

THE LONG-TERM TREND OF APPLYING CHEMICAL AND NATURAL FERTILIZERS IN ROMANIA

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Abstract

Land improvements, in the last decades, have received a special attention, representing the whole complex of hydrotechnical works that are carried out in order to improve land, ensure soil fertility by improving its qualities in order to capitalize on agricultural land for unproductive land or improve crop development conditions, agricultural land on some poorly productive land. The five categories of fertilizers applied on agricultural lands in Romania are chemical, nitrogen, phosphate, potassium and natural. The purpose of this paper is to study the management of the application of chemical fertilizers in the analysed period and implicitly the spatial evaluation. In the last 32 years the area of land on which chemical fertilizers have been applied has increased considerably from 3,528,354 ha in 1990 to 8,400,360 ha in 2021. Phosphate fertilizers are maintained around the average of 4,364,177 ha while natural fertilizers are applied on fairly small 826,420 ha in 1990 sweeping up to 877,985 ha in 2020. If we discuss the regions at the national level, a significant difference can be observed, even from singles to doubles in the region Centru 41,941,745 ha and the Sud-Muntenia region 8,753,2752 ha.

Keywords: *chemical and natural fertilizers land improvements, eco-friendly agriculture*

1. INTRODUCTION

As a consequence of the increasing population and subsequent requirement of utilize, agricultural terrain should preserve appropriate scales of quantity and quality to generate food putting in the foreground the impact on their volume of nutrients, robustness, or their capacity to operate [1]. The utilization of inorganic fertilizers has long-term been an essential instrument to compensate nutrient crops and hence obtain higher profits. In the circumstances of zero chemical fertilizer increase, applying natural or organic as opposed to chemical fertilizers is the compulsory subsequent of agricultural production, and the funds and natural resources may be the most significant items that influence if farmers decide to use organic or chemical fertilizer. Fertilizer utilization is considered to have been liable for at the minimum 50% grow in crop yield in the 20th century [2-3].

Both chemical and also physical and biological indicators demonstrated such as excessive use or application in insufficient amounts of nitrogenous and phosphate fertilizers had as consequences the reduction of production capacity, fertility and groundwater pollution. Hence, inappropriate fertilizing technique might have a damaging impact on soil quality and soil-connected ecosystem services [4-5]. Unequal utilize of chemical fertilizers may modify soil pH, and expand pests attack, oxidation, and the appearance of a dry crust, that can be observed in a reduce in soil organic carbon and beneficial bacteria, stunting plant development and yield, and more than that leading to the emanation of air pollutants and greenhouse gases. Nitrogen is an exceedingly significant constituent in food production [6-7]. Various chemical fertilizers include nitrogen, that is a crucial component for supporting food production to fulfil the requirements of an increasing population which is anticipated to achieve nearly 10 billion by 2050. Simultaneously, there is additionally concern that chemical fertilizers have a rather negative effect on the environment [8]. The questions are carbon depletion in chemical fertilizers fabrication and maximization in nitrogen cycling. As concerns decarbonization, the complete process for nitrogen fertilizer is estimated at 2.1% of total greenhouse gas emissions in atmosphere [9-10].

According to The European Green Deal a series of objectives for 2030 have been defined: to decrease the utilize of chemical and additional precarious pesticides by 50 %, to diminish fertilizer apply by at a minimum 20 %; and, to purpose for 25 % of total cultivated land being utilized for organic farming [11]. Moreover, the European Commission intends to reduce the food waste by 50% in the following period

using legally mandatory targets. According to recent strategies by 2050 Europe will be the first climate-neutral continent as stated in The European Green Deal and on May 2020 was adopted by the European Commission” The Farm to Fork Strategy” which contains a number of targets for an environmentally-friendly food system. In view of this context the EU has established a challenging target of diminishing the utilization of chemical fertilizers by 20% until 2030 respecting” Farm to Fork Strategy” with the goal of obtaining eco-friendly agriculture [12]. Nevertheless, there are difficulties that solely decreasing the quantity of fertilizer applied will conduct to a decrease in production. In order to avoid the negative impact as pollution, the loss of biodiversity and the excessive use of natural resources is considered the goal to expand the area of organic farming up to 25 % by 2030, a target that is closely tied with actions to reduce the climate change impact. Concomitant several targets intend to reduce dependence on chemical pesticides and antibacterial and lessen excess fertilizer application.

As stated in” Forecast of food, farming and fertilizer use in the European Union 2022-2032” during the season, fertilizers containing a mean of 9.8 million tons of nitrogen, 2.5 million tons of phosphate, and 2.8 million tons of potash were used to 123.8 million hectares of farmland and 38.7 million cultivable hectares in the EU were not fertilized [13].

In the last decades in Romania, industrial agriculture has regrettably caused negative environmental consequences including varied forms of pollution as a result of the use of fertilizers without to carry out scientific research without taking into account the recommendations of the specialists [14].

2. MATERIALS AND METHODS

2.1. Materials

This article analyzes five categories of fertilizers: Chemical, Nitrogen, Phosphate, Potassium and Natural fertilizers that were used in Romania between 1990 and 2021. The data are provided by the National Institute of Statistics, being collected through questionnaires aimed at agricultural holdings without legal personality included in the sample and all agricultural holdings with legal personality, which carried out agricultural activities [15]. Annually, Romania must carry out the structural survey in agriculture and the survey on agricultural production methods. The data regarding the surface of the lands on which chemical and natural fertilizers were applied by property types, macro-regions, development regions and counties are collected on the seven development regions at the national level: Northwest, Center, Northeast, Southeast, South-Mountain, Southwest Oltenia, West region to which the Bucharest - Ilfov area is added.

Obtaining this information through the annual questionnaires has an extremely important role, that of monitoring the impact of fertilizer application in the context of conservation and promoting the necessary changes in agricultural practices that make a positive contribution to the environment and climate. The inclusion of agri-environment and climate payments in rural development programs is mandatory at national and/or regional level. Organic agriculture refers to the support provided per hectare of agricultural land to farmers or groups of farmers who voluntarily undertake to adopt or maintain practices and methods specific to organic agriculture.

3. RESULTS AND DISCUSSION

The consumption volume of chemical and natural fertilizers should be constantly monitored being an indicator of the evolution of the usage of the nutrient’s nitrogen and phosphorus in mineral fertilizers by agriculture in a certain period.

Figure 1 presents the evolution of surfaces on which chemical and natural fertilizers were applied in Romania during the period 1990-2021.

From the analysis of the five categories of fertilizers applied, it is obvious that the largest surface is that of chemical fertilizers, the sum of the analyzed period being of 175.635,856 hectares. As an evolution over time, the fact is visible that starting with the year 2004. If in 1990 the surface on which fertilizers

were applied was 3,528,354 hectares, it reached a surface of 8,400,360 hectares in 2021, which is an order of magnitude larger than from single to double. Nitrogen fertilizers is in second place as the area of land on which fertilizers were applied. The sum of the surfaces for the 32 years studied was 139,653,662 hectares. The trend of the surfaces where Nitrogen fertilizers were used is an increasing one with larger quantities in the period 1990-1995, of approximately 4179835 hectares, followed by a decrease in the period 1996-2008 when the average was 3948738 hectares and starting with 2009 until 2021 these surfaces increased considerably to 5003320 hectares.

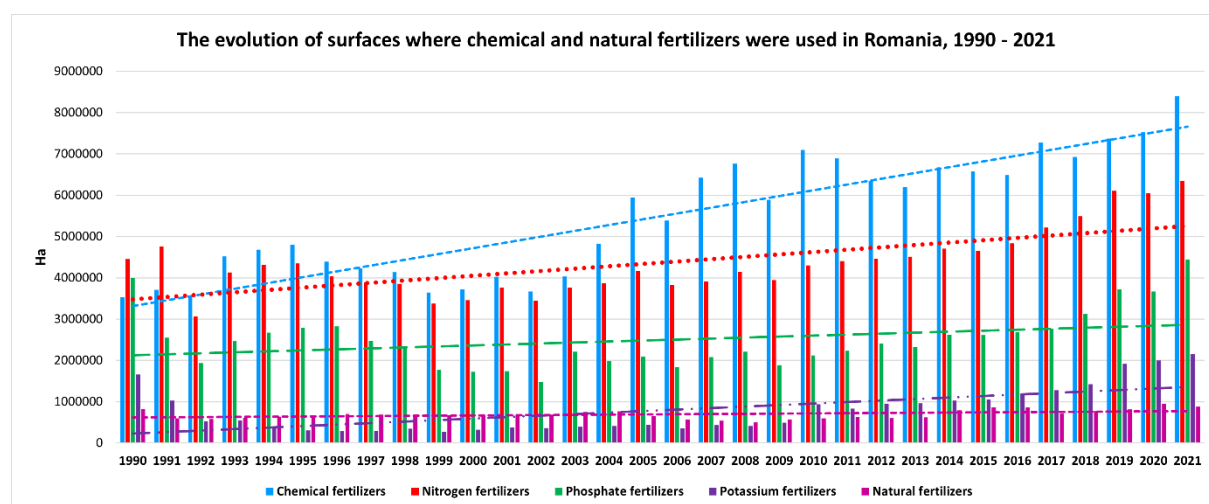


Fig. 1. The evolution of surfaces on which chemical and natural fertilizers were in Romania during the period 1990-2021

The evolution of Phosphate fertilizers is relatively constant, although even in this case the surfaces vary from 3,999,734 hectares in 1990 to 4,445,478 hectares in 2021. Phosphate is the most immobile of the important plant nutrients, and if it does not exist in a soluble form, it is problematic, if not impossible, for plants to obtain it. Phosphorus deficiency is commonly not as easy to identify in vegetation as deficiencies in various other nutrients. The use of slow-release phosphorus fertilizers is crucial for achieving sustainable agriculture.

The surfaces on which Potassium fertilizers were applied in the period 1990-2021 vary from 1,659,424 hectares in the first year studied and reach 2,155,198 hectares in the last year. The surfaces on which Potassium fertilizers were applied in the period 1990-2021 vary from 1659424 hectares in the first year studied and reach 2155198 hectares in the last year, being the largest surface in the entire interval. In the period 1992-2012, the surfaces on which they were applied are even a quarter compared to the year 2021, and it is interesting to investigate why they started using this type of fertilizer.

The usage of natural fertilizers is applicable for the growth of more sustainable farming operations, consequently supplying multiple advantages to a considerable percentage of actual society. Organic matter is the most common natural fertilizer utilized in agriculture. It is a plentiful reservoir of carbon and has a notable role in preserving the CO₂ balance in the atmosphere. 22,143,551 hectares is the total surface for the period 1990-2021 on which natural fertilizers were applied. 22143551 hectares is the total surface for the period 1990-2021 on which natural fertilizers were applied. For this type of fertilizers, the largest registered area is that of 2020, 952,337 hectares, the smallest being that of 1992, of only 579,512 hectares.

The chemical structure of diverse fundamental minerals and elements used for the regular in addition to hastened growing and nourishment of all plants have been used constantly to support and improve the productivity of commercial crops. Fertilizers increase the fertility of the soil and nourish it with necessary nutrients. By fertilizing the soil, also growth the productivity of the crops. This is the reason

why it is very important to monitor the type and quantities of fertilizers that have been applied in a precise area during a distinctly defined period. Figure 2 present the percentage of surfaces on which chemical and natural fertilizers were applied in Romania during the period 1990-2021.

The highest percentage of fertilizers applied in the thirty-two years analyzed was that of chemical fertilizers, 40%. Nitrogen fertilizers were used in a percentage of 31%. Nitrogen fertilizers were used in a percentage of 31%, 18% is the percentage related to Phosphate fertilizers. 5% and 6% are the percentages for Potassium fertilizers and Natural fertilizers. Applying the fertilizers in agriculture may be very beneficial for a food production, although on the contrary it could be extremely hazardous for environment. For this reason, just required quantity of fertilizers should be utilized for a sustainable agriculture.

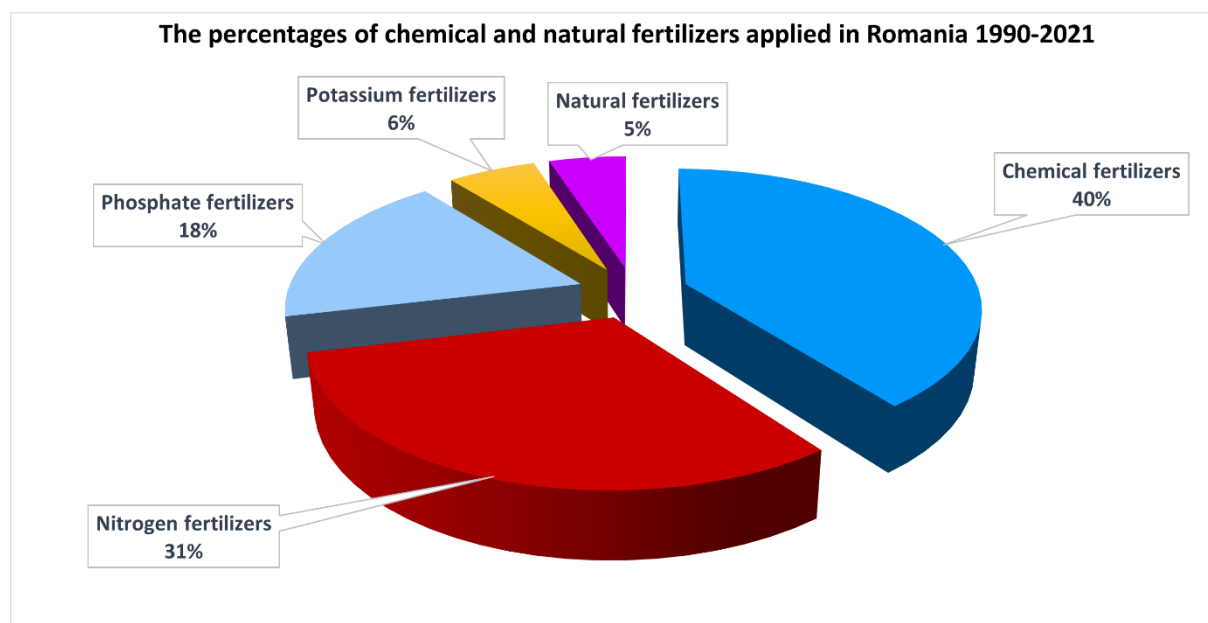


Fig. 2. The percentage of surfaces on which chemical and natural fertilizers were in Romania during the period 1990-2021

In order to analyze the land surfaces on which chemical and natural fertilizers were applied by development regions and counties, we created five maps in which we graphically represented the percentage calculated for the period 1990-2021.

Each map shows one category of fertilizer: Chemical, Nitrogen, Phosphate, Potassium and Natural fertilizers, by regions and counties being graphically represented according to the percentage of surfaces, the more intense colors being given by a higher percentage compared to the more faded shades. Figure 3 indicates the surface of the lands on which chemical and natural fertilizers were applied by development regions and counties in the period 1990-2021 in Romania.

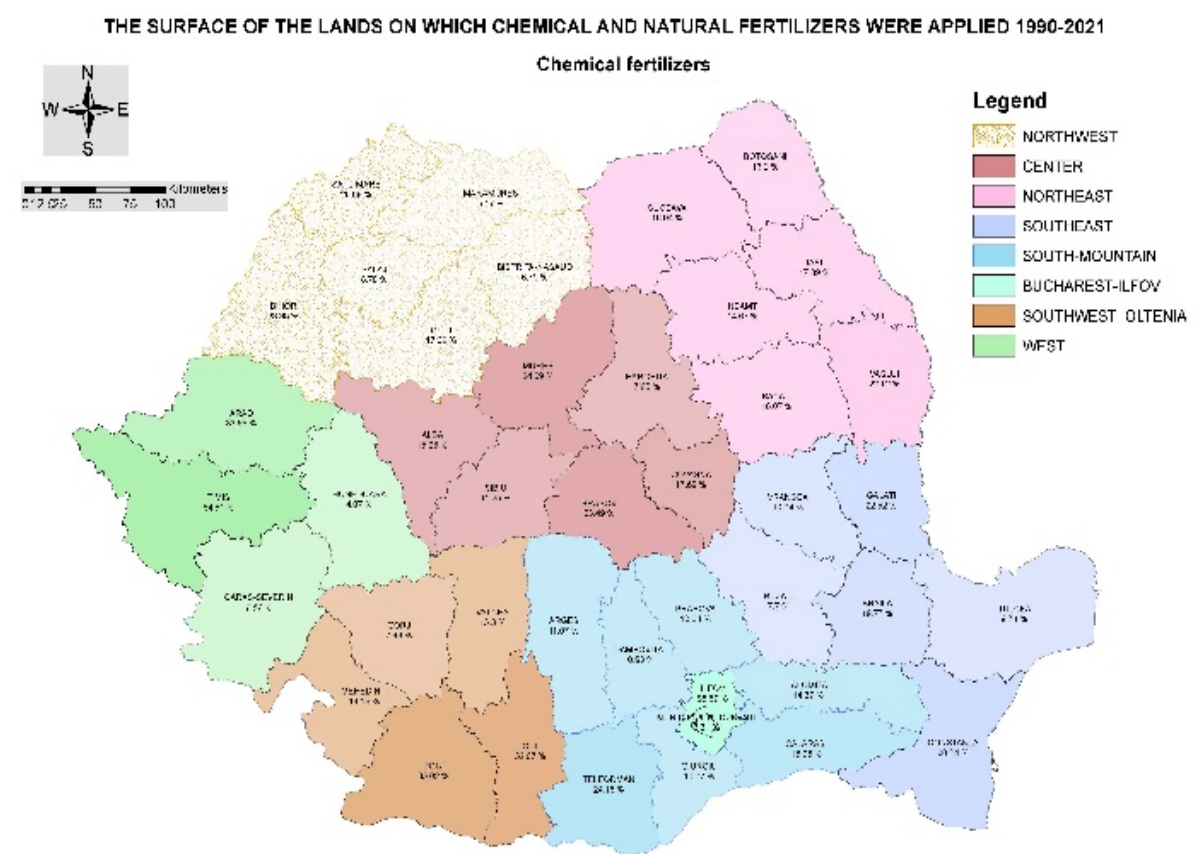
Following the analysis of the areas grouped by region, it can be seen that the South-Mountain region has a total area of 87,532,752 hectares on which fertilizers were applied in the period 1990-2021 compared to the Bucharest - Ilfov area of only 4038137 hectares. The West region has areas of 68,900,943 hectares and the South-East of 66,244,672 hectares, values relatively close to those of the North-West region that have 59038141 hectares, South-West Oltenia region with 57,230,368 hectares and North-East region that have 55,321,980. On the last place is the Center region having only 4,194,745 hectares.

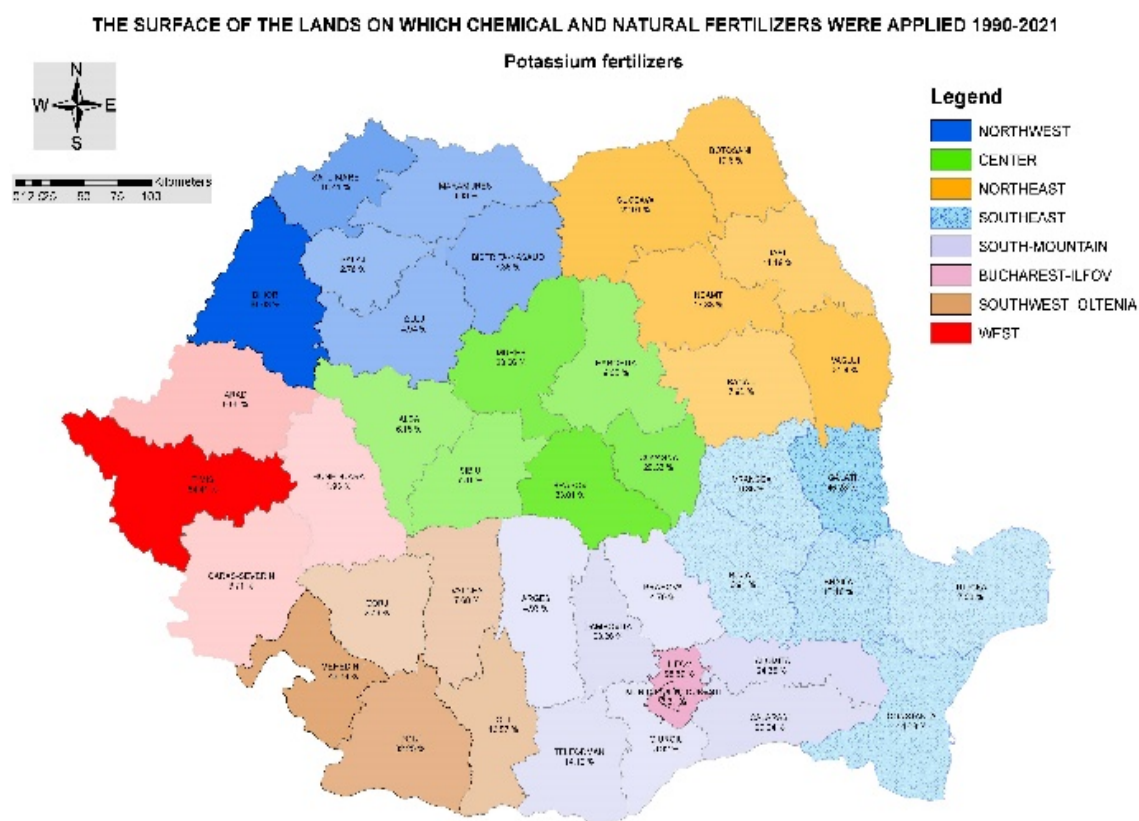
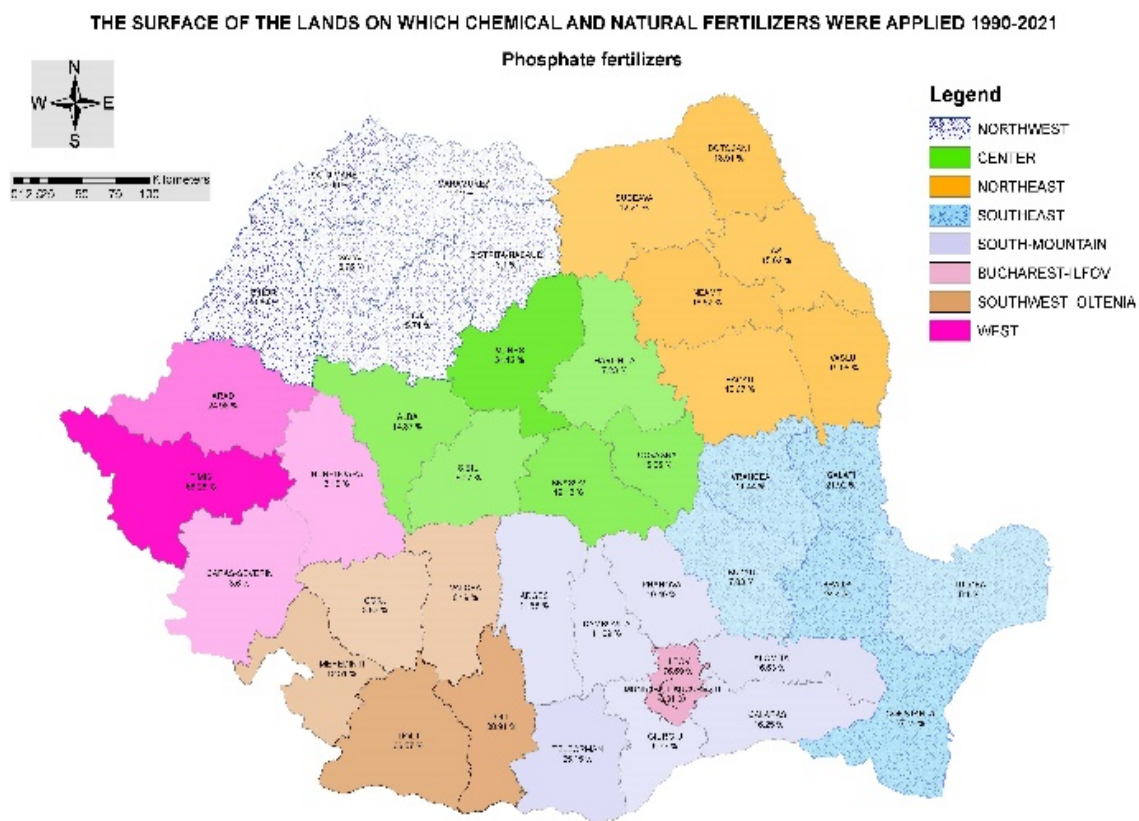
From the analysis of the surfaces on which chemical fertilizers were applied, it can be seen that the surfaces in the South-Mountain region are the largest. Teleorman and Calarsii counties are the ones where

chemical fertilizers were applied in the proportion of 24.16% and 18.96%, respectively. The lowest percentages are those from the Center region 15,679,765 hectares and if we talk about counties we must mention Harghita with an percentage of 7.65% and Sibiu with a percentage of 11.25%.

The largest areas on which nitrogen fertilizers were used is South-Mountain region with 30,293,267 hectares. The first two counties with the largest percentages of areas where nitrogen fertilizers were applied are Teleorman and Calarasi with 25.15% and respectively 16.31%. And for this category of fertilizers, the Center region had the smallest area of 10851914 hectares, and the counties with the lowest percentages in this region are Harghita with 7.58% and Sibiu with 11.16%.

In the South-East region, Phosphate fertilizers were applied on an area of 13,952,282 hectares in the period 1990-2021. At the national level, in Romania, in the South-East region, Phosphate fertilizers were applied on an area of 13,952,282 hectares in the period 1990-2021, this being the highest value in contradiction with the Bucharest - Ilfov region where we are discussing an area totaling only 826,840 hectares. If we discuss from the point of view of the organization of Phosphate fertilizers by county, we can see that in Timis county they were applied in percentage of 65.28%, in the second place being Bihor 40.86% and at a short distance is the Olt county with 38.91%. The lowest percentages of surfaces on which Phosphate fertilizers were used are those in the counties of Hunedoara 3.16%, Gorj 3.83% and Maramures 4.2%.





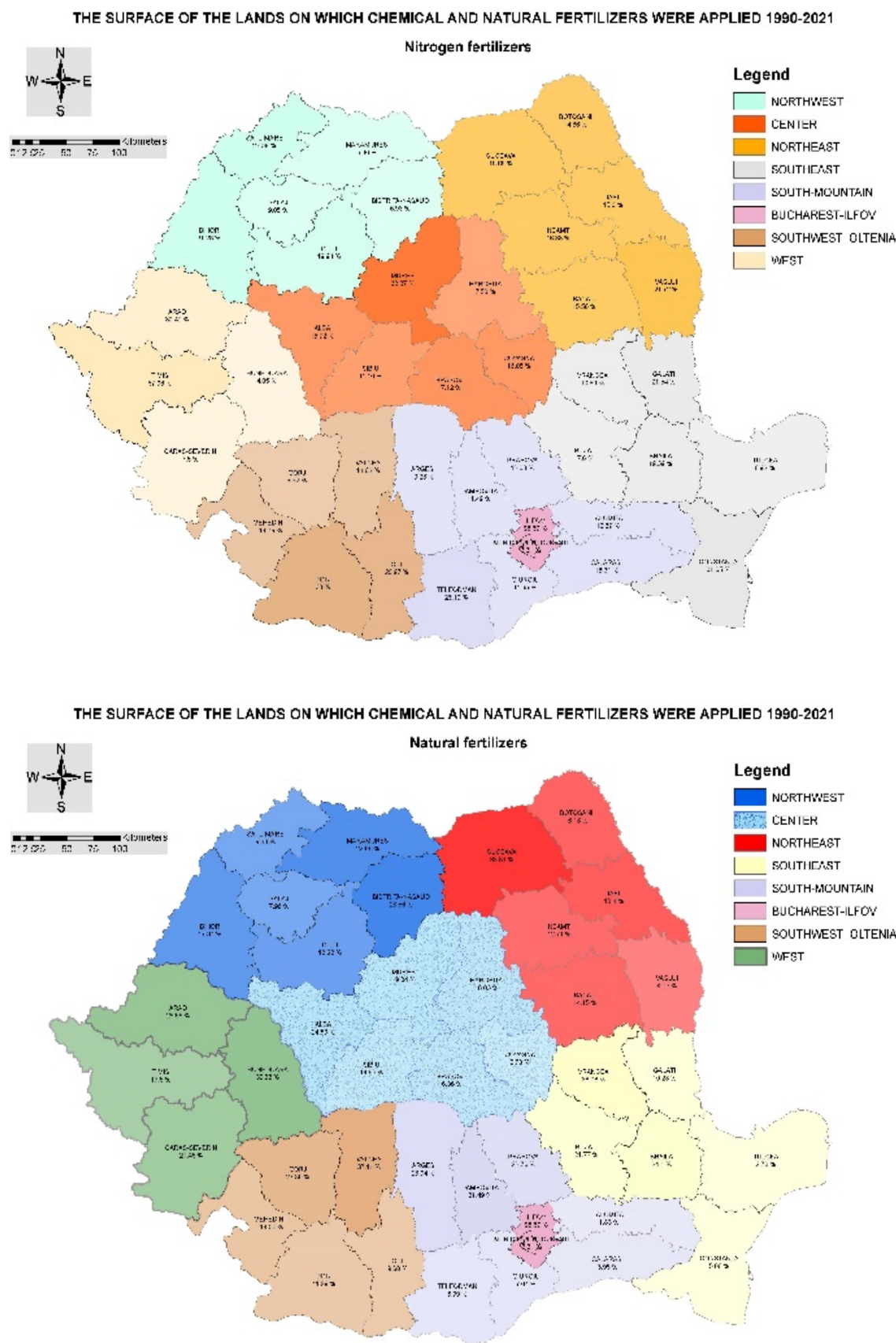


Fig. 3. The surface of the lands on which chemical and natural fertilizers were applied by development regions and counties in the period 1990-2021 in Romania

In the period 1990-2021, West region is the area where Potassium fertilizers were used on the largest surfaces of 7,609,543 hectares compared to Bucharest - Ilfov region with a surface of 161,765 hectares. 84.41% is the percentage related to Timis County, which has the largest area on which Potassium fertilizers were applied, followed by Bihor 61.63% and Galati 45.28%. The counties with the lowest percentages of surfaces on which Potassium fertilizers were applied are Hunedoara 1.93%, and Salaj and Gorj counties at 2.76%.

Natural fertilizers are the last category of fertilizers analyzed in this study. Organic fertilizers are not so injurious as the inorganic ones despite that the natural needs more time comparing to the chemical to reach the roots of the planted or of trees. The largest areas on which Natural fertilizers were applied are those in the North - West region, 5,973,345 hectares, compared to Bucharest - Ilfov region with 113404 hectares. The first three counties with the highest percentages where Natural fertilizers were applied are Valcea with 37.11%, Vrancea 36.06% and Suceava 33.81%. Ialomita is the county with the lowest percentages of areas where Natural fertilizers were applied 1.83%, Tulcea 2.78% and Calarasi 3.95%.

4. CONCLUSIONS

The present article presents the analysis of the surfaces on which five categories of fertilizers were applied: Chemical fertilizers, Nitrogen fertilizers, Phosphate fertilizers, Potassium fertilizers and Natural fertilizers, for a period of 32 years starting with 1990 until 2021, at the national level, according to the data published by the National Institute of Statistics. For three (chemical fertilizers, nitrogen fertilizers, phosphate fertilizers) from the five categories of fertilizers applied, an upward trend can be observed with quantities that differ significantly in 2021, compared to 1990. In the case of natural fertilizers, the trend is relatively constant with an average of 691,985 hectares.

If 5% is the percentage of natural fertilizers applied in Romania in the thirty-two years studied, in the case of chemical fertilizers it reaches a percentage of 40%, eight times higher.

In the North-West region, fertilizers were applied on 5,973,345 hectares compared to the Bucharest - Ilfov region where we are talking about only 113,404 hectares. Although it is preferable, in the context of eco-friendly and sustainable agriculture, to apply organic fertilizers, but in Romania, in the period 1990-2021, it is observed that on most of the surfaces were applied chemical and not natural fertilizers.

In Timis county, quantities of chemical fertilizers are applied on surfaces in a percentage of 54.51%, nitrogen fertilizer in a percentage of 57.96%, 68.26% phosphate fertilizer, potassium fertilizer 84.41% and only 17.5% natural fertilizers, which leads to the conclusion that this county has an intensive agriculture and it would be preferable for the application of fertilizers to be done after accredited laboratory analyzes and not only according to the opinions of farmers, who most of the time can follow an immediate income and not necessarily maintaining the quality of the soil in certain parameters.

If we analyze from the point of view of the surfaces on which natural fertilizers were applied in the period 1990-2021, Valcea county has the highest percentage of 37.11% compared to 13.3% chemical fertilizers, 14.62 nitrogen fertilizers, phosphate fertilizer 8.19% and potassium fertilizer 7.68%.

A great challenge for agricultural sustainability is to preserve ecosystem service simultaneously with maximizing agricultural yields. From now on, chemical fertilizers are estimated to have a crucial role in supporting growing food production, and it is recommended to take into account the negative impact it will have on the quality of environmental factors, at a global level. Excessive fertilization will stimulate great yields but ecosystems must not be destroyed. Furthermore, agricultural fertilizers are a mix of risky and favorable fertilizers. The innovation and sustainability of agriculture must find solutions including for lower amounts of waste and implicitly of greenhouse gases.

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