STUDY ON THE MANAGEMENT OF ORGANIC NUTRIENTS AT THE FARM LEVEL IN THE DEVELOPMENT MACRO REGIONS 3 AND 4 IN ROMANIA

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Abstract

In the context of modern agriculture practiced in the conditions of favorable soil evolution, of increasing fertility in the conditions of maintaining a real ecological balance, organic fertilization by introducing humiferous resources into the soil has and maintains a well-defined place in increasing yields quantitative and qualitative per surface unit. No other simple or compound mineral fertilizer can replace the specific but also complex effects of organic fertilizers on soils and also on the evolution of crops.Organic fertilizers have a multitude of effects and advantages, but mainly they have an essential supply of organic substances for the process of synthesizing humus from the soil, for stabilizing or increasing the reserve of this important soil component and for the dynamic balancing of the two predominant global processes in the evolution of soil organic matter – humification and mineralization. The data presented in this paper are based on a study carried out within development macro regions 3 and 4 aimed at collecting information from farmers who use organic fertilizers on their farms. From total number of respondents, 54.5% mentioned the use of this practice currently, and 33.3% only used manure in the last year on an area varying between 25% and 50% of the cultivated area of the farm. The research also revealed that more than 83% of the respondents indicated that the organic fertilizer came from their own farms, which greatly reduces the costs of the agricultural activity and contributes significantly to the increase of the total profit from the farm.

Key words*:*organic fertilizers, agricultural practices, manure, macro regions

INTRODUCTION

In European legislation, there is no uniformly used definition for manure. While Regulation EC/1069/2009 on animal by-products defines manure as "*any excrement and/or urine of farm animals other than farmed fish*" being an organic fertilizer. The Nitrates Directive (Directive 91/676/EEC) defines livestock waste as "*residual products excreted by animals: or a mixture of litter and residual products excreted by animals, even in processed*

form." EU agricultural policy covers a wide range of areas, including food quality, traceability, trade and promotion of EU farm products (Paraschivu M. et al., 2023). The EU financially supports its farmers and encourages sustainable and eco-friendly practices, while also investing in the development of rural areas (Matei Gh. et al., 2022).

Due to the increase in the consumption of meat and meat-based products, as well as the increase in the export of meat and dairy products, a sharp increase in the amount of manure generated in intensive agricultural systems was noted. Thus, in Europe, in 2018, 80% of the amount total garbage was produced in about 4% of agricultural farms (Amann et al., 2018).

The composition of manure is different depending on the type of animal, breed, feeding method, feed quality, breeding system, etc. Thus, Velthof et al. (2015) noted that poultry litter has the highest N and P contents (estimated 34 grams N/kg litter and 9 grams/kg litter), while in pig sludge suspension, due to the low content of dry matter, the concentrations of nutrients are lower (2 gramsnitrogen (N) respectively 0.3 gramsphosphorus (P) per kilogram of litter).

However, a pig will excrete 8 to 20 kg of nitrogen (N) during a year and a chicken less than 1 kgnitrogen (N).

The physico-chemical properties of manure justify its wide use as a soil conditioner and organic fertilizer (Liang et al., 2014), improving the physical and chemical properties of soil (Kheyrodin and Antoun, 2011; Rayne and Aula, 2020). Because it can slow down the rate of decrease pH value in soil due to its high buffering capacity (Cai et al., 2015) and/or contribute to the decrease of aluminum toxicity (de la Luz Mora et al., 2017).

Some studies also suggest that solid manure can increase soil pH due to the presence of significant amounts of potassium, sodium, magnesium and calcium, calcium carbonate/bicarbonate (Whalen et al., 2000) and organic products. increasing buffering and ion exchange capacity. However, the effects of manure on soil pH depend on its initial value, the diet of the animals, the amount of manure applied (Hao and Chang, 2002) and the treatments it undergoes before its application.

(Cavalli et al., 2016; Cavalli et al., 2017). Manure also provides essential mineral nutrients such as inorganic nitrogen in the form of ammonium (Geisseler et al., 2010), carbon (Francioli et al., 2016), phosphorus and sulfur (Liu et al., 2020 and metals such as zinc and copper. Consequently, in a long-term economic perspective, manure could replace part of mineral fertilizers, lowering production costs at the farm level and reducing the EU's dependence on phosphorus imports from other countries (Drangert et al., 2018; Garske et al., 2020).

It is estimated that at EU level the total amounts of nitrogen and phosphorus excreted by animals reach somewhere around Total N and P excreted 7-9 Mt N/year and 1.8 Mt P/year, but these values are subject to uncertainty due to the different ways of estimation of excretion coefficients (Oenema et al. 2007, Velthof et al. 2015).

The organic fertilizers, especially manure, due to the content of organic and chemical constituents, has an energetic role in soils, reducing and equalizing entropy, which provides them with sustainable effects in the evolution of soil fertilization. Also has a positively influences some physico-chemical and microbiological characteristics of soils, essential to their

fertility - cationic exchange capacity, buffering capacity, reaction regime and nutrient elements. It activates microbiological life and gives it a high biological and biochemical level, specific to fertile soils;

MATERIALS AND METHODS

In order to collect data about the way of used manure at farms level in the development of macro regions 3 and 4 we start to develop a set of questions in a questionnaire to answer the issues proposed in the study regarding the monitoring and evaluation of agricultural practices at the farm level regarding nutrient management.The structure of the questionnaire included 4 parts:

• *the first part* concerned the identification elements of the farm and its legal representative;

• *the second part* included a set of questions that included questions about the farm's economic activity, emphasizing the perspective of the legal representative in relation to a series of agricultural indicators and practices:

• *the third part* included a set of questions that referred to the quality, fertilization and exploitation of the soils within the farm;

• *the last part* concerned information on the livestock sector - where it existed - with an emphasis on the use of manure, compost and digestate to maintain and restore soil health in terms of improving environmental sustainability.

The method used was the Questionnaire. Different types of questionnaires are used to analyse and collect different information, depending on the nature of the information to be collected (Constantin M. et al., 2007)

The questionnaire must comply with certain rules regarding its size and structure, as well as the way of formulating the questions (Pânzaru R. L. et al., 2007: Pânzaru R. L., 2019).

Evaluation of the data collected in the questionnaires made available through the application used in the survey carried out at the level of the 2 development macro regions (3 and 4) - Google forms (https://www.google.com/intl/ro/forms/about/) was made following the synthesis and graphic expression related to each question in the questionnaire.

RESULTS AND DISCUSSIONS

The European Union (EU) produces a significant amount of organic manure or waste: 1.4 billion tonnes of manure from farmed animals were produced annually in the period of 2016 – 2019 in the EU27 and the UK (Eurostat, 2019). Six large countries (Denmark, Spain, France, Italy,. Over 75% of existing manure comes from cattle, while pigs and chickens produced approx. 12% each (fig. 1).

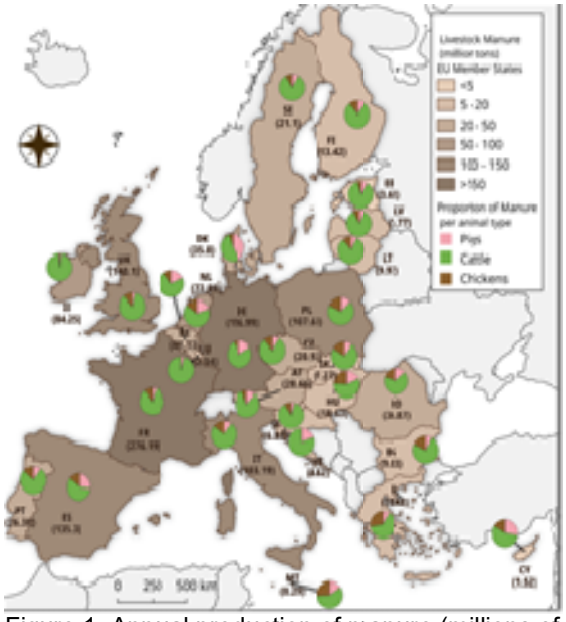

Figure 1. Annual production of manure (millions of tons) at the level of the EU and Great Britain, in the period 2016-2019

Poland and Great Britain) produce approx. 68% of the total amount of manure,

Ireland (84 million tons) and the Netherlands (73 million tons) also make important contributions.

A data series of 1961-2021 show us that the total manure applied to soils, at world level, ranged between 18,2G kg manure in 1961 to 27,8 G kg manure in 2021 (fig. 2).

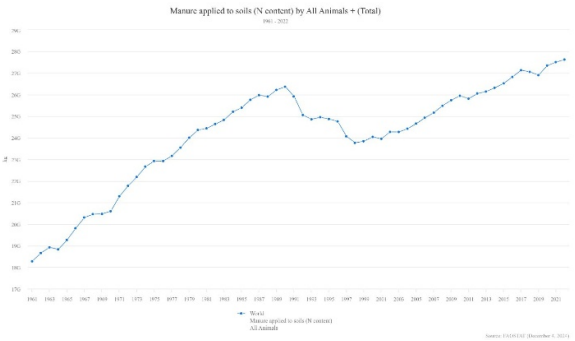

Figure 2. Manure applied to soils (N content) by all animals (Total), in the period 1961-2021 (World level)

With the exception of the interval of 1991 – 1999 years, when the rate decreased, the trend being for all data was an increasing one.

The statistical data show us that worldwide, in the same period, the first 3 countries where the largest amounts of manure were applied are: the USSR, China and the USA (fig.3).

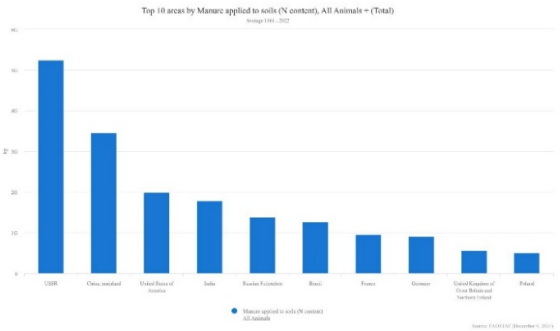

Figure 3. Top 10 areas by Manure applied to soils (N content) by all animals (Total), in the period 1961-2021 (World level)

Regarding this agricultural practice at the level of the continents, it can be seen from figure 4 that Europe has the highest percentage, of 41.1%, followed by Asia with 34% and America (N+S) with a value of 20, 6% (fig. 4).

Davidescu and Davidescu, (1981) established both experimentally and through estimation calculations that annually from an animal are obtained differentiated from raw manure.

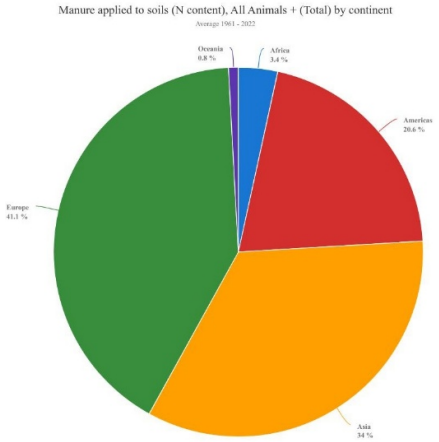

Figure 4. Applied manure to soils (N content) by continent (all animals) in the period 1961-2021 (World level)

Thus, in figure 5 it is presented the applied manure to soil by species and as can be seen on the first place are Cattle non-dairy with 19,3%, followed by Cattle dairy with 18,1%, Swine with a percent of 14,7%, Swine market with 12,7% and Chickens with a percentage of 10,4%.

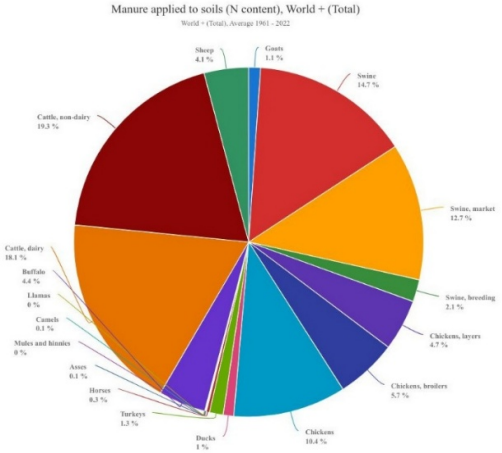

Figure 5. Applied manure to soils (N content) by species in the period 1961-2021 (World level)

The situation of this practice in Romania, for the same interval – 1961 – 2021, show that on the interval 1961-1989 the amount has grown until reach the value of 500 M kg manure. After the highest point from 1986, the tendency has changed to decrease and in 2021 reach the lowest value, under 200 M kg manure (fig. 6).

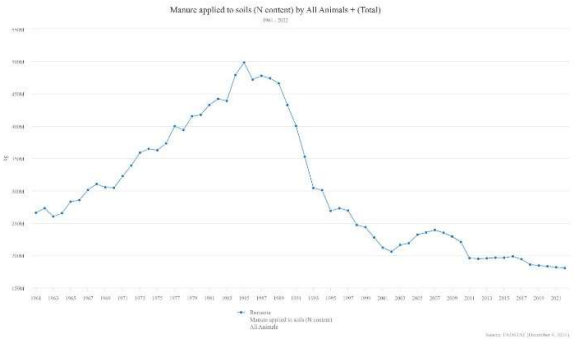

Figure 6. Manure applied to soils in Romania (N content) by all animals (Total) - 1961-2021

Of the total answers regarding the **form of farm organization**, 50% mentioned that they manage individual (family) farms, 20.8% agricultural companies and 12.5% have a partnership. The rest of the answer variants had values below 10% (fig. 7).

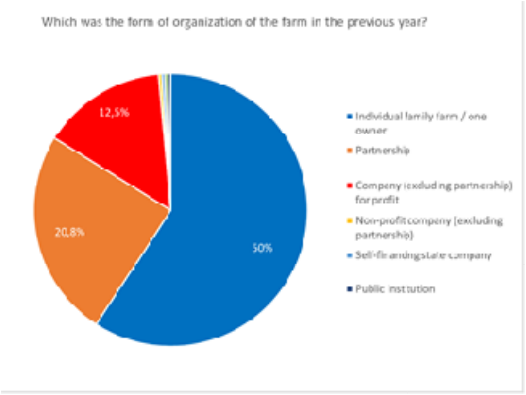

Figure 7. Graphical quantification of responses relating to form of farm organization

Regarding **the farm's main field of activity**, figure 8 shows that more than 60% of the farms have as their object of activity the cultivation of field plants (cereals, legumes, etc.), followed by farms with a horticultural profile or have a mixed activity - crops of field and zootechnical sector. Regarding the quality, management of fertilizers and how the soils are exploited within the farm, questions were formulated that led to answers with a wide range of variation on the rating scale.

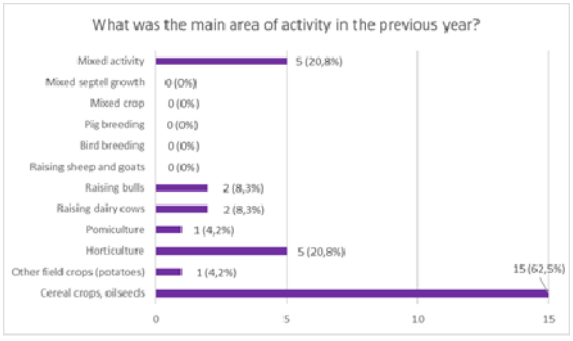

Figure 8. Graphical quantification of responses relating to the main area of activity on the farm

Thus, regarding the assessment made by the respondents on **the quality of the farm soils**, we can see from figure 9 that 70.8% assessed their quality as good, on the opposite side only 8.3% of the interviewees assessed that the soils on the farm have poor quality (fig. 9).

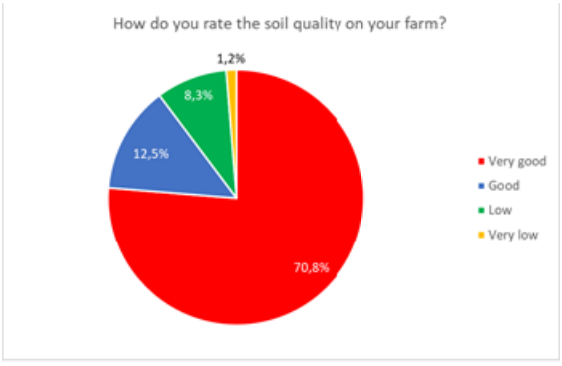

Figure 9. Graphical quantification of responses relating to the assessment of soil quality from farm

The application of a **nutrient management system at the farm level** is a characteristic of companies that manage

their use responsibly, both in the case of synthetic nutrients and those of organic origin.

The intentions declared by the respondents regarding this aspect (fig. 10) show that the approach of such a practice is perceived by farmers first from an economic point of view (45.8%) and then with reference to the maintenance of soil health (33.3%).

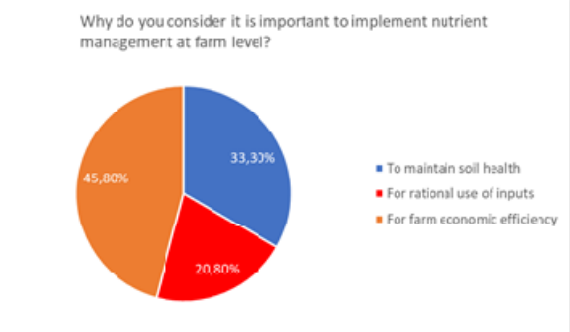

Figure 10. Graphical quantification of responses on the intention of the importance of implementing a nutrient management system at farm level

Regarding the **implementation of such a nutrient management system**, over 54.2% have already carried out a first form of monitoring of how these resources are managed at the farm level (fig. 11).

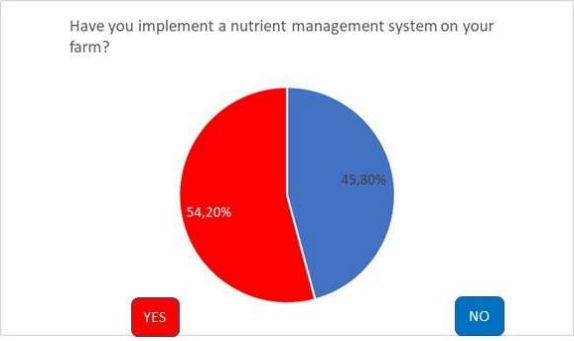

Figure 11. Graphical quantification of responses on the implementation of a nutrient management system at farm level

Agricultural practices that can correctly manage the level of adequate soil use within vegetable or mixed farms in development macro regions 3 and 4 are diverse, and nutrient management, by the nature of the system, the time of application and the type of intervention can ensure optimal exploitation or they can negatively influence the evolution of the state of natural fertility or other agro-productive characteristics of them.

Regarding the **manure used as organic fertilizer in large or mixed crop farms**, ICPA Bucharest recommends, within the Code of Good Agricultural Practices, the application as early as possible, during the crop growth period, in order to maximize the uptake of crop nutrients and minimize the risk of pollution; every year, at least half of the amount of litter produced during the winter must be spread by July 1, and the rest by September 30.

The respondents to this question mentioned in proportion of 54.5% that they frequently apply manure within the plant cultivation technologies (fig. 12).

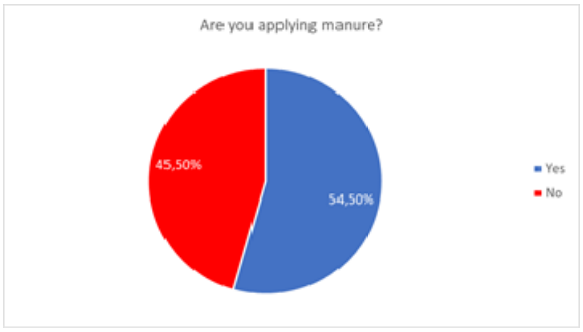

Figure 12. Graphical quantification of responses on application of organic fertilizers (manure)

Also, they declare that **they have been using this practice**, equally, 33,3% for all three variants: less than 5 years, between 5-10 years and more than 5 years (fig. 13).

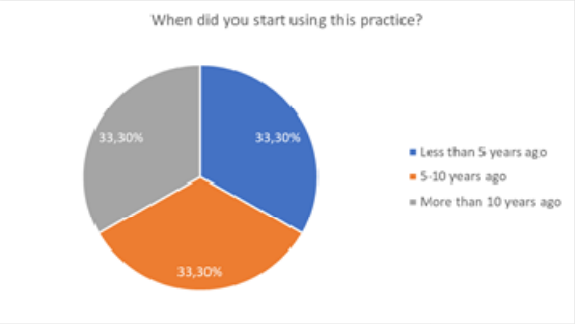

Figure 13. Graphical quantification of responses related to period of application of organic fertilizers (manure)

Regarding the **origin of the manure applied** per hectare of land (figure 14), it had as its source the own farm for 83.3% of respondents and only 16.7% from neighbouring farms.

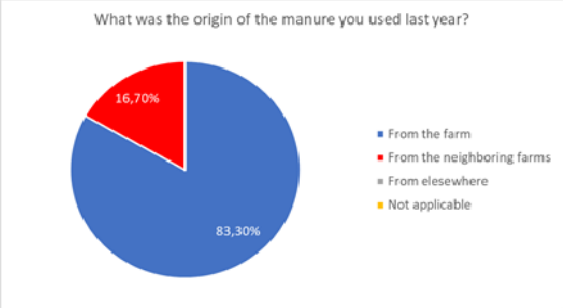

Figure 14. Graphical quantification of responses on the source of organic fertilizers (manure)

The average amount of manure applied by farmers varied from 10 t/ha to over 20 t/ha equally in the responses generated by farmers.

Regarding the **intention expressed by the respondents to keep or change this practice in the following years**, figure 15 shows that the tendency of the majority is to keep this practice unchanged (50%) and only 16.7% mention that they will no longer use it.

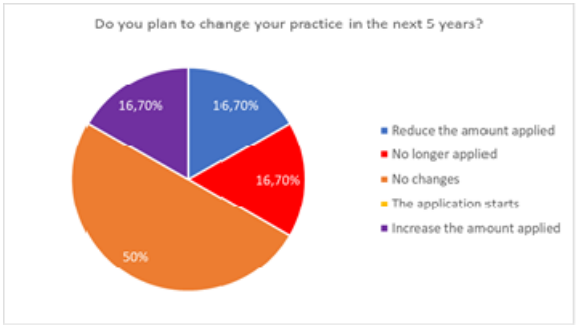

Figure 15. Graphical quantification of responses on intention to change this practice

CONCLUSIONS

Practicing sustainable farming systems, which ensure stable production and appropriate quality, reasonable costs, harmonious relations with the main natural resources (soil, water, flora, fauna, etc.), a good specialization and structure of production, with flexibility and capacity to react to climate changes and those required by complex market mechanisms, represent important objectives in the work schedule of farmers and agricultural producers.

In a modern agriculture, the importance of using fertilizers is undeniable. The results obtained worldwide demonstrate that fertilization contributes, on average, by 30-50% to the increase of yields per unit area, for most cultivated plants, and the productions obtained are closely correlated with the types and doses of fertilizers used. Without proper fertilization, the productive potential of the new genotypes created by geneticists and breeders cannot be realized.

The soil exploitation policies in environmentally friendly conditions promoted by the European Union over time have had quantifiable results in the level of use of organic fertilizers at the global level, where on the continent of Europe the highest percentage of manure application is used, of over 41% on farm surfaces.

In Romania, due to the decrease in livestock, especially cattle, the amount of manure used as direct fertilizer in agriculture tends to decrease at level of under 200 M kg manure.

Romanian farms from macro regions 3 and4 are over 50% organized as family business or belongs to private owners and as main domain they grow cereals and oleaginous plants (over 62%), followed by farms with a horticultural profile or having mixed activity (20,8%).

The application of a nutrient management system at the farm level shows that the approach of such a practice is perceived by farmers first from an economic point of view (45.8%) and then with reference to the maintenance of soil health (33.3%), over 54.2% from the questioned farms have already carried out a first form of monitoring of how these resources are managed at the farm level.

The average amount of manure applied by farmers varied from 10 t/ha to over 20 t/ha equally in the responses generated by farmers and one of the most important fact is that amount provide by their own farms, which subscribes to the new Sustainable and Inclusive Growth Strategy to stimulate the economy, improve health and quality of life, take care of nature, while responding to the EU 2030 Biodiversity Strategy (with reference to the Management of genetic resources (animals, plants) in order to maintaining biodiversity) and the Climate Target Plan (EU 2030).

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