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# MAIN FACTORS OF AGRICULTURAL LAND USE CHANGE IN ROMANIA – A TERRITORIAL ANALYSIS

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**Abstract:** *In Europe, in the last decades, there have been significant changes in the categories of agricultural land use, in the two main directions of change: intensification and extensification. The main objective of this paper aims to analyze the main factors that influenced these changes in Romania at county level. The research methods used to achieve the main objective were: i) bibliographic documentation; ii) statistical analysis (data on the land fund structure at county level); and iii) cluster analysis. Starting from the theoretical model proposed by van Vliet, who identified multiple factors that affect changes in land use categories (demographic, economic, technological, institutional, socio-cultural and location factors) in his papers, it can be concluded that understanding the processes of changing the use of agricultural land and the factors that influence this process is important to anticipate Romania's future development paths.*

**Keywords:** *agricultural land use, factors of agricultural land use change, Romania*

**JEL Classification:** Q15, R14

## INTRODUCTION

Land is an important input for the production of a wide range of goods, including but not limited to the production of agricultural commodities. Private decisions on the use of agricultural land often give rise to both external costs, such as restrictions on land access and damage to wildlife habitat, and external benefits, such as visual landscape, opportunities for recreational and rural activities, etc. Changes in agricultural, agro-environment, land use and regional policies and many non-political factors, such as climate change, demographic change and globalization, are increasingly affecting land use and management (OECD, 2009).

In recent decades, in Europe, the use of agricultural land has been subject to significant changes. Exploring these changes is important because of the major consequences they have, mainly in the field of environmental protection and human well-being (Plieninger et al., 2015). These changes were mostly captured in case studies implemented at local level. As socio-economic and biophysical conditions vary from one location to another, the conclusions of the case studies cannot be generalized. In this context, in order to get an overview, a series of meta-studies have been carried out that synthesize the conclusions from local studies and identify global/regional patterns of change in land use categories (Magliocca et al., 2015).

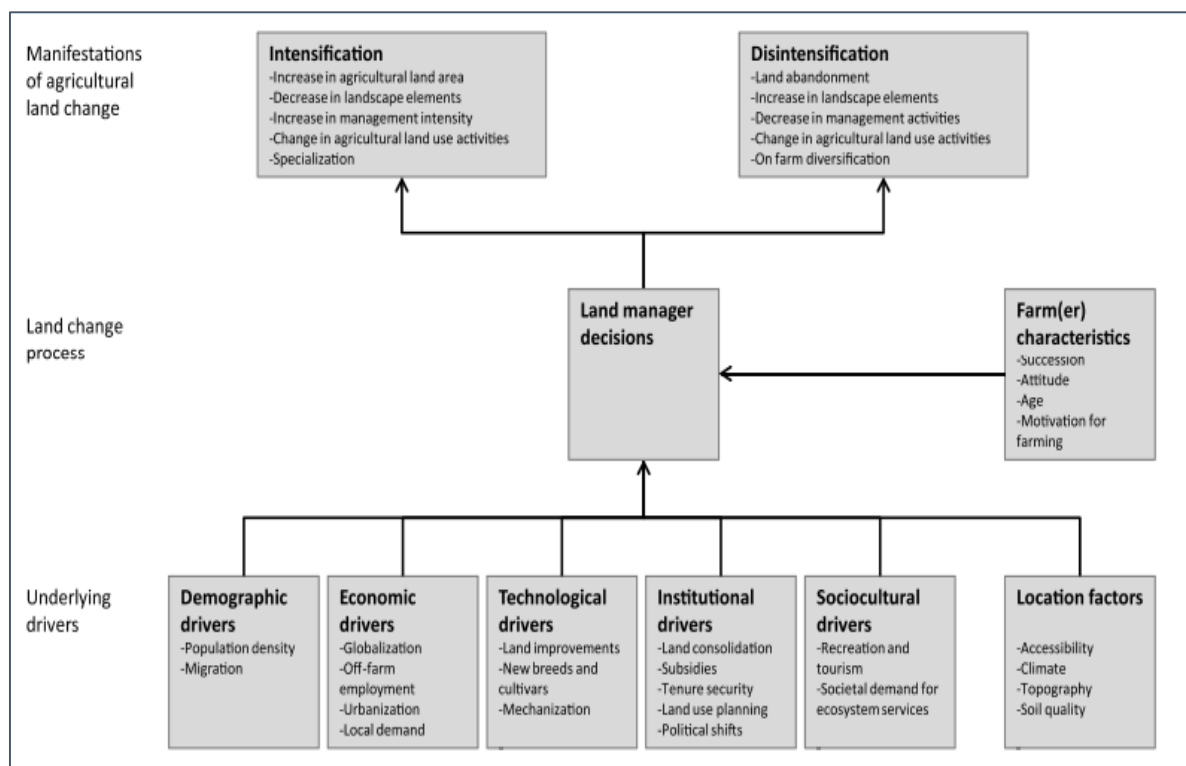
At European level, such a study was carried out by vanVliet and his colleagues. They present the fact that Europe has heterogeneous patterns of agricultural land use change and analyze the two directions of its change: intensification and extensification (vanVliet et al., 2015a). The understanding of changes in agricultural land use, especially those aimed at intensity, is limited because the studies conducted are few and heterogeneous. In his approach, to analyze patterns of land use change, vanVliet aims to recognize and analyze the factors leading to these changes.

## MATERIAL AND METHOD

The objective of this paper aims to identify and consider the main factors that influenced the changes in the categories of agricultural land use at county level. The main objective was approached through the five classes of agricultural land use: arable, vineyards, orchards, pastures and hayfields.

The methods used to achieve the proposed objective included: i) bibliographic documentation; ii) statistical analysis, which involved the analysis of periodic primary data and the analysis of secondary data collected by the National Institute of Statistics (NIS) at county level; and iii) multivariate analysis.

For the selection of specific indicators, the theoretical model developed by vanVliet was used (Figure 1). This model aims to better understand both the connection between land use change and urban development processes, as well as their consequences at different territorial levels. To facilitate the aggregation of the conclusions from the case studies, the authors conducted a meta-study that summarizes the results of the studies based on a systematic review of the specialized literature. A model of the manifestations and underlying factors of agricultural land use change in Europe was thus obtained. As it can be seen in Figure 1, demographic, economic, technological, institutional, socio-cultural and location factors were identified. Information on farm and farmer has also been added to these.



**Figure 1. Conceptual framework of the manifestations and factors underlying agricultural land use change**

(Source: van Vliet et. al., 2015a, p.27)

Based on the theoretical model previously presented in this paper, we used a set of indicators at the level of the 41 counties of Romania, which were grouped into seven categories. In the process of building the database, there was a certain limitation generated by the availability of indicators: many indicators proposed in the literature could not be used because they are not available at county level or their accuracy is not satisfactory. Thus, a number of 29 indicators were selected to be analyzed.

In order to have an integrative approach to the intensive and extensive agricultural use categories, an integrated/multidimensional data processing method was applied: the selected variables were processed through factor analysis and cluster analysis (Jaba & Grama, 2004). As a

result, six clusters/classes of change in agricultural land use categories were found for the 41 counties of Romania (Table 1).

**Table 1. Intensity of change of agricultural land use categories, by types of clusters \***

	<b>Cluster 1</b>	<b>Cluster 2</b>	<b>Cluster 3</b>	<b>Cluster 4</b>	<b>Cluster 5</b>	<b>Cluster 6</b>
Counties	Botoșani, Neamț, Bacău, Vaslui, Constanța, Bistrița-Năsăud, Mureș, Brașov, Prahova, Dâmbovița, Argeș, Vâlcea, Gorj, Mehedinți, Caraș-Severin, Timiș, Bihor, Sălaj	Cluj, Hunedoara, Harghita	Satu-Mare, Maramureș, Suceava, Iași, Arad, Sibiu, Vrancea, Galați, Buzău, Dolj	Alba, Covasna, Olt, Ilfov	Tulcea, Brăila, Ialomița, Giurgiu	Teleorman, Călărași
Arable	- /+	- - -	- /+	- /- -	+	- -
Vineyards	- -/- - -	- - -	- /+	- /+	- -	- /+
Orchards	- -/- - -	- - /- - -	- -	- - -	- - -	- - -
Pastures	- /+	- /+	- /+	+	- /++	+ + +
Hayfields	+ /++	- /- -	- - /+	- /+	- - -	+ + + /++

\* In order to present the changes that took place in the period 1990-2020 in the agricultural land use categories, specific to each cluster, three intensities were used, which were noted as follows: high growth +++, medium growth ++, low growth +; large decrease - - -; average decrease - -; small decrease -. This classification corresponds to three ranges established according to the average value.

Following the analysis carried out, it can be concluded that each analyzed cluster registered changes both in the categories considered intensive and in the extensive categories, with different intensities.

## RESULTS AND DISCUSSIONS

Debates on the drivers of change in agricultural land use categories are generally dominated by simplifications involving concepts, values and policy decisions (Lambin et al., 2001).

*Demographic factors* represent an important topic of analysis in the framework of territorial planning policies, being considered important for future developments: they play an essential role in the changes in the structure of ecosystems and land use (Nelson et al., 2007). In this paper, three demographic factors were studied: population evolution, evolution of population density and degree of urbanization. The demographic context in which agricultural activity is carried out is generated by the characteristics of the population. The viability of agriculture and the rural area is dependent on the quantitative and qualitative dimensions of the demographic volume, on the processes that define it, on the characteristics that describe its specificity. One of the main effects of the demographic decline process is the contraction of the pool of labour resources, with implicit effects on the use of agricultural land and on the development opportunities of the territory implicitly.

The results of the analysis show that the demographic variables are different from one cluster to another. Population decline can be seen in all 6 clusters. The population density has also decreased. Cluster 2 and cluster 6 registered a slight decrease in the degree of urbanization in the context where this indicator registered slight increases in the case of the other clusters.

*Economic factors.* The models of participation in economic activities and employment, existing at the level of the agricultural sector, determine both the viability and the economic and social

sustainability of rural communities, considering zonal agricultural specificity, production traditions, productive structure etc.

The indicators selected for the description of the economic dimension indicated a series of particularities for each cluster. Thus, Cluster 1 is characterized by a small to medium increase in GDP/capita and a medium to large increase in the value of agricultural production. Even though the population engaged in agriculture has registered an important decrease, the number of waged workers in agriculture and agricultural income have increased.

**Table 2. Determinants of the change in the pattern of agricultural land use\***

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
<b>Demographic factors</b>						
Population evolution	- - / - - -	- / - - -	- / - -	- - / - - -	- / - -	- - / - - -
Evolution of population density	- - - / - -	- - - / - -	- - - / -	- - / +	- - / -	- - - / - -
Degree of urbanization	- / +	- / - -	- / +	+ / + + +	- / +	- / - -
<b>Economic factors</b>						
Evolution of population engaged in agriculture	- - / - - -	- -	- - / - - -	- - / - - -	- -	- - / - - -
Evolution of wage earners working in agriculture	+ + / + + +	- / +	+ + / + + +	+ / + +	- / +	+
Evolution of agricultural output value	+ + / + + +	+ +	+ + / + + +	+ + / + + +	+ / + +	+ / + +
GDP/inhabitant	+ / + + +	+ + / + + +	+ / + + +	+ / + +	+	+
Nominal agricultural income	+ / + +	+ / + +	+ / + +	+ / + +	+ / + +	+ / + +
<b>Technological factors</b>						
Large Livestock Units/100ha	- / +	- - -	- - / - - -	- - / - - -	- - -	- - -
Number of tractors/ha	- / +	+ + / + + +	- / + +	- / + +	- / + +	- / + +
Consumption of chemical fertilizers/ha	- - / - - -	+ / + +	- - / + + +	- - / +	- / +	+ / + +
% irrigated area	- / +	0	- / - -	+	+ + / + + +	+
% unused agricultural area	+ + / + + +	+ / + +	+ / + +	+ / + +	+ / + +	+ / + +
<b>Location factors</b>						
Evolution of modernized roads	+ / + + +	+ / + + +	+ / + + +	+ / + + +	+ / + + +	+ + / + + +
ANC-areas facing significant natural constraints	-	0	0	0	+	0
ANC-mountain areas	- / +	+ + / + + +	- / + +	+ + / + + +	0	0
ANC-areas affected by specific constraints	- / +	-	- / +	- / + +	+ + / + + +	+ + / + + +
<b>Socio-cultural factors</b>						
Poverty rate	- / +	- / + +	+ + / + + +	++	+ + / + + +	+++
Evolution of the number of agropensions	- / + + +	+ +	+ / + + +	- / + + +	+ / + +	+
Producer groups	- / + + +	-	- / +	- / +	-	- / +
Production cooperatives	- / + + +	- / + +	- / + + +	- / + +	-	- / + +
<b>Institutional factors</b>						
% farms under 5 ha subsidies	+ + / + + +	++	- / + +	-	-	-
% farms over 500 ha subsidies	- / + +	-	- / + +	- / + +	+ + / + + +	+++
<b>Farms and farmers</b>						
% crop farms in total farms	- / + +	+++	- / + + +	- / + + +	-	-
average area of a farm	- / + + +	++	+ / + +	+ / + + +	+ / + + +	++
agricultural training of farmers	- - - / + + +	- - - / + + +	- - - / + + +	- - - / +	+ / + + +	+ + / + + +
% young farmers	+ + / + + +	- / + + +	- / + + +	- / + +	- / + +	- / + +

\*To present the changes in agricultural land uses, specific to each cluster, three intensities (positive or negative) were used, which were noted as follows: high growth + + +, medium growth + +, low growth +; large decrease - - -; average decrease - -; small decrease -. This classification corresponds to three ranges established according to the mean value.

Cluster 2 is characterized by an average decrease of the population engaged in agriculture, accompanied by a slight decrease of the number of waged workers in this sector. The value of

agricultural wages, the value of agricultural production and GDP/capita show average increases. In the case of Cluster 3, with the exception of the agricultural population engaged in agriculture (that experienced a sharp decrease), all other indicators have positive, increasing values. The situation is almost similar in the case of Cluster 4, which is characterized by a small to average increase in the number of waged workers. Specific to Clusters 5 and 6 is the low growth of GDP/capita and also a small to average increase in the value of agricultural production. The difference between the two clusters is given by the evolution of the population engaged in agriculture, which registers a slight decrease in the case of Cluster 5 and a slight increase in the case of Cluster 6. The evolution of waged workers in agriculture have slightly positive values in the case of Cluster 6.

*The technological factors* have a specificity for each cluster: i) Cluster 1 records a range of values, from slight decrease to slight increase in the case of LLU per hectare, number of tractors per hectare and irrigated area. Fertilizer consumption recorded a moderate to large decrease. On the other hand, the share of uncultivated agricultural land experienced a significant increase; ii) Cluster 2 is characterized by a significant decrease in the livestock sector. The endowment with tractors experienced a medium to large increase and the consumption of fertilizers per hectare also recorded a medium-level increase. The share of unused agricultural areas also increased, registering an average level; iii) in the case of Cluster 3, there is an important decrease in the LLU per hectare and also a slight to average decrease in the irrigated areas. The endowment with tractors shows a medium to high growth. The uncultivated agricultural area registers a range of values up to an average level; iv) Cluster 4 has a small to medium increase in unused agricultural areas and also a slight increase in irrigated areas. The consumption of chemical fertilizers and the endowment with tractors range from a moderate decrease to a slight increase, and animal husbandry shows a significant decrease; v) Clusters 5 and 6 follow the same trends with small differences: strong decrease in the animal husbandry sector, slight decrease to average increase in the number of tractors per hectare and small to average increase in the unused agricultural area. The differences appear in the case of fertilizer consumption, which registers a slight to medium increase in the case of Cluster 6 and a slight decrease to a slight increase in the case of Cluster 5. The irrigated area experienced a medium to large increase in the case of Cluster 5.

In the case of *location factors*, in addition to the evolution of the share of modernized roads in total roads, we also analyzed the areas facing natural constraints. The density of transportation infrastructure is a major factor that can influence agricultural land use, as accessibility helps transport agricultural products to local markets and inputs to the farm. The influencing mechanism of accessibility on the land use pattern is complex and also depends on economic, demographic and cultural factors, land availability, land demand and territorial policies (Yongwei et al., 2020). Areas facing natural constraints are areas difficult to operate due to problems caused by naturally restrictive conditions (classified in three categories: i) mountain areas; ii) areas facing significant natural constraints; and iii) other areas facing specific constraints. The analysis of the evolution of the share of modernized roads shows an increase in the case of all six clusters. In the case of areas facing natural and specific constraints, the following particularities can be noted: Cluster 2 and 4 have the most important areas belonging to the ANC-ZM category; the ANC-SPEC category is found in Cluster 5; ANC-SMN is specific to Clusters 5 and 6.

Analyzing the *socio-cultural factors*, the following features of the six clusters can be highlighted: the poverty rate has the highest values in the case of Cluster 6; Clusters 3, 4 and 5 generally fall within the range of average values of poverty rate; Clusters 1 and 2 have a better situation, with poverty rates with low to medium values. The evolution of the number of agro-

pensions registered increases in all clusters: the most important were found in Cluster 3. Producer groups and cooperatives register low values in all six clusters; the best situation is found in Cluster 1.

*Institutional factors* – in terms of subsidies, it can be noted that the highest amounts for farms under 5 hectares are specific to Cluster 1, followed by Clusters 2 and 3. On the other hand, the share of subsidies for farms larger than 500 ha are characteristic of Clusters 6 and 5.

*Farms and farmers* – the share of crop farms in total farms has the highest values in the case of Cluster 2, followed by Clusters 3 and 4; Clusters 5 and 6 have low values. The evolution of farm size increased slightly in Clusters 4 and 5 and had an average value in the case of the others. The training of farmers registered a medium to high increase in the case of Cluster 6. For this indicator, the value had a wide range of values: from a strong decrease to a strong increase in the case of Clusters 1, 2 and 3. On the other hand, Cluster 1 had a medium to large increase in young farmers; in Clusters 2 and 3 the evolution of the number of young farmers is heterogeneous and in the case of Clusters 4, 5 and 6 it registers low values.

## CONCLUSIONS

Starting from vanVliet's scheme, who identified the main factors that affect the change in agricultural land use categories (demographic, economic, technological, institutional, socio-cultural and location-related factors) in his works, it can be concluded that in the case of Romania, the economic, institutional and location factors can be considered the main factors influencing both intensification and extensification. Demographic factors are primarily mentioned in the context of extensification. Differences in institutional factors are significant at territorial level and differ across regions, depending on the different subsidy systems that are implemented. Technological factors influence the intensification of agricultural land and are manifested, first of all, by an increase in the intensity of land management. Farm and farmer characteristics are important for both intensification and extensification. The methodology used has both strengths and weaknesses. The advantages of this approach are the transparency of data in the framework matrix of indicators and the possibility of their evaluation at county level. On the other hand, presenting results at county level may lead to false accuracy (each county has significant micro-level heterogeneity).

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