soil erosion represents the complex of hydrotechnical works carried out to reduce or stop the degradation of the soil surface by removing its fertile layer under the action of external geographical agents and carrying out regularization works to avoid rainwater runoff from the slopes to avoid damage caused by floods on the lands at the foot of the slope [13, 16].

In the West Region, improvement programs focus on soils affected by erosion and on combating soil acidity in hilly areas [2].

The main indicators, when it comes to combating soil erosion, include areas protected by anti-erosion works, the application of crop rotation and the degree of afforestation of vulnerable slopes [4].

In the hilly and mountainous areas of Hunedoara and Caraș-Severin, erosion control projects contribute significantly to land stability and to reducing the loss of fertile soil.

These aspects of the surfaces developed with improvement and erosion control works are highlighted in the following figures (Figure 7, 8).

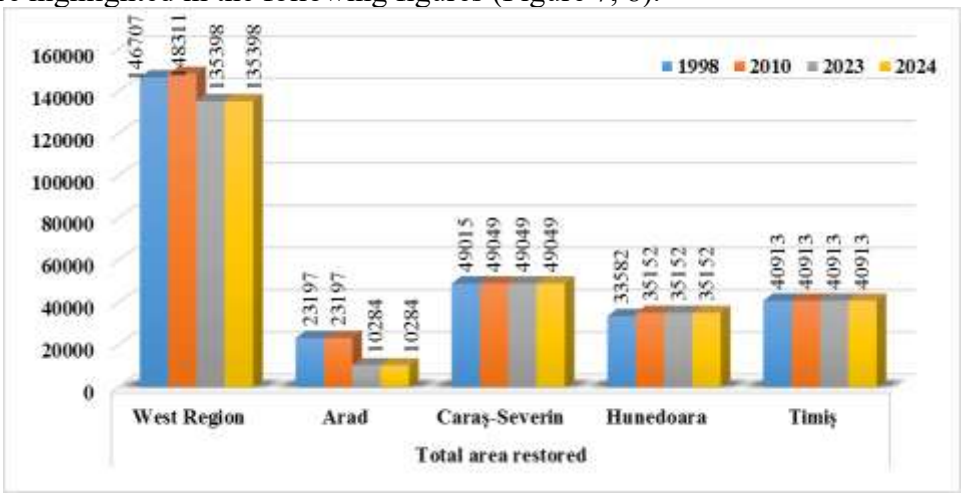

Figure 7. Total area of land with improvement works and soil erosion control

Source: Processing based on Tempo online data [9,10]

The evolution of the areas restored with soil improvement and erosion control works in the region indicates a general trend of reduction during the analyzed period. The total developed area decreases from 146,707 ha in 1998 to 135,398 ha in 2024, which corresponds to a decrease of approximately 7.7%, reflecting the reduction of interest or capacity to maintain anti-erosion works in recent decades.

At the county level, a pronounced stability of the areas is noted in Caraș-Severin, Hunedoara and Timiș, where the values remain constant, signaling the maintenance of the existing infrastructure. In contrast, Arad records a significant decrease (from 23,197 ha to 10,284 ha), suggesting the withdrawal of some areas from the improvement works perimeter, possibly as a result of the change in land use or the reduction of erosion pressures.

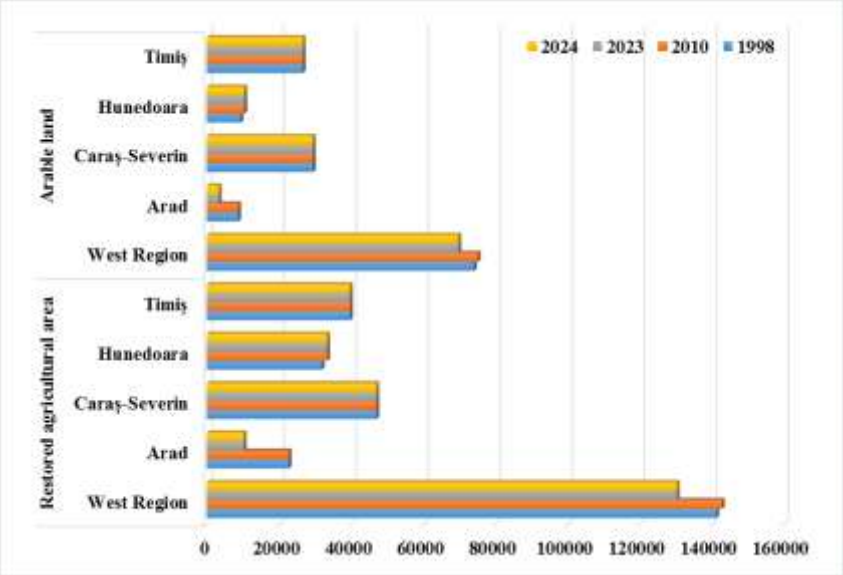

Figure 8. Total area of agricultural and arable land with improvement works and soil erosion control

Source: Processing based on Tempo online data [9,10]

The developed agricultural area follows the same dynamics, with a reduction from 141338 ha in 1998 to 130394 ha in 2024, which confirms a slight degradation of the functional extension of anti-erosion works. As for arable land, the decrease from 74126 ha to 69781 ha denotes a moderate reduction of the land effectively protected against erosion.

CONCLUSIONS

Agri-environmental indicators provide an integrated picture of the balance between agricultural productivity and environmental protection in the Western Region of Romania. By analyzing these indicators, vulnerable areas, trends in pressure on natural resources and opportunities for intervention for the transition to a sustainable and resilient agriculture can be identified.

The analysis of agri-environmental indicators in the Western Region of Romania highlights a complex evolution of the interaction between agricultural activities and the environment, reflecting both progress towards sustainability and the persistence of structural imbalances. Although the utilized agricultural area has remained relatively constant, a significant increase in land designated for organic farming is noted, indicating a gradual orientation towards sustainable agricultural practices and the use of agri-environmental support schemes.

As regards land improvements, the general trends reveal a gradual decrease in the areas designed for irrigation and those actually irrigated, due to the wear and tear of the existing infrastructure, the fragmentation of holdings and the decrease in the economic attractiveness of investments in this area. At the same time, a concentration of functional irrigation systems is observed in Timiș County, while Caraș-Severin and Hunedoara counties remain poorly represented.

The areas designed for drainage remain relatively stable, which denotes a consolidated infrastructure, essential for maintaining production capacity in lowland areas. However, the lack of investment in modernization and the absence of ecological land restoration measures may lead, in the long term, to the degradation of soil quality.

Regarding soil improvement and erosion control works, the evolution is downward, with a reduction of approximately 7–8% of the developed areas in the analyzed interval. This trend reflects the decrease in institutional and financial interest in the maintenance of anti-erosion works, although they remain essential for the stability of agricultural ecosystems in hilly and mountainous areas.

Overall, the dynamics of the analyzed indicators reveal a slow transition towards a more sustainable agricultural model, but dependent on the adaptation capacity of the agricultural infrastructure and the coherent implementation of public policies in the agri-environmental field. Consolidating investments in land improvement works, irrigation and erosion control, correlated with the promotion of organic agriculture, constitute priority directions for ensuring the sustainability of agro-ecosystems in the Western Region.

REFERENCES

[1]. ALEXANDRI CECILIA, DAVIDOVICI I., GAVRILESCU D., 2003, Tratat de economia agriculturii, Ed. Expert, Bucureşti

[2]. MATEOC-SÎRB N., MĂNESCU C., 2012, Dezvoltare rurală și organizarea teritoriului, Editura Mirton Timișoara

[3]. MĂNESCU CAMELIA, MATEOC-SÎRB NICOLETA, DINCU ANA-MARIANA, BĂEȘU VIORICA , CHIURCIU IRINA, 2025, Socio-economic analysis of the West Region, Lucrări Științifice Management Agricol, Vol 27, No 2, ISSN print 1453-1410, Timișoara

[4]. OTIMAN P.I., MATEOC-SÎRB NICOLETA, MĂNESCU CAMELIA, 2013, Economie rurală, Editura Mirton, Timişoara

[5]. POPESCU C., 2019, Dezvoltarea spațiului rural și rolul agriculturii în economia națională. București, Editura Economică

[6]. SICOE-MURG O. M, MATEOC T., MATEOC-SIRB N., DINCU A.M, ȘONCA B, 2022, Study on the development of Făget area, Timiș county, Romania, based on area specific resources, International Multidisciplinary Scientific GeoConference: SGEM; Sofia, vol. 22

[7]. ȚUȚUIANU O., 2011, Evaluarea și raportarea performanței de mediu-Indicatori de mediu, Ediția a III-a, Editura AGIR, București

[8]. VASS H., MĂNESCU C., SICOE-MURG O., MATEOCT., MATEOC-SÎRB N., 2021, Study on climate change issue and environmental degradation in Romania, Agricultural Management, Lucrari Stiintifice Seria I, Management Agricol 23(2), pp. 89-96

[9]. *** Tempo online, Indicatori de agri-mediu

[10]. *** Institutul Național de Statistică

[11]. *** Agenției pentru Finanțarea Investițiilor Rurale (AFIR)

[12]. *** Ministerului Agriculturii și Dezvoltării Rurale (MADR)

[13]. *** Strategia regională pentru Dezvoltare 2021-2027, REGIUNEA VEST

[14]. *** https://startupcafe.ro/banat-regiunea-vest-program-operational-regional-bani-imm-htm-19589

[15]. *** https://ro.wikipedia.org/wiki/Regiunea_de_dezvoltare_Vest

[16]. *** https://adrvest.ro/infrastructura-verde-2/?utm_source

[17]. *** https://www.ghidulfondurilor.ro/investitii-de-peste-11-milioane-de-euro-pentru-dezvoltarea-infrastructurii-ecologice-in-regiunea-vest/?utm_source.