

## Fertilizers and Pesticides Consumption at the Global and the EU level and in Romania

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\* Presented at the 38th IBIMA International Conference, 23-24 November 2021, Seville, Spain

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### Abstract

The paper analyzed the consumption of fertilizers and pesticides in the world, the EU and Romania, based on the data collected from various official statistical information sources. The classifications and comparisons were made to establish the big and small consumers, the position of the EU countries and especially Romania regarding fertilizer and pesticides consumption. The global average consumption of mineral fertilizers reached 199.6 kg/ha, but the highest level exceeded 3,500 kg/ha, a real "alarm bell" regarding the risk for environment pollution and food safety. Also, 24.9 kg/ha pesticides represents the world highest mean consumption. In the EU, both fertilizer and pesticides consumption is much smaller than the global mean, ranging between a little bit more than 100 kg/ha in four member states and below 60kg/ha in three member states. The top consumption of pesticides is 12 kg/ha, twice less than the global highest level, while the lowest level accounts for 0.6 kg/ha. In 2020, Romania consumed in average 98 kg/ha mineral fertilizer active substance, of which nitrogen 59.2 kg/ha and 0.8 kg/ha pesticides, which are among the lowest levels in the EU, which justify its low risk for pesticides indicator accounting for 48. The results emphasized the efforts made in the EU countries to reduce the use of mineral fertilizers and pesticides and to pass to bio alternatives for developing a sustainable agriculture according to Green Deal 2021 which has to reduce health and environment risk and ensure food safety.

**Keywords:** Fertilizers, Pesticides, Consumption, Worldwide, EU, Romania.

### Introduction

Agriculture has to produce more and high quality food for maintaining life on the Earth as mentioned Fisher et al (2014).

Productivity in agriculture is ensured by the technological factors among which the most important ones are: seed quality and its yield potential, fertilization, plant protection, irrigation etc. In order to grow, besides oxygen, hydrogen and water, the plants need essential minerals which have to be absorbed from the soil during the vegetation period. In their book, Madjar and Davidescu (2009) affirmed that this justifies why fertilization is the technological factor which contributes to the enrichment of agricultural land with essential nutrients to keep its fertility and help the plants to grow and produce.

Mineral fertilizers are frequently used in the conventional agriculture for obtaining high yields. Nitrogen, phosphorus and potassium are the major fertilizers, while sulfur, magnesium, calcium belong to the secondary group and, finally, iron, boron, manganese, copper, cobalt, zinc and molybdenum are included in the third class.

However, nitrogen, phosphorus and potassium based fertilizers are the most important ones. Nitrogen stimulates plant growth, protects the plants against falling, diseases, drought and frost. However, only about 60% of soil nitrogen is used by plants, because a part of it is lost due to erosion, leaching, washing and denitrification.

Phosphorus accelerates the development of the plant regarding the vegetative mass, roots and ensure production. Potassium intensifies water absorption, photosynthesis, favors cell division and plant growth. The other chemical elements have also specific duties in plant development and productivity.

European Parliament (2019) pointed out that the lack of nitrogen diminish plant growth, determines plants to be sensitive to falling, diseases, drought, and frost, the lack of phosphorus slows down the roots growth and vegetation mass, and reduces production and the lack of potassium diminish photosynthesis, causes the plant to dry out, the roots to rot, uneven maturity, and reduce the resistance to drought, diseases and pests.

These three major minerals, NPK, are essential in agriculture and for this reason a corresponding ratio between them is required to help the plants to reach the desired performance.

Many research results, like the ones obtained by Ladha et al (2005), Cociu and Alionte (2011), Litke et al (2017), Belete et al (2018), De Oliveira et al (2020) and Kosti et al (2021), proved the efficiency of the use of nitrogen-based fertilizer on cereals yield despite that it also increased costs and polluted the environment. In their studies, Yousaf et al (2017) and Beres et al (2019) mentioned that the use of the nitrogen-based fertilizer also stimulate production for many other crops.

However, other authors like Savci (2012) and Bisht and Chauhan (2020) found that the excessive use of mineral fertilizers has deeply affected crop culture, environment quality (polluting air, soil, water) and human life.

For this reason, organic fertilizers are considered an alternative to mineral fertilizers. They are helpful to improve soil microbial activity, fertility, humus amount, structure and raise crop yield. Also, organic farming is becoming increasingly important in ensuring healthy and environmentally friendly food as mentioned Mie et al (2017).

Pesticides are other chemicals which are used in conventional agriculture in order to protect the plants against diseases (Fungicides), pests (Insecticides), weeds and other undesired plans (Herbicides), to stimulate production etc.

In their research work, Aktar et al (2009) and Nicolopoulou-Stamati et al (2016) found that the increased utilization of pesticides could led to soil, air, and water pollution, to the remanence of toxic compounds in plants affecting the lives of humans and animals.

For this reason, the use of pesticides has to be kept under a permanent control and to be made within certain limits to reduce at minimum the risk of environment pollution and human health as sustained Aktar et al (2009) and Europa Chemicals Agency (2021).

At the world level, both production, consumption and trade with fertilizers and pesticides have grown across the time to enable agriculture to increase productivity.

Many international bodies are concerned with establishing regulations to diminish the use of chemicals in agriculture and to find solutions to maintain production and produce healthy food for the population, ensuring environment protection and biodiversity conservation as mentioned by Europa EU (2021), European Commission (2009, 2021a, 2021b, 2021c), FAO (2017), Amanatidis (2021).

In this context, the purpose of the study was to analyze fertilizer and pesticides consumption at the global and EU level in order to establish the position of the EU countries and especially Romania regarding fertilizer and pesticides consumption. Also, the study has the goal to emphasize Romania's advantages in its way towards a "green agriculture" by its low use of fertilizers and pesticides.

## **Materials and Methods**

### ***Data collection***

The data used in this study are provided by various sources of information, especially from FAO, Eurostat, National Institute of Statistics, Worldometer, Knoema etc from where there were taken the empirical data regarding total consumption of fertilizers and pesticides, the main countries where chemicals are used in agriculture, and also consumption per surface unit.

### ***Methodological aspects***

In this study, the data were processed using the following procedures:

- Fixed basis Index:  $I_{FB(\%)} = (X_n/X_1) \times 100$ , where:  $X_n$  is the value of the variable in the year  $n$  and  $X_1$ , the value of the variable in the year 1.
- Structural index,  $S_{\%}$ , was used for reflecting the share of the countries in the total consumption.
- Graphical representations were used to visualize the trends in chemicals consumption.
- Comparisons were made to establish the hierarchy of the countries and appreciate the top users and lowest consumers, and to establish Romania's position.

The results were presented in tables accompanied by the corresponding comments. At the end of the study, the main ideas resulting from this research were highlighted.

## Results and Discussions

### *Fertilizers and Pesticides at the global level*

#### *(a) Fertilizers*

The demand for fertilizers has continuously increased worldwide. Compared to the year 2015, in 2020, the demand for fertilizers accounted for 201.5 million tonnes, being by 9.5% higher, while the supply reached 273.3 million tonnes, that is by +11.2% more. In consequence, offer/demand ratio increased from 1.33 in 2015 to 1.36 in 2020.

The nitrogen-based fertilizer is the most requested in agriculture. In 2020, it represented 58.9% of supply and 62.4% of offer at the global level. Phosphate comes on the second position with a share of 22.7% in demand and 19.4% in offer, while Potash is ranked the 3rd for 18.4% in demand and 18.2% in supply (Table 1).

Of the total demand of 118.7 million tonnes fertilizers in the year 2020, the request by continent was the following one: Asia (60.2%), Americas (20.6%), Europe (13.9%), Africa (3.6%) and Oceania (1.7%) as mentioned in FAO reports (2017 and 2021).

In the global production of fertilizers (in nutrients), accounting for 250.9 million tonnes, the EU-28 has a share of 9% in nitrogen, 3% in phosphate and 7% in potash.

**Table 1: World fertilizer balance in 2020 versus 2015 (Million tonnes)**

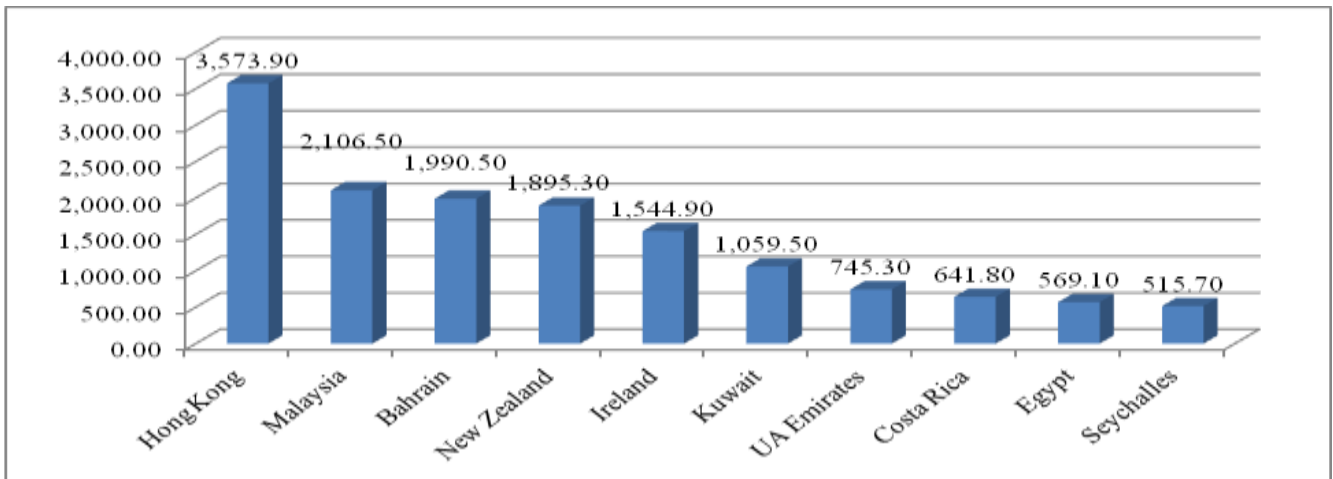
	2015		2020		Demand/Offer ratio	
	Demand	Offer	Demand	Offer	2015	2020
<b>Nitrogen N</b>	110	154.7	118.7	170.7	1.41	1.44
<b>Phosphate P<sub>2</sub>O<sub>5</sub></b>	41.1	47.4	45.8	53.1	1.14	1.16
<b>Potash K<sub>2</sub>O</b>	32.8	43.6	37.0	49.5	1.33	1.36
<b>Total NPK</b>	184	245.7	201.5	273.3	1.33	1.36

Source: CISION PR Newswire (2021).

World fertilizer consumption per unit of arable land accounted for 136.8 kg/ha in 2018 compared to 105.3 kg/ha in 1999, which means + 29.9% as determined by Knoema (2021).

The statistical mean of the world consumption in 162 countries in 2018 was 199.6 kg/ha arable land, ranging between 3,573.9 kg/ha in Hong Kong, the highest level and zero kg/ha in Singapore.

The top consumers of fertilizers in the world are Hong Kong, Malaysia, Bahrain, New Zealand, Ireland, Kuwait, U.A. Emirates, Costa Rica, Egypt and Seychelles as shown by The Global Economy (2021) (Fig. 1).

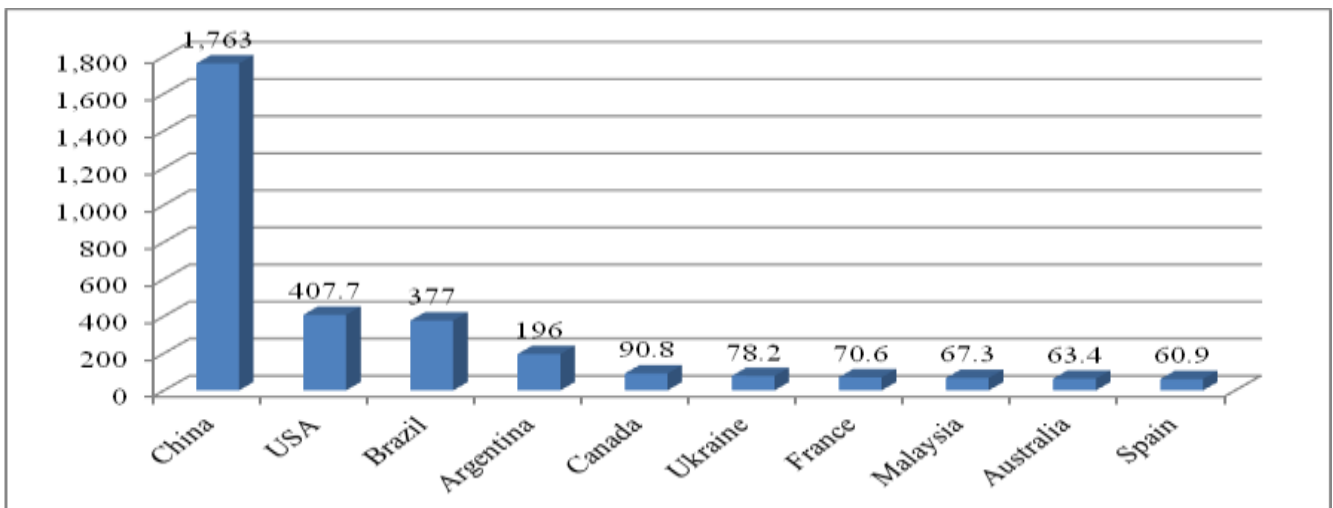


**Fig. 1. Top consumers of fertilizers worldwide (kg/ha arable land)**

Source: Own design based on the data from *The Global Economy* (2021).

**(b)Pesticides**

Pesticides are largely used at the global level, taking into account their role in plant protection and yield growth. The major users of pesticides in the world are: China, USA, Brazil, Argentina, Canada, Ukraine, France, Malaysia, Australia and Spain (Fig. 2 ).



**Fig. 2. Top consumers of pesticides worldwide (Thousand tonnes)**

Source: Own design based on the data from *Worldometer* (2021).

The consumption of pesticides in terms of kg/ha in these top countries differs from a country to another, in accordance with the specificity local conditions regarding crop structure, soil and climate conditions, technologies applied etc. The concrete figures referring to pesticides consumption per ha are: China 13.1 kg/ha, USA 2.5 kg/ha, Brazil 6 kg/ha, Argentina 4.9 kg/ha, Canada 2.4 kg/ha, Ukraine 2.3 kg/ha, France 3.6 kg/ha, Malaysia 8.1 kg/ha, Australia 2 kg/ha and Spain 3.6 kg/ha.

However, at the global level, the top 10 countries using the highest amount of pesticides per ha are: Trinidad and Tobago 24.9 kg, Costa Rica 22.5 kg, Barbados 21.1 kg, Hong Kong 16.6 kg, Ecuador 13.9 kg, China 13.1 kg, Israel 12.6 kg, South Korea 12.4 kg, Seychelles 12.1 kg and Malta 12 kg as displayed online by *Worldometer* (2021).

***Fertilizers and Pesticides in the European Union***

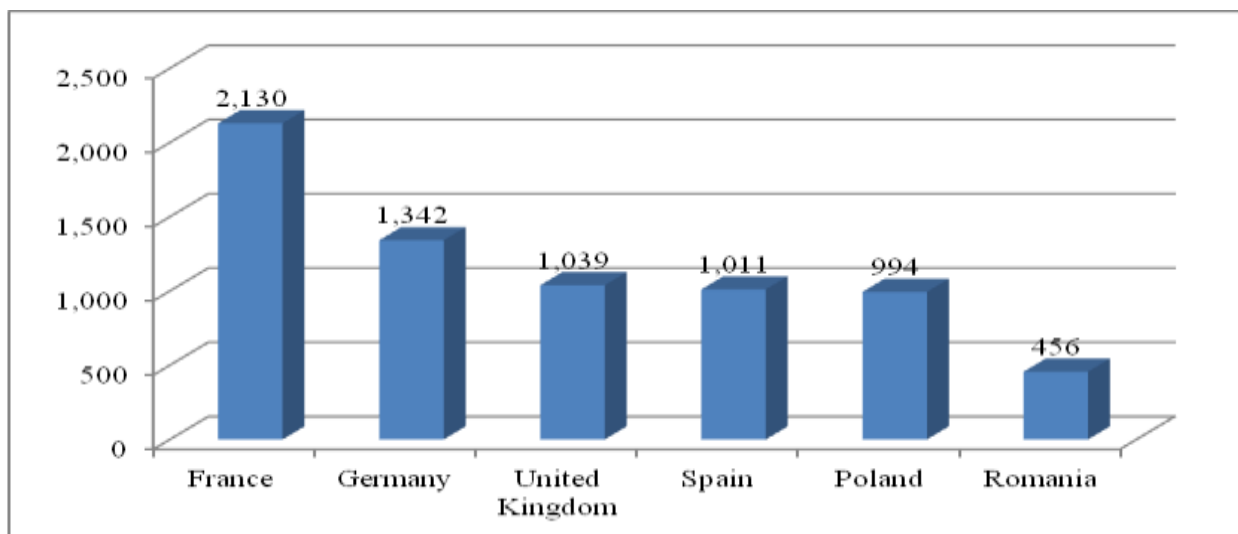
**(a)Fertilizers**

Fertilizers are very important in the EU for increasing yields, obtaining a high production performance and enabling carbon sequestration from air into the soil by agricultural crops.

In 2009, the EU-28 consumed 9.1 million tonnes nitrogen-based fertilizer and 0.8 million tonnes phosphorus fertilizer. In 2018, its consumption reached 10.2 million tonnes nitrogen and 1.1. tonnes phosphorus as shown by Eurostat (2021a and 2021b).

As consumption is higher than production, the EU has to import amounts of fertilizers. In 2019, it imported 8.1 million tonnes, of which: 49.1% nitrogen, 29.5% potassium and 1.9% phosphorus. Also, the EU produces and exports fertilizers. In 2019, its exports accounted for 3.5 million tonnes, of which 62.8% nitrogen, 14.3% phosphorus and 22.9% potassium. By crop, the highest amount of fertilizers is required by wheat 26%, coarse grains 25%, oilseeds 10%, fodder 7%, permanent crops 7% etc.

In 2019, the EU countries which consumed the highest amount of nitrogen-based fertilizer were: France, Germany, United Kingdom, Spain, Poland and Romania (Fig. 3).



**Fig. 3. Top 5 EU countries for consumption of nitrogen-based fertilizer**

Source: Own design based on the data from Eurostat (2021c).

According to the data provided by The Global Economy (2021), it was established the hierarchy of the EU countries, divided into four groups based on the consumption of fertilizer per ha arable land: over 200 kg/ha, 150-199 kg/ha, 100-149 kg/ha and below 100 kg/ha as presented in Table 2.

In the existing 179 million ha agricultural land in the EU, 75% are fertilized with mineral fertilizers. About 50% of these fertilizers are applied on cereals crops, 16% on grasslands and 11% on oilseeds crops.

In the past decade, the fertilizer amount utilized in the EU was stabilized after the deep reduction generated by the implementation of the Common Agricultural Policy reforms in the 1990's and 2000's.

The fertilizer market in the EU was dominated by France, Germany and United Kingdom till Brexit, all these three countries together keeping a share of 40% in the fertilize consumption value as mentioned in a Report of EU Commission (2021a).

In 2018, the average consumption of nitrogen-based fertilizer in the EU accounted for 77.2 kg/ha agricultural area, being 2.9 times smaller and far away from the world average of 199.6 kg/ha.

Even though Belgium, Netherlands, Slovenia, United Kingdom, Luxemburg and Croatia consumed that time more than 200 kg/ha, ranging between 221 kg/ha in Croatia and 293.4 kg/ha in Belgium, these countries are far away from the consumption per surface unit in the top consumers of fertilizers worldwide.

In the category with 150-199 kg/ha fertilizer consumption, there are nine countries whose consumption per surface unit of arable land varied between 150.7 kg/ha in Hungary and 198.5 kg/ha in Portugal.

Other nine EU member states are included in the class of 100-149 kg/ha fertilizer consumption. Their consumption level ranged between 104.1 in Sweden and 131.1 in Austria.

**Table 2: The classification of the EU countries based on the consumption of fertilizer per ha arable land in 2018 (kg/ha)**

Over 200			150-199			100-149			Below 100		
World rank	Country	kg/ha	World rank	Country	kg/ha	World rank	Country	kg/ha	World rank	Country	kg/ha
21	Belgium	293.4	40	Portugal	198.5	67	Austria	131.1	87	Finland	91.6
23	Netherlands	265.9	47	Poland	177.6	68	Lithuania	133.5	89	Estonia	87.7
24	Slovenia	261.8	50	Czechia	174.4	69	Greece	133.3	105	Romania	59.2
29	United Kingdom	245.6	51	France	172.7	72	Italy	130.6			
34	Luxemburg	234.7	54	Malta	167.8	73	Slovakia	129.3			
35	Croatia	221.0	55	Germany	166.5	75	Bulgaria	126.9			
			56	Cyprus	157.7	83	Denmark	108.1			
			57	Spain	157.7	85	Latvia	101.2			
			61	Hungary	150.7	86	Sweden	100.4			

Source: Own conception based on the data from *The Global Economy (2021)*.

The last group includes three countries: Finland, Estonia and Romania, where the fertilizer consumption per ha arable land is the smallest in the EU, varying between 59.2 kg/ha in Romania and 91.6 kg/ha in Finland as affirmed by *The Global Economy (2021)*.

According to Eurostat (2021c), at present Belgium, Netherlands, Czechia and Denmark are the only countries which consume more than 100 kg fertilizer per ha. In the category with 80-100 kg/ha fertilizer consumption, there are: France, Germany, Poland, Ireland, United Kingdom, Bulgaria, Hungary and Croatia. The Baltic states, Italy, Malta, Austria, Portugal and Romania are a group of countries with the lowest consumption of fertilizer per ha, more exactly less than 60 kg N/ha.

Besides the mineral fertilizers, natural fertilizers are successfully used both in the conventional agriculture and organic farming, as animal farms are an important source of manure (or slurry). In fact, natural fertilizers are used all over the world, not only in the EU.

However, in the EU, the manure production declined during the last decade due to the reduction in livestock, especially in cattle.

The high demand of fertilizers led to the price grow and implicitly to higher input costs. Despite that, farmers need to use fertilizers to grow yield, biomass production and to facilitate the capture of carbon dioxide from the air and store it into the soil, therefore to practice an agriculture friendly with the environment.

European Parliament (2019) in the new EU 1009/2019 Regulation regarding Circular Economy Fertilizing Products, which will start to be applied in the member states from July 2022, brings new elements regarding: "the market for new and innovative organic fertilizers, strict rules on safety, quality and labeling requirements for all fertilizers which will be traded freely across the EU, the classification of the fertilizers into different product function categories (PFCs) based on their destination, the component materials of the fertilizers have to comply to specific process requirements and control mechanisms, new limits for contaminants in fertilizers especially concerning the maximum Cadmium limit below 1.5 mg/kg organic fertilizer and other bio-fertilizer and below 20 mg/kg in organo-mineral fertilizers, boosting the use of organic and bio/waste-based fertilizers".

The purpose of this new regulation is to offer more options for farmers regarding the choice and use of fertilizers, to improve soil protection and environment quality and to reduce the health risk for consumers as presented European Parliament (2019).

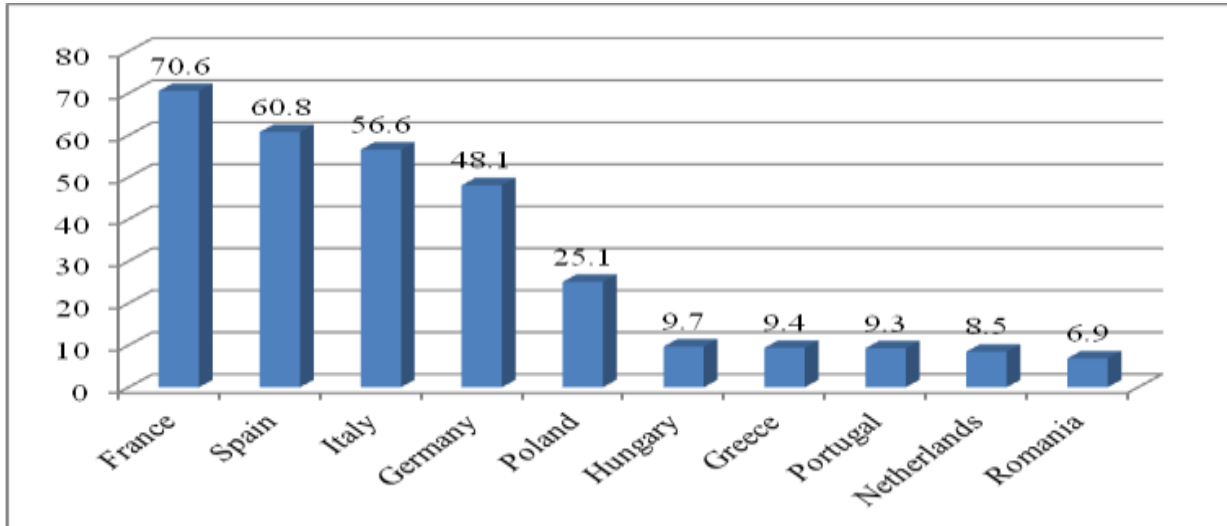
### **(b) Pesticides**

In the EU, the biggest amount of pesticides are used in France, Spain, Italy, Germany, Poland, Hungary, Greece, Portugal, Netherlands and Romania. The lowest consumption is in Malta and Luxemburg (125 tonnes, and respectively, 177 tonnes) as shown by Worldometer (2021) (Fig. 4).

Regarding the consumption of pesticides per surface unit in the EU, the hierarchy of the top countries with the highest consumption is: Malta, Netherlands, Belgium, Ireland, Italy, Portugal, Germany, France and Spain. At the opposite pole, there are: Finland 0.6 kg/ha, Sweden 0.6 kg/ha, Romania 0.8 kg/ha, Bulgaria 0.9 kg/ha and Estonia 1 kg/ha (Fig. 5).

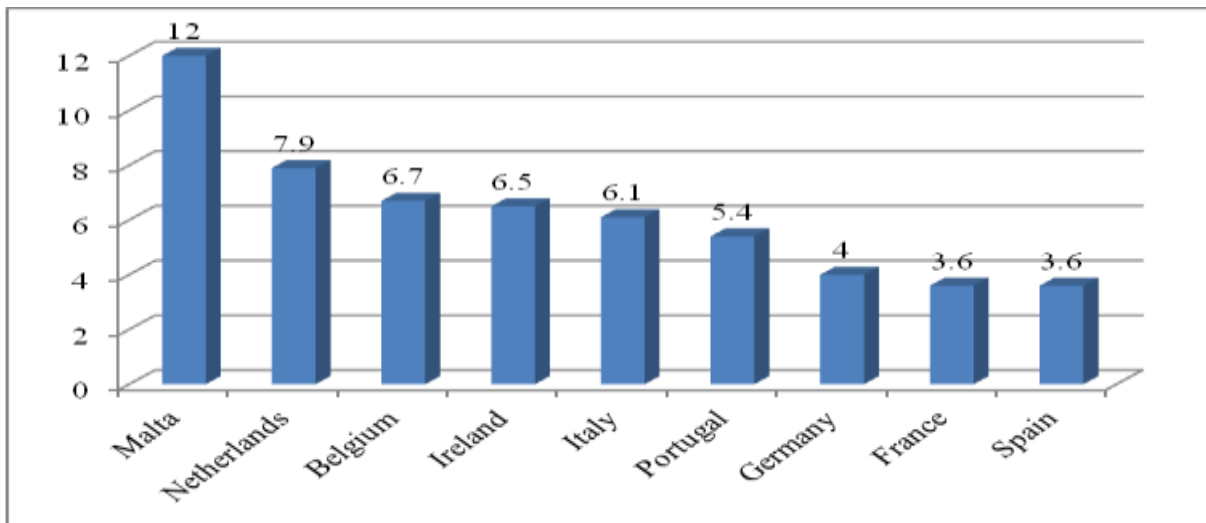
In 2019, in the EU, the main countries producing pesticides which also had the highest sales were: Spain 34.07 million tonnes, France 24.48 million tonnes, Italy 24.29 million tonnes, Germany 10.22 million tonnes, United Kingdom 6.06 million tonnes, Poland 6.87 million tonnes, Portugal 5.77 million tonnes and Romania 4.02 million tonnes.

According to European Commission (2009), the amount of pesticides was restricted to specific thresholds in order to reduce pollution of air, soil, water environment in general and ensure a high food quality for the population and food safety.



**Fig. 4. Top 10 EU countries based on the consumption of pesticides in 2018 ( thousand tonnes)**

Source: Own design based on the data from Worldometer (2021).



**Fig. 5. Top EU countries based on the consumption of pesticides per surface unit in 2018 ( kg/ha)**

Source: Own design based on the data from Worldometer (2021).

The EU established the so called Harmonized Risk Indicator 1 (HRI 1) which is determined by multiplying the quantities of active substances placed on the market in plant protection products by a weighting factor.

In the year 2018, the harmonized risk indicator 1 for pesticides by active substances accounted for 83, this level representing the EU average. The countries with a higher risk for pesticides were: Finland 144, Latvia 140, Cyprus 134, Estonia 131, Austria 129, Slovenia 109, France 100, Italy 91, Lithuania 86 and Hungary 84, being situated over the EU mean. The lowest risk indicator belonged to the following countries: Romania 48, Greece 59, Czechia 61, Croatia 62 and Luxemburg 62.

In 2019, the average Harmonized Risk Indicator 1 in the EU declined by 18.9% to 79 compared to 111 registered in the year 2011.

### ***Fertilizers and Pesticides in Romania***

Romania is an important agricultural country which has 13.93 million agricultural utilized area (UAA) and 3.48 million of farms, meaning 3.99 ha the average farm size. About 46% of the the agricultural land is worked by less than 1% agricultural holdings represented by commercial companies deeply oriented to market, and 54% belongs to the small holdings characterized by subzistence and semisubzistence family farming.

The main crops cultivated in the country are cereals, especially maize and wheat as affirmed Popescu (2018a) and oilseeds mainly sunflower, rape and in a lower proportion soybean as mentioned by Popescu (2012 and 2018b).

Also, Romania cultivates vegetables, forage crops, and has grasslands, vineyards and orchards.

Agricultural output increased by 19.1% from Euro 14,134 million in 2009 to Euro 16,849 Million in the year 2020.

Popescu and David (2015) sustained that this was due to the efforts made agricultural farms especially by the commercial companies to modernize endowment, technologies, and optimize the combination between the three production factors: land, labor and capital in order to produce more and of higher quality.

According to the study made by Popescu (2015) and Popescu and David (2015, Gross Domestic Product achieved in agriculture represents 4.5% of Romania's GDP. Also, Romanian agriculture brings its contribution to the EU agricultural output and GDP as affirmed Popescu (2020).

To produce more and of high quality, Romania needs to utilize both chemical and organic fertilizers and also pesticides.

#### **(a) Fertilizers**

In Romania the surface of agricultural land where fertilization is applied increased by 27.7% in case of chemical fertilizers and by 67.2% in case of organic fertilizers. In 2020, about 7.52 million ha were fertilized with inorganic fertilizer and 0.95 million ha with natural fertilizer (Table 3).

**Table 3: Surface of application and amount of fertilizer used in Romania in 2020 versus 2009**

	Area of application ( Million ha)			Fertilizer amount (100% active substance (Thousand tonnes)			Fertilizer amount ( kg/ha)		
	2009	2020	2020/2009%	2009	2020	2020/2009%	2009	2020	2020/2009%
<b>Chemical fertilizer</b>	5.88	7.52	127.8	426	738	173.2	72	98	136.1
<b>Natural fertilizer</b>	0.56	0.95	169.6	13,748	18,680	135.8	24,550	19,663	80.1

Source: Own calculation based on the data from National Institute of Statistics (2021).

The amount of the used inorganic fertilizer increased by 73.2%, while the quantity of organic fertilizer raised by 35.8% in 2020 compared to 2009. In consequence, in 2020, the quantity of fertilizer applied per ha accounted for 98 kg mineral fertilizer and for 19,663 kg organic fertilizer.

The results showed an increase by +36.1% in case of mineral fertilizer and a decline by 20 % in case of organic fertilizer. This was caused by the reduced number of cattle livestock during the last decade.

The nitrogen-based fertilizer is the most used in Romania like in the EU and worldwide. In 2019, Romania utilized 456 thousand tonnes N fertilizer, an amount by 54% higher than in 2019. For this amount of N fertizer used, Romania comes on the 6th postion in the EU, after France, Germany, United Kingdom, Spain and Poland.

However, taking into consideration, the agricultural land on which N fertilizer is utilized, Romania registered the lowest consumption per ha, less than 60 kg. This is an advantage for the country, reflecting that it practices an agriculture more friendly with the environment than other EU countries. But, it also registered a lower performance in terms of yield. However, having in mind that a large surface is cultivated, agricultural production is high mainly concerning cereals (maize and wheat) and oilseeds (sunflower), Romania being among the top producers for the grains of these crops in the EU.

At the world level, Romania is ranked 105th for its consumption of 59.2 kg fertelizer per ha arable land, which is a small quantity compared to the amount utilized in other countries.

#### **(b) Pesticides**

Pesticides are also important in Romania for sustaining agricultural production performance by ensuring plant protection. In 2020 versus 2009, the agricultural area, where pesticides were applied, increased by +27.9% in case of insecticides, by +7.5% for fungicides and by +23.6% for herbicides.

But, the total amount of utilized pesticides in kg active substance per ha declined by 38.8% in case of insecticides, by 12.3% for fungicides and by 15.4% for herbicides.

This happened due to the higher and higher price for pesticides and also due to the regulations imposed by the EU regarding the use of PPP according to the new CAP oriented to a healthier agriculture and environment.

In consequence, the amount of pesticides per surface unit is very small. In the year 2020, it accounted for only 0.27 kg/ha insecticides, 0.76 kg/ha fungicides and 0.75 kg/ha herbicides. The decline of the amount per ha accounted for 52.7% for insecticides, 18.3% for fungicides and 31.2 for herbicides (Table 4).

For its consumption of 6.9 thousand tonnes pesticides in the year 2019, Romania was situated on the 10th position in the EU -28 as shown by Worldometer (2021).

For the consumption of pesticides per surface unit, Romania is classified in the group of EU member states with the smallest level, accounting for 0.8 kg/ha, for which the country comes of the 3rd position at the end of the EU countries list, being next to Finland and Sweden.

This is also an advantage for Romania reflecting that its agriculture corresponds much better to the requirements of the EU for ensuring a lower use of pesticides in order to protect environment and population health.

**Table 4: Surface of application and amount of pesticides used in Romania in 2020 versus 2009**

	Area of application ( Million ha)			Pesticide amount (Million kg, active substance)			Pesticide amount ( kg/ha)		
	2009	2020	2020/2009%	2009	2020	2020/2009%	2009	2020	2020/2009%
<b>Insecticides</b>	1.83	2.34	127.8	1.05	0.64	60.9	0.57	0.27	47.3
<b>Fungicides</b>	2.23	2.40	107.6	2.08	1.82	87.5	0.93	0.76	81.7
<b>Erbicides</b>	3.14	3.89	123.8	3.43	2.90	84.5	1.09	0.75	68.8

Source: Own calculation based on the data from National Institute of Statistics (2021).

Among the EU countries selling pesticides, Romania came on the 8th position in 2019 after Spain, France, Italy, Germany, United Kingdom, Poland and Portugal. In the period 2011-2019, its sales increased by 15.54% from 3.48 million tonnes pesticides in 2011 to 4.02 million tonnes in 2019.

Regarding the risk for pesticides of active substance, Romania has the lowest value, accounting for 48, which is by 42.2% lower than 83, representing the EU average.

Amanatidis (2021) and Frische et al (2018) affirmed that according to the EU legislation regarding chemical substances, human health and environment have to be protected and the obstacles of trade to be prevented.

For achieving this goal, pesticides use had to be limited, registered, evaluated and authorized for promoting the sustainability in agriculture from "farm to fork" and for assuring biodiversity and environment protection as presented by Europa EU (2021).

As mentioned by the EU Green Deal approved in May 2021, it is provided a reduction of 50% in chemical pesticides by 2030.

For reducing pesticides, an alternative is the expand of organic farming on larger surfaces and in a higher number of farms in the EU. At present, organic farming agriculture covers 13.8 million ha, that is just 8.5% of the EU agricultural land.

In Romania, in 2016, according to Eurostat, only 1.3% of the total utilized agricultural area and 0.06% of the number of farms were under organic farming as mentioned by Eurostat Statistics Explained (2021). Organic farming is based on natural fertilizers and bio tools for plant protection for producing healthy food and protect enviroment and biodiversity as affirmed Mie et al (2017).

The green architecture of the future EU agriculture will be built by farmers and rural communities by applying a sustainable food system along the product chain, harmonized with the efforts for achieving net-zero emmissions in the EU by 2050 contributing to the decrease of climate change impact and also combined with zero pollution plan for ensuring a healthy environment.

Romania benefits of the advantage as it has a low consumption of fertilizer and pesticides per ha agricultural area and also a low risk indicator 1. However, it has to strengthen the efforts to develop a sustainable and competitive agriculture to promote healthy food and transform rural areas in vibrant regions.

The national strategic plan has to be adapted to the new challenges and needs, and to support the competitiveness, farmers' income, to improve food chain, to reduce climate change actions, to protect environment, to preserve biodiversity and landscapes and assure food safety.

## Conclusions

Fertilizers are obviously needed to increase soil fertility and crop production, but consumption of mineral fertilizers reached to high levels which are an "alarm bell" regarding the risk for environment pollution and food safety.

The demand of fertilizers has continuously increased at the global level and in 2020 it accounted for 201 million tonnes NPK, of which 13% belongs to Europe, but the EU requires just 9% nitrogen, 3% phosphate and 7% potash.

The average world consumption reached 199.6 kg/ha, but the highest level exceeded 3,500 kg/ha, while the lowest one is zero.

Consumption of pesticides has also raised and reached the maximum of 24.9 kg/ha, which has also to worry the producers and consumers.

In 2020, compared to the world average fertilizer consumption, in the EU only three countries Belgium, Netherlands, Czechia and Denmark utilized more than 100 kg nitrogen per ha, while most of the member states consumed 80-100 kg/ha, and eight countries below 60 kg/ha.

The average consumption of pesticides in the EU is much smaller than the world mean, Malta occupying the top position with 12 kg/ha, twice less than the top consumption in the world (24 kg/ha). The lowest level is 0.6 kg/ha and belongs to Finland and Sweden.

Romania is a particular case in the EU, being the country with the most numerous agricultural holdings, but with the smallest farm size, agriculture being dominated by family subsistence and semi-subsistence farming and only 1% representing commercial companies working 46% of arable land. In this case, the use of fertilizers and pesticides per surface unit is very small, in the year 2020, accounting in average for 98 kg/ha mineral fertilizer active substance, of which nitrogen fertilizer 59.2 kg/ha.

From this point of view, Romania comes on the 105th position in the world and on the last position in the EU.

Regarding the consumption of pesticides, Romania registered 0.8 kg/ha which brings the country on the 26th position in the EU.

However, Romania comes on the 6th position in the EU for the total consumption of 456 thousand tonnes nitrogen fertilizer, on the 46 position in the world and on the 10th position in the EU for the total consumption of pesticides accounting for 6.9 thousand tonnes.

It is also a producer of pesticides and for its sales of 4.02 million tonnes in 2019, Romania was ranked the 7th in the EU. Romania has the lowest risk for pesticides indicator 1, accounting for 48, which situates the country on the last position in the EU.

The EU pays a special attention to fertilizers and pesticides production and consumption and for attaining its goal established by Green Deal 2021, new regulations were issued to reduce the use of mineral fertilizers and pesticides and strengthen the use of more bio products destined to protect environment pollution, preserve biodiversity and ensure food safety.

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