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THE CONSEQUENCES OF THE USE OF FERTILIZERS ON THE PRODUCTION OF THE MAIN CULTIVATED PLANTS, IN THE SOUTH-EAST REGION, ROMANIA

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Abstract

In the recent past in order to increase the harvest, the production per hectare and its protection against pests and diseases, began to be used, in high doses, chemical and natural fertilizers. The aim of this paper is to analyse the impact of using five categories of fertilizers: chemical, nitrogen, phosphate, potassium and natural fertilizers from 1990 to 2022, in the South-East region of Romania, a predominantly agricultural area on vegetable agricultural production taking into account the three main types of crops: grains, maize, sunflower. In the 33 years, in the South-East region of Romania, the following amounts of chemical fertilizers 2.72 tons of 100% active substance/hectares; nitrogen fertilizers 2.22 tons of 100% active substance/hectares; phosphate fertilizers 1.79 tons of 100% active substance/hectares; potassium fertilizers 1.37 tons of 100% active substance/hectares and natural fertilizers 651.83 tons of 100% active substance/hectares. The analysis of the impact of fertilizers grains production varies from 2808398 tons in 1990 to 3387102 tons in 2022.

Key words*: chemical and natural fertilizers, agricultural production, main types of crops.*

INTRODUCTION

The large use of fertilizers in the course of the last decennaries had as a consequence an enormous expand in the worldwide potential of food production. According to the UN Population prospects, the world-wide population is foreseen to increase approximately 35% in the coming 40 years (UN, 2022). Agricultural production will ought to grow considerably to adapt the increasing population. A considerable percent of the expand (in agricultural productivity) is estimated to consist in producing a large quantity of food on current farmland, despite the fact that some modern farmland will potentially be necessary (Penuelas et al., 2023). This increase and development could, anyhow, cause negative consequences on carbon stocks in soil and plants and on bio-diversity in the most productive arable lands at the global level (Alexandratos et al., 2012; Springmann et al., 2018).

Extension crop production and ending the gap among existent and achievable targets may be accomplished by performing multiple technologies and biotechnologies, e.g., the appropriate apply of fertilizers and systematic nutritional management may have an elemental roles for international farming and food production (Stewart et al., 2012).

Despite that, the fertilization enhancement of the recent decades intended to expand yields that has developed several recent ecological and geo-strategic issues, including nutrient disparity, (Lobell et al., 2009; Lu et al., 2017), percolation of nutrients from harvests to environment and the connected effects (Finér et al., 2011; Weihrauch et al., 2022), and raising price of fertilizers with severe bio-geographical and financial difficulties for the food preservation in poverty-stricken countries (MacDonald et al., 2011; Cordell et al., 2014). The growth of fertilizer demand at global proportions has risen at an exponential rate for nitrogen, phosphorus and potassium (White et al., 2008; Cleveland et al., 2011).

MATERIALS AND METHODS

For the purpose of studying the ratio between the quantity of fertilizers applied in the South-East Region (in the counties of Braila, Buzau, Constanta, Galati, Tulcea and Vrancea) in the

period 1990-2022 and the surface of the lands on which chemical and natural fertilizers were applied, we used a series of data sets collected by the National Institute of Statistics. The European legislation, regarding the statistics of agricultural items, provides for the organization and performing of public statistical surveys regarding the form of agricultural properties, respectively general agricultural inventories once every ten years and structural surveys in agriculture, based on statistical investigations.

The calculation of this paper allowed us to observe for each county and year the period of fertilizers applied to a certain surface and more than that we studied five types of fertilizers: chemical, nitrogen, phosphate, potassium and natural.

In this article, with the aim of obtaining a complete picture of the quantities of fertilizers used in the period 1990-2022, we added up these quantities for each type of fertilizers (chemical, nitrogen, phosphate, potassium and natural) and represented them graphically in the form of maps in Figures 2-6, on the six counties in the South-East region of Romania. In Figure 1, tons of 100% active substance/hectares are represented, the calculations being made by dividing the quantities of fertilizers, for each type, on the respective surface.

Considering that the South-East region is a predominantly agricultural area, the three most important types of agricultural crops are: grains, maize and sunflower. Given the fact that these are the main types of agricultural vegetable crops, it is important to analyse the evolution of the quantity of fertilizers applied per hectare and their agricultural production.

RESULTS AND DISCUSSIONS

A permanent monitoring of the quantities of fertilizers applied, regardless of whether we are talking about chemical or natural fertilizers, is extremely important, especially in the context where, depending on the quantities used, a series of negative effects can occur. In Figure 1 chemical fertilizers, nitrogen fertilizers, phosphate fertilizers and potassium fertilizers are represented as column and natural fertilizers are represented as line (green) using the second axis.

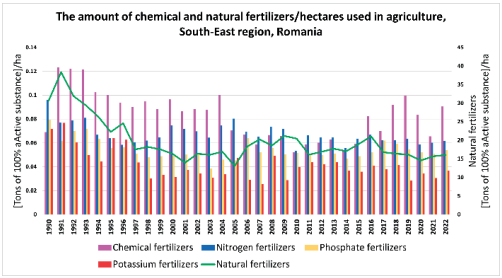

Figure 1. The amount of chemical and natural fertilizers/hectares used in agriculture, South-East region, Romania

In the period 1990-2022, the average annual quantities of fertilizers are as follows: chemical fertilizers 0.0825 tons of 100% active substance/hectares; nitrogen fertilizers 0.0674 tons of 100% active substance/hectares; phosphate fertilizers 0.0542 tons of 100% active substance/hectares; potassium fertilizers 0.0417 tons of 100% active substance/hectares; natural fertilizers 19.7524 tons of 100% active substance/hectares. More than that if we sum up the first four categories of fertilizers, we get a value of 8.1209 tons of 100% active substance/hectares comparable to the natural ones 651.8317 tons of 100% active substance/hectares. All five categories of applied fertilizers have a downward trend. As an evolution in time, it is obvious that in the years 1990-1996 much larger quantities were used compared to the last years.

For example, in the case of natural fertilizers in 1990, 30.7104 tons of 100% active substance/hectares were used compared to 2022 when only 16.0382 tons of 100% active substance/hectares were applied. During 1990-2022, in the period in the South-East region they were used cumulated 2,286,802 tons of 100% active substance of chemical fertilizers which were applied to a cumulated surface of 29,752,052 hectares.

Figure 2a shows the amount of chemical and natural fertilizers used in agriculture and Figure 2b shows the surface of the lands on which chemical and natural fertilizers were applied.

It is obvious that in the analysed period, 1990-2022, in the Southeast region, the county with the largest quantity of chemical fertilizers used was in Constanta County, 640407 tons of 100% active substance, in second place being Braila County with 567678 tons of 100% active

substance, and the smallest amounts of chemical fertilizers are in Buzau County 190786 tons of 100% active substance and Tulcea County 194591 tons of 100% active substance.

If we analyse the surface of the lands on which chemical fertilizers were applied, it can be seen that the largest surfaces on which fertilizers were applied are those in the counties of Constanta 8957995 hectares and Galati 6616642 hectares respectively, and the smallest surfaces are those in Buzau 2265453 hectares and Tulcea 2886812 hectares. Continuous monitoring in each county is important precisely for the purpose of preventing and combating some negative effects.

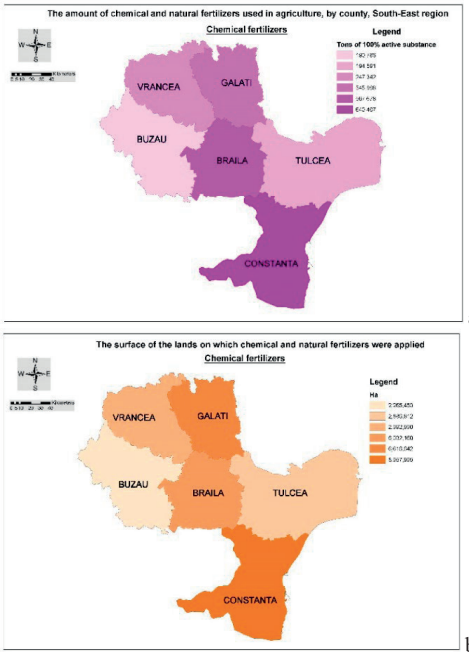

Figure 2. a. The quantity of chemical fertilizers used in agriculture, South-East region, Romania
b. The surface of the lands on which chemical fertilizers were applied, South-East region, Romania

From the analysis of the quantities of nitrogenous fertilizers applied in the analysed period, it appears that 1450183 tons of 100% active substance were used for 21587041 hectares in the South-East region of the country.

Nitrogenous fertilizers contain calcium, ammonium sulphate, sodium nitrate, urea and affects crop growth in several ways like stimulate the growth of foliage, confer a green colour to leaves and more than that in case of cereals, it tends to cause lumpiness in seeds and generate succulence or fragility in the plant. Constanta 396314 tons of 100% active substance and Braila 323189 tons of 100% active substance are the counties where the largest quantities of nitrogenous fertilizers were applied in the 33 years to which this study refers and on contrary on the last two places are situated the counties of Tulcea 125631 tons of 100% active substance and Buzau 121490 tons of 100% active substance are on the last places.

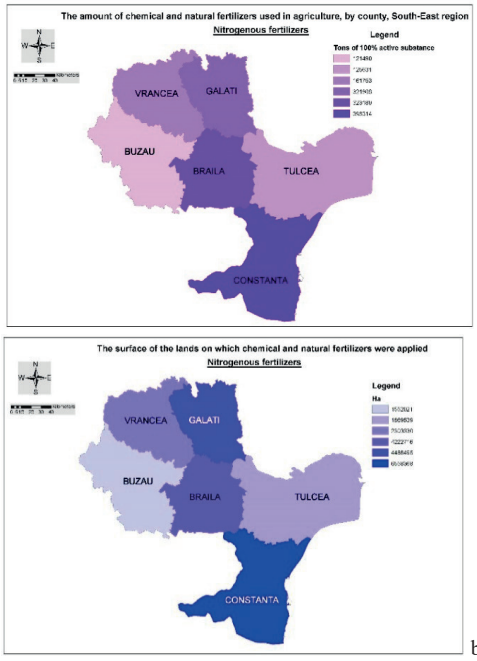

Figure 3. a. The nitrogenous quantity of fertilizers used in agriculture, South-East region, Romania
b. The surface of the lands on which nitrogenous fertilizers were applied, South-East region, Romania

According to the evaluation of the surfaces on which nitrogenous fertilizers were used, the counties of Tulcea 1869539 hectares and Buzau 1552021 hectares are on the last places and Constanta County 6558368 hectares and Galati County 4486495 hectares are on top.

Phosphate fertilisers are the second most significant fertilizers for numerous crops. In contrast to the nitrogen that is a mobile nutrient, phosphate ions have a minor change in the soil. Many of the soils are properly

abundant in soil phosphorus, however just more than one percent or lower of the phosphorus is accessible for plant absorption without continuing additional transformation to a form that is more easily obtainable. Consequently, it is essential to use a soil analysis to establish the quantity of phosphorus that is usable to a crop, and then utilize the phosphorus fertilizers more efficiently to optimize economic crop profits.

Majority of the phosphate fertilizers used nowadays are produced from rock phosphate that is processed with acid. It is furthermore critical to understand that nearly all phosphorus fertilizers contain considerably water-soluble phosphorus. Hence, it is not as significant which phosphorus fertilizer material is chosen for application to an area. Liquid fertilizers generally do not have supplementary utility or agronomic advantages upon the dry fertilizers.

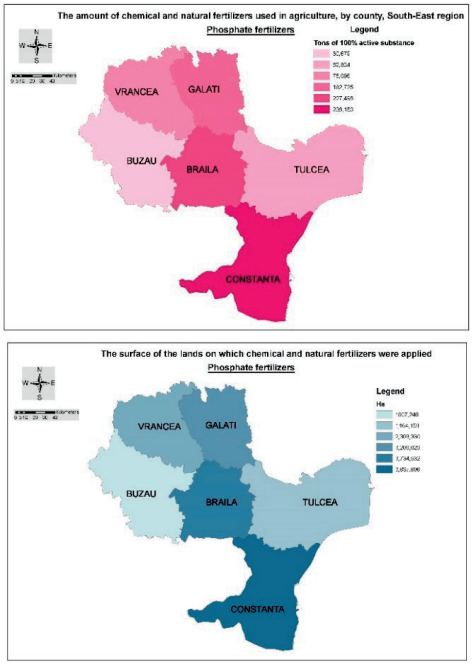

Figure 4. a. The phosphate quantity of fertilizers used in agriculture, South-East region, Romania
b. The surface of the lands on which phosphate fertilizers were applied, South-East region, Romania

The phosphate fertilizer, in the South-East region, are mainly used in Constanta County 236153 tons of 100% active substance and Braila County 227496 tons of 100% active substance, while Tulcea County 62834 tons of 100% active substance and Buzau County 62834 tons of 100% active substance use approximately three times less amount.

A careful analysis of the surfaces on which phosphorus-based fertilizers were applied in the period 1990-2022 indicates the following aspects: is at the top of the use of this type of fertilizers Constanta County 3867896 hectares and Braila County 3734532 hectares, and Tulcea County 164159 hectares and Buzau County 1007246 are the areas where the smallest quantities were used.

Potassium fertilizers are additional option for agriculture. Potassium fertilizers may without difficulty combine with granular complex fertilizers since their size is adaptable. This feature also permits device spreading. Most of them contain chloride, therefore their apply on sensitive harvests is not appropriate. Sulphate-containing potassium fertilizers are efficacious fertilizers but more overpriced as compared with nitrogen ones, so they are frequently used for major types of fruit and vegetable farming that enhance the crops quality.

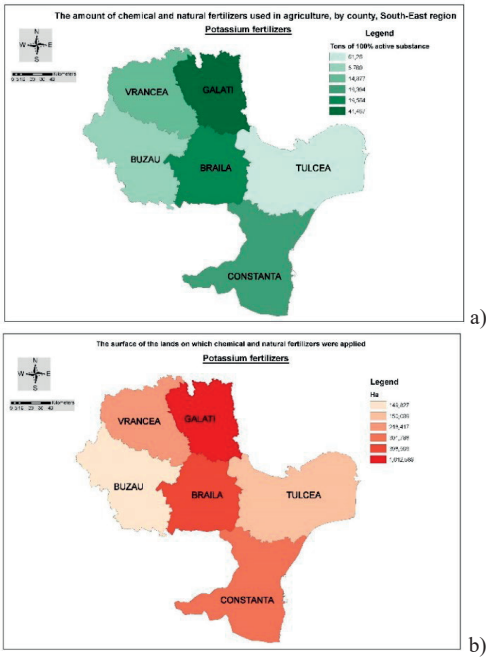

Figure 5. a. The potassium quantity of fertilizers used in agriculture, South-East region, Romania
b. The surface of the lands on which potassium fertilizers were applied, South-East region, Romania

Natural organic fertilizers are fundamentally available mineral sources that contain medium quantity of plant essential nutrients. Those ones are sufficient for reducing issues closely associated with synthetic composts. They diminish the necessity of regular request of synthetic fertilizers to maintain soil productivity. This type of fertilizers gradually releases nutrients into the soil solution and retain nutrient balance for beneficial rise of crop vegetation, being in the same time a substitute for an effective vitality source of soil bacteria that constantly increase soil system and crop growing.

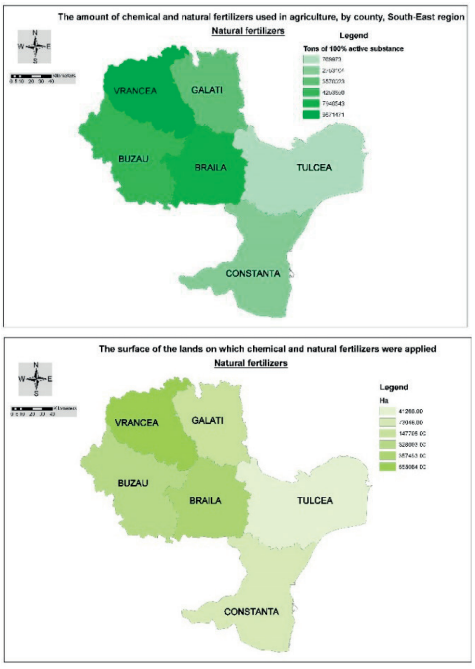

Figure 6. a. The natural quantity of fertilizers used in agriculture, South-East region, Romania
b. The surface of the lands on which natural fertilizers were applied, South-East region, Romania

From the analysis of the evolution of the amounts of fertilizers applied per hectare in the analysed period, it can be observed that in 1990 the quantity of fertilizers applied per hectare is 30.71 tons of 100% active substance/hectares compared to 16.04 tons of 100% active substance/hectares in 2022, when this amount practically halved.

In the South-East region, in the period 1990-2022, Vrancea county 9871471 tons of 100% active substance is at the top, in second place is Braila County 7948543 tons of 100% active substance, and in the last two places is Constanta 2753104 tons of 100% active substances and Tulcea 769973 tons of 100% active substances. From the analysis of the surfaces on which natural fertilizers were applied in the South-East region, Vrancea county is in first place with 555,084 hectares, Braila County is in second place with 357,463 hectares, and Constanta is also in the last two places. 73048 hectares and Tulcea 41266 hectares.

In order to analyse the influence of fertilizers compared to the vegetable agricultural production of grains, maize and sunflowers in the South-East region, for the period 1990-2022 we calculated the Pearson corelation coefficient considering the three categories of vegetable agricultural production and the fertilizers (summing up the five categories of fertilizers used in this study).

In Figure 7, is graphically represented the quantities of the three categories of production and natural and chemical fertilizers that were applied in the studied area.

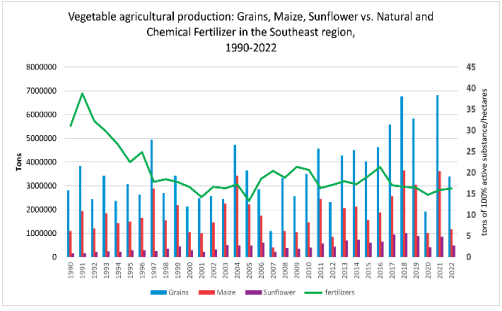

Figure 7. Vegetable agricultural production: Grains, Maize, Sunflower vs. Natural and Chemical Fertilizer in the South- East region, Romania 1990-2022

The Pearson correlation coefficient for grains and fertilizers is a negative one, indicating a relatively low influence of the two categories of variables - 0.207. There is also an insignificant negative correlation -0.236 between maize and fertilizers, while the strongest correlation is -0.522 between sunflower and fertilizers. If we analyse only from a graphical point of view the evolution over time of plant production compared to the quantity of fertilizers applied per hectare, we notice that the quantity of

fertilizers has decreased over time, and production has increased, especially in the case of grains.

CONCLUSIONS

The request on agriculture to enhance production will persist to develop anyway for the next several decades. The majority of the states intend to expand production, thus requiring more intensive agriculture and greater crop yields. The main question for the world's farmers will thus be to increase production in a sustained mode that reduce environmental impact and simultaneously provides sufficiently, safe and nutritive products. From the analysis of the quantities of fertilizers applied per hectare in the period 1990-2022, it appears that natural fertilizers were applied in the largest amount 651.83 tons of 100% active substance/hectares and potassium fertilizers have the lowest use of only 1.37 tons of 100% active substance/hectares. From the point of view of evolution over time, it is obvious that in 1991 there was a maximum point of use of fertilizers 38.71 tons of 100% active substance/hectares, after which there was a sudden decrease in 1997 until 17.80 tons of 100% active substance/hectares, a value which, with small fluctuations in 2007-2011, was maintained in around this value, and in 2022 it reached 16.28 tons of 100% active substance/hectares.

Constanta county is in the top of the use of chemical fertilizers both in quantity 640407 tons of 100% active substance and in area 8957995 hectares, but also of nitrogen fertilizers with 396314 tons of 100% active substance and 6558368 hectares and Constanta County is in first place in the use of Phosphate fertilizers with 396314 tons of 100% active substance and 3867896 hectares. Potassium fertilizers were the most used in Galati County 41467 tons of 100% active substance and 1012589 hectares. In Vrancea County, the largest amounts of natural fertilizers 9871471 tons of 100% active substance were used on an area of 555084 hectares.

Recently, a series of recommendations have appeared whose main goal is the use of natural fertilizers, considering that these are safer alternatives to chemical fertilizers. Although there are a multitude of positive aspects and advantages of using fertilizers, I must not omit the fact that the inappropriate use of organic fertilizers causes overfertilization or nutrient deficiency in the agricultural land. Therefore, managed release of organic fertilizers is an efficient and progressive approach to overcome the negative consequences and support sustainable agriculture production.

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