A PERSPECTIVE ON AGRICULTURAL LABOR PRODUCTIVITY AND GREENHOUSE GAS EMISSIONS IN CONTEXT OF THE COMMON AGRICULTURAL POLICY EXIGENCIES

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ABSTRACT

European agriculture is the result and experiences of a numerous and md determinant reforms during last period of time. Labor productivity and green gas emissions represents two major turning points in analyzing the Common Agricultural Policy evolution. The main aim of this research is to make a synoptic analysis of the agriculture evolution in context of the new Common Agricultural Policy paradigm transformation from the perspective of sectorial structural changes determined by the new environmental exigencies and labor productivity.

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Introduction

Agriculture represents more than a source of food production and it is a sector that brings many contributions, except consolidating the GDP – more in the case of Romania, than in the case of the European Union (EU). Agriculture involves much more: rural communities rely on agricultural activities; agriculture involves natural resources management, preserves the specific lifestyle in rural areas and much more. Not only that, but also agriculture acts as an important generator of jobs in rural areas, especially in developing countries, where the share of the population living in the rural area from total population is considerable.

As it is already argued in literature (Burlacu, 2018; Galluzzo, 2018; Lupu, 2020), the Common Agricultural Policy has had a significant impact on the Romanian agricultural sector in both financial frameworks: 2007-2013 and 2014-2020. Not only that, but CAP will also continue to have a major influence on the Romanian agricultural sector, as the next financial framework approaches: 2021-2027. This policy is one of the most important European policies affecting such an important part of the economy and population, which passes through a new reform at the beginning of the 2021-2027 financial framework.

Through its pillars, the Common Agricultural Policy is not only affecting EU farmers, but it is actually affecting all the EU citizens, in many ways. As is already highlighted (Matthews, 2018; Lovec et al., 2020), Common Agricultural Policy is structured on two complementary pillars. Pillar I concerns direct payments and market-oriented measure, aiming to contribute to achieving a higher level of environmental and climate ambition. Pillar II is meant to aid development in rural areas through economic and social schemes. According to (Kiryluk-Dryjska and Baer-Nawrocka, 2019; Pawłowski and Piotr, 2020), there are two essential mechanisms at designed to finance measures the CAP, specific to each of the two pillars: EAFRD (The European Agricultural Fund for Rural Development) and the EAGF (European Agricultural Guarantee Fund).

The latter finances expenditure meant to support the direct payments to farmers, measures designed to inform and promote agricultural products on the Community's internal market, intervention measures aimed at regulating agricultural markets and other specific measures. On the other hand, the EAFRD corresponds to Pillar II of the CAP and it designed to finance rural development measures in the EU. In this context, CAP has multiple dimensions: the market-oriented and financial support dimension and the rural development dimension. Both dimensions are interconnected and sustainable, considering that they act complementary and the each EU Member State must co-finance the projects which contribute to the rural development in their country. CAP is not only helping farmers ensure food security in the EU, but it also has a significant contribution to developing rural areas and to building a more sustainable and environmentally-friendly economy in the rural areas.

Even on the verge of the 2014-2020 financial frameworks' end, Romania's agriculture is still trying to catch up to the competitiveness and green criteria of the European

Union. Reducing the gaps in productivity and competitiveness represents Romania's main focus when approaching the agricultural sector. Romanian rural areas are the evidence of an intense out emigration to urban agglomerations and wealthy cities. Mitigating the negative socio-economic impact of this transition and the lack of competitiveness in the agriculture, the CAP represents the main instrument for improvement in the case of Romania.

The main aim of this research is to study the evolution of the Romanian agriculture in the context of the new Common Agricultural Policy paradigm transformation from the perspective of sectorial structural changes determined by the new economic exigencies. This research paper contributes to an explicit understanding of the CAP problems as a specific policy with great impact on Romanian agricultural system and rural community's development.

Literature Review

Agriculture in the EU countries is differentiated in many regards, similar to the many ways each of the CAP measures have different results, based on the specificities of each state. Romania tries to converge to the sustainable development of agriculture in the European Union by using CAP instruments in order to adopt measures that fit best the national circumstances; measure meant to mitigate the effects of the declining rural population, poor development of non-agricultural activities in rural areas which generates dependence on subsistence agriculture; low level of labor productivity are other issues (Comanescu, Foris and Foris, 2019). Additionally, through adopting CAP measures, agricultural entrepreneurial income is meant to increase among all EU Member States (Marcuta and Marcuta, 2019). This can also be achieved by empowering the diversification of entrepreneurial initiatives in the rural economy – financeable through the second pillar of the CAP (Răzvanță, 2020).

Divergence still exists between the EU Member States when approaching the agricultural sector. Denmark is a country with a low population and high-income potential. On the other hand, Poland and Romania are countries with high population potential, with an important share of people working in agriculture, but with low-income potential (Tluczak, 2020).

However, converge must be achieved in the agricultural sector in the EU. The measures supported by the CAP must be constantly updated according to the needs of farmers and according to the market situation at different moments and eventually trying to anticipate future outcomes (Dumitru et al., 2017a). For developing countries such as Romania and Bulgaria, both CAP pillars are critical for agriculture, but with an emphasis on the first pillar. Adopted measures need to be taken in order to eliminate the existing gaps with the other countries, especially in the Northwestern EU (Dumitru et al., 2017b).

Galluzzo (2016) demonstrated the existence of a direct correlation between the Single Area Payments Schemes and crop specialization. Mack, Fintineru and Kohler (2020)

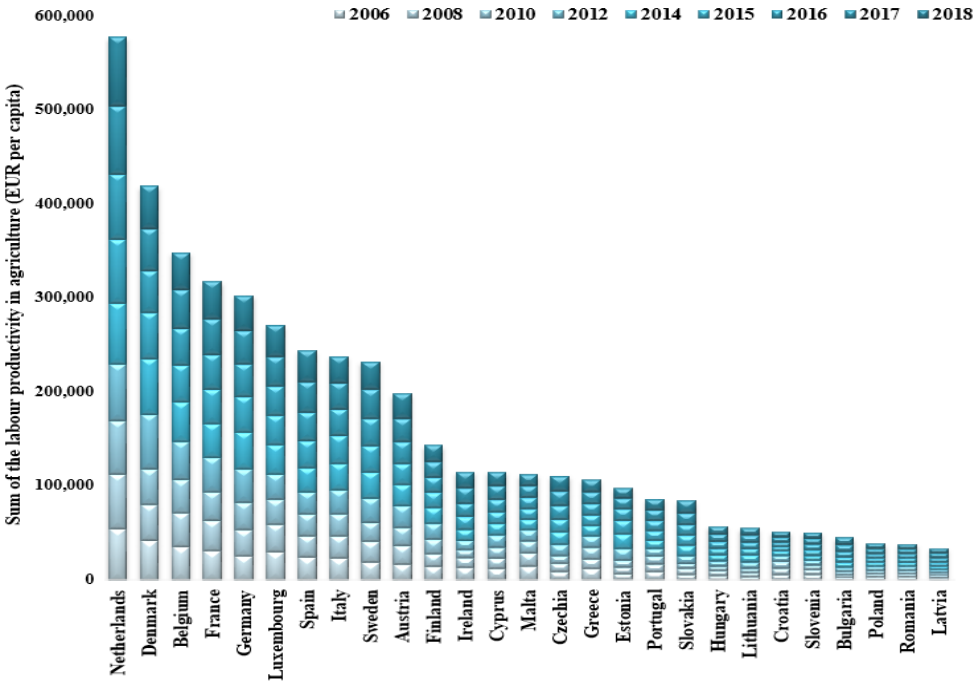
demonstrated that the results of implementing the CAP in Romania have positive outcomes: higher the treatment intensity imply the generation of more new enterprises and that funds higher than €50 per capita significantly contribute to the generation of newly established in rural areas. Through the first pillar of the CAP, the financial subsidies allocated for Romania have had an effect on the development of agritourism, yet this is in contrast with the subsidies disbursed under the second pillar have had no unique effects in any Romanian development region (Galluzzo, 2020).

As it is remarked by Lupu,(2020), during the 2014-2020 financial framework, Romania encountered several difficulties related to the CAP structure: Romania has a deeply fragmented agricultural land and there are many small and very small farms, therefore there is a lack of cooperatives; the population working in agriculture is aged and the labor force involved in agriculture is inefficient (Lupu, 2020).

Research findings

When analyzing the evolution of the labour productivity in agriculture (EUR per capita), one can notice the divergence between the Northwestern European countries and those from the Eastern Europe and the Baltics.

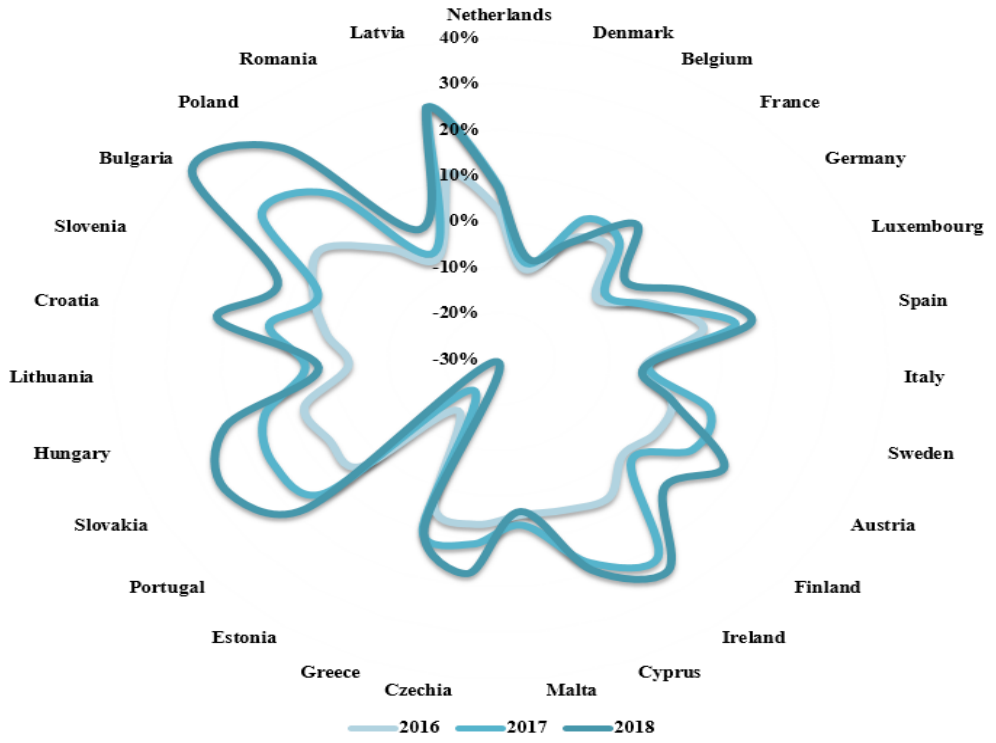
Figure 1. The evolution of the labour productivity in agriculture (EUR per capita), per country and year in the EU-27



Source: Own representation, based on the CTX_SOC_12_1 raw data Eurostat, 2020

During the 2006-2018 period, even though the CAP tried to adjust the existing labour productivity discrepancies between the EU-27 members via various changes made at the level of the measures and of the budget structure, those initiatives could not and still cannot successfully and completely mitigate the huge progress made in terms of the agriculture labor productivity by Northwest EU-27 members, such as: Netherlands (72,825 EUR/capita in 2018), Denmark (45,506 EUR/capita in 2018), Belgium (39,082 EUR/capita in 2018), France (39,736 EU/capita in 2018) and Germany (37,165 EUR/capita in 2018). Even though the mean of the labour productivity in agriculture in the EU-27 in 2018 was 20,829 EUR/capita, the Baltics and Eastern European members are below average and in need to align with the European competitiveness in terms of the labour productivity. The most affected countries by the labour productivity gap: Romania (4,955 EUR/capita), Latvia (5,075 EUR/capita), and Poland (5,692 EUR/capita) should try to identify those measures in the CAP that are meant to transform traditional agricultural labor patterns into modern models of agriculture: precision agriculture highly digitized. Romania's agriculture needs to harness its development potential by mixing digitalization with performant equipment and technologies, as this could increase the labour productivity.

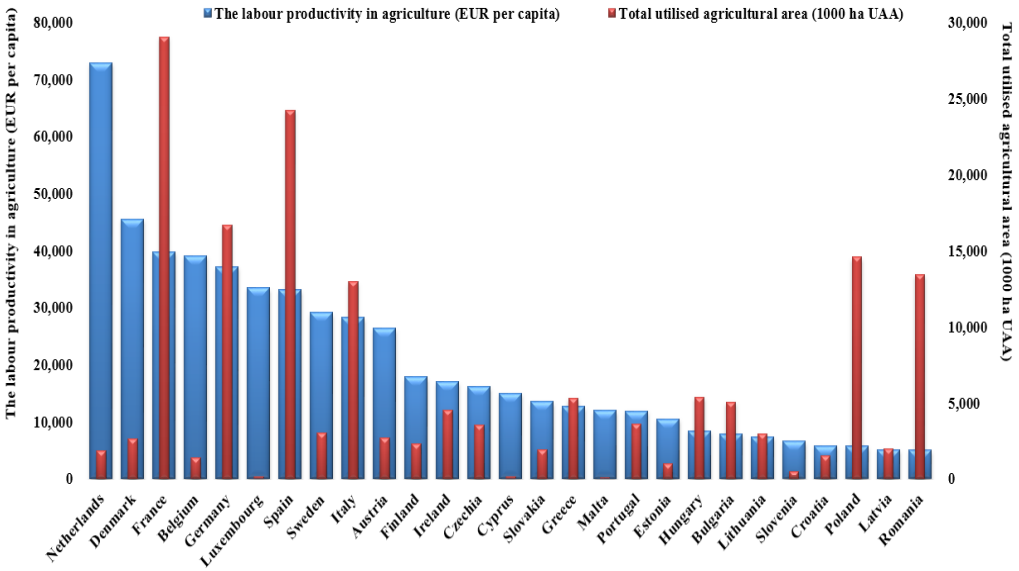
Figure 2. The dynamics of the labour productivity in agriculture (percentage change), per country and year in the EU-27, base year = 2015



Source: Own calculations and representation, based on the CTX_SOC_12_1 raw data Eurostat, 2020

Regarding the dynamics of the labour productivity in agriculture (percentage change) one can notice the tendency for convergence in the case of the Baltics and Eastern European states to the EU-27 average. Even though these states are facing issues in terms of the labor productivity in agriculture, they are catching up to the labour of the Northwestern European countries through harnessing the instruments of CAP. The Northwestern European states have a slower rate of growth in terms of the labor productivity in agriculture, since they are already ahead of the Baltics and Eastern European states. For these findings, there is evidence: huge increases (expressed procentually) of the labor productivity in agriculture in country such as: Bulgaria (38.6%), Poland (30%), Slovakia (26.73%), Latvia (26.41%) and Hungary (21.07%), along with decreases or small increases in the case of the Northwestern EU-27 countries, such as: Denmark (-7.51%), Belgium (-1.65%), Germany (-1.66%), Netherlands (7.19%) and France (8.35%). Unfortunately, Romania is still behind of the Baltics and other Eastern European States in terms of converging to the EU-27 mean, mainly due to the small increase rate (1.62%) in terms of labor productivity in agriculture, while simultaneously having the least labor-productive agriculture in the EU-27 in 2018.

Figure 3. The labour productivity in agriculture (EUR per capita) in relation with the total utilised agricultural area (1,000 ha UAA) per country UE-27, reference year: 2018

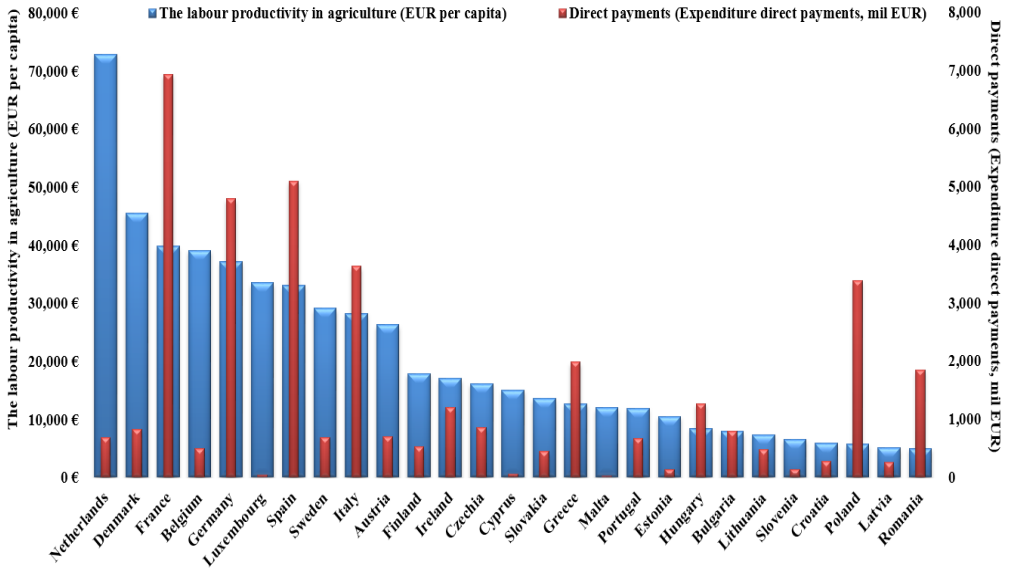


Source: Author's own representation, raw data source: Eurostat, 2020

Correlating the labor productivity in agriculture with the total utilized agricultural area in the EU-27, more discrepancies are observed. With the exception of France, Germany and Spain, the Northwestern European countries and more specifically: Netherlands, Denmark and Belgium are among the most labor-productive countries in the EU-27 in terms of agriculture, yet the total utilized area in those countries is below the average of the EU-27. With extremely limited areas dedicated for agriculture, the Netherlands

(1,822.4), Denmark (2,632.5) and Belgium (1,356.08) registered high values of labor productivity in agriculture in 2018 and they are in the top 5 best performing countries regarding this indicator. Unfortunately, Poland and Romania are not successfully harnessing their agricultural potential when reported to their total utilized agricultural area: 14,539.55 and 13,413.77 (1,000 ha UAA). Their labor productivity in agriculture represents only 6.76% of the Denmark's, Belgium's and Netherland's labor productivity in agriculture. On the other hand, Denmark's, Belgium's and Netherland's utilized agricultural area represents only 20.79% of Romania's and Poland's utilized agricultural area. The gap between the previously analyzed countries can be mitigated through specific measures through the CAP.

Figure 4. The labour productivity in agriculture (EUR per capita) in relation with the direct payments (expenditure direct payments, million EUR) per country UE-27, reference year: 2018



Source: Author's own representation, raw data source: Eurostat, 2020

The same type of relationship can be observed when considering the CAP direct payments (expenditure, expressed in million EUR) in relation with the labor productivity in agriculture. Results confirm that Romania's and Poland's labor productivity represents only 6.76% of the Denmark's, Belgium's and Netherland's labor productivity in agriculture, while the latter's direct payments sum up only to 38.02% of the expenditure made in Romania and Poland.

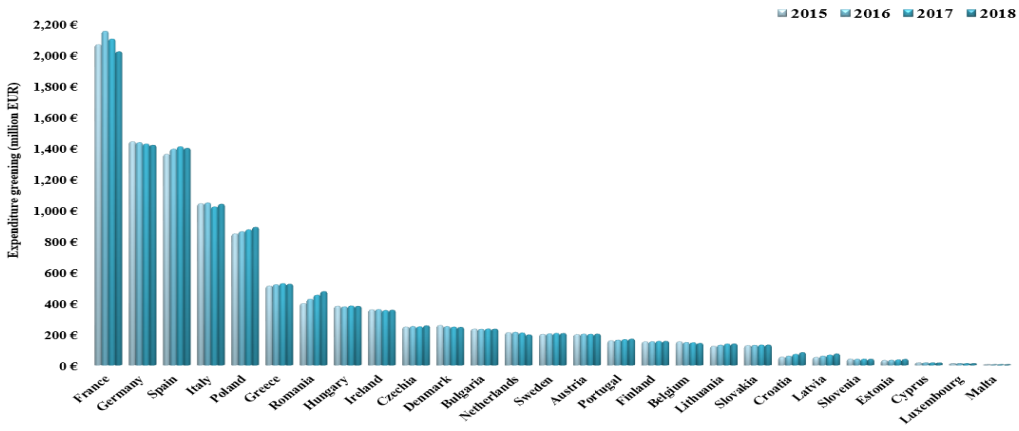
Consequently, through the CAP, the EU supports countries like Romania and Poland, with huge labor productivity gaps, yet countries with impressive agricultural areas when reported to the mean recorded in the EU-27. An emerging question is whether the CAP should be reevaluated in order to include the necessary instruments to finance investments and the transition to a more digitized agriculture with modern technologies

and equipment. Is the current distribution of the CAP budget structured well enough in order to ensure the success of countries such as Poland and Romania in their mission to converge to at least the average labor productivity in agriculture in the EU-27?

Countries such as France and Germany are competitive in terms of the labor productivity in agriculture and still the direct payment expenditure in these countries sum up to 30.75% on the total direct payments in the EU-27. Taking all these findings into account, one can notice that labor productivity in agriculture is definitely not tied to the direct payments expenditure, nor is it with the utilized agricultural area. Mitigating efforts in the sense of labor productivity convergence in the EU-27 is dependent on factors such as: fostering precision agriculture, ensuring investments in highly performant technologies and equipment, knowledge transfer and others. However, the volume of the direct payment expenditure needs to be considered differently in less productive countries, mainly because an important share of the total population relies on subsistence farming. In this context, CAP budget allocation becomes a double-edged sword.

One of the components of the first pillar of the CAP is meant to provide an additional support to offset the cost of delivering public environmental goods not remunerated by the market. This component can be referred to as the 'greening' component. Through this component of the first pillar, the CAP brings its contribution to the 13th goal of sustainable development, by integrating climate change measures and fostering green initiatives in the EU's agriculture.

Figure 5. The evolution of the greenhouse gas emissions from agriculture (1,000 tonnes of CO_2 equivalent), per country and year in the EU-27

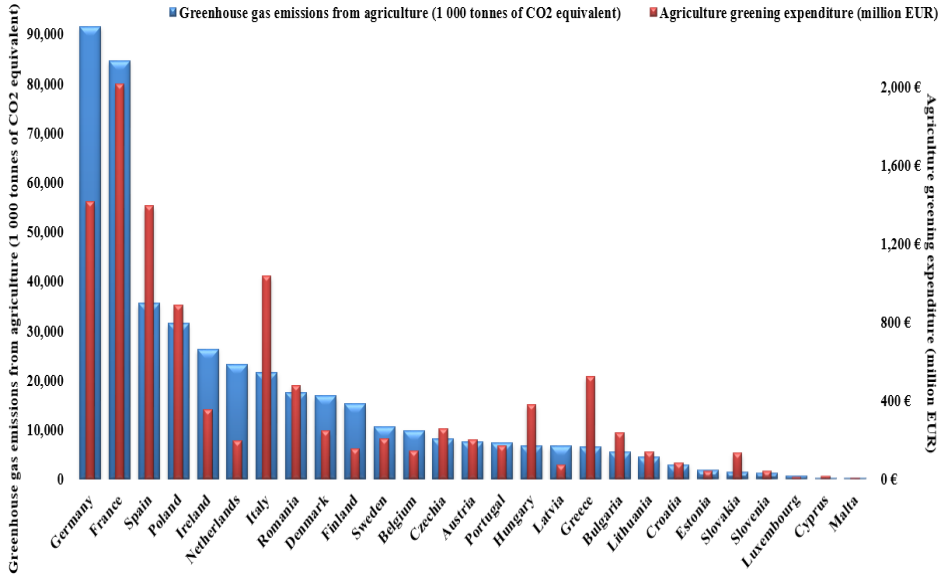


Source: Author's own representation, raw data source: Eurostat, 2020

Considering this, it is important to analyze the evolution of the greenhouse gas emissions generated by the agriculture of the EU-27 members. The trend should be descending judging from the perspective that the CAP finances green agricultural practices. At the level of the EU-27, the CAP successfully managed to decrease the volumes of the greenhouse gas emissions in 2018 by 0.32% (reported to 2017).

The biggest EU-27 contributor to the generation of greenhouse gas emissions, France, has reduced the volume of emissions by 2.34% in 2017 (reported to 2016) and 3.89% in 2018 (reported to 2017). By empowering green practices in agriculture, the EU-27 members converge towards a cleaner and sustainable agriculture. Regarding the Romania, the latter is the 7th biggest generator of greenhouse gas emissions from agriculture in the EU-27, with an average of 437.13 (1,000 tones of CO_2 equivalent) or 4.05% of the EU-27 members' emissions in the 2015-2018 period. The contribution of France, Germany and Spain (top 3 contributors) sum up to 34.2% of the total greenhouse gas emissions generated from agriculture (2015-2018).

Figure 6. The greenhouse gas emissions from agriculture (1,000 tonnes of CO_2 equivalent) in relation with the agriculture greening expenditure per country UE-27, reference year: 2018



Source: Author's own representation, raw data source: Eurostat, 2020

Correlating the greenhouse gas emissions from agriculture with the agriculture greening expenditure through the first pilar of the CAP, very few discrepancies can be noticed:

– The Netherlands and Ireland generate high volumes of greenhouse gas emissions (11.08%), yet receive only 5.1% of the sum of greening expenditure (EU-27), which signals the lack of green initiatives and practices in their agriculture;

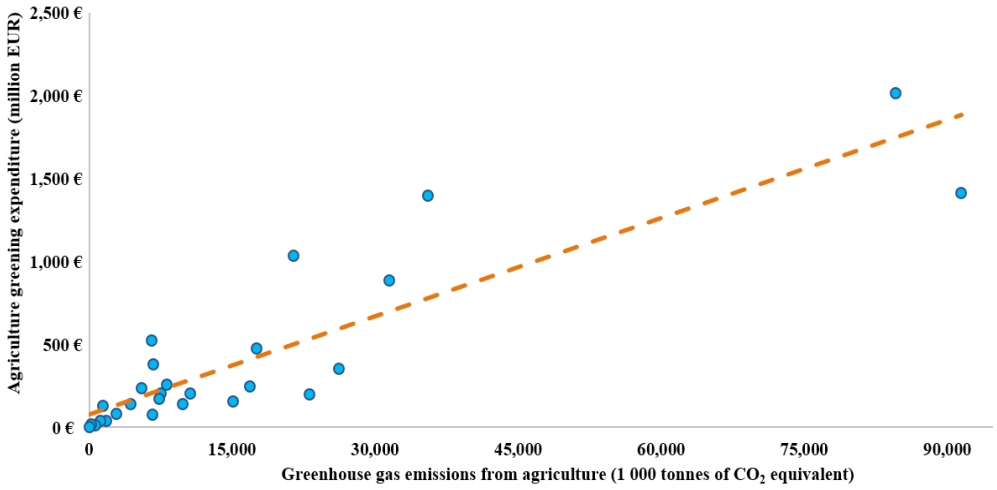
– Spain, Italy, Poland, Romania, Czechia, Hungary and Bulgaria are fond of eco-friendly practices in agriculture (14.70% of the total greening expenditure is allocated to those states) and produce only 16.60% of the greenhouse gas emissions in the EU-27

Even though the Netherlands is the most labor-productive country in agriculture in the EU-27, the same country encounters issues in the transition toward applying eco-friendly practices in agriculture. Germany, the biggest greenhouse gas emissions

generation from agriculture, follows the same pattern: even though 13.09% of the total greening expenditure is redirected to Germany, this percentage is not sufficient when considering that 20.56% of the total greenhouse gas emissions is generated by the German agriculture.

Regarding Romania's greening expenditure – greenhouse gas emission ratio, the latter is in the favor of the greening expenditure: 1.11. A much more favorable situation than in the case of Germany (0.63), let alone Ireland (0.55) the Netherlands (0.35), but greening the agriculture requires changes at the top of the list of the greenhouse gas emissions generators. Spain is the best example to be followed in this regard, the third generator of greenhouse gas emissions, yet with a greening expenditure – gas emissions ratio of 1.61. In the EU-27, the average of this ratio is 1.26, with a maximum value in the case of Slovakia (3.82) and minimum in the case of the Netherlands (0.35).

Figure 7. The scatter point of the greenhouse gas emissions from agriculture (1,000 tonnes of CO_2 equivalent) in relation with the agriculture greening expenditure per country UE-27, reference year: 2018



Source: Author's own representation, raw data source: Eurostat, 2020

Discussions

In 2018, in the EU-27, the greenhouse gas emissions from agriculture are highly positively correlated with the agriculture greening expenditure: 88.59%, which is statistically significant (*p-value* is 0.00). The existence of the high positive correlation and the scatter plot in Figure 7 confirm that a linear regression model can be constructed. This research method is quantitative, based on cross-section statistical data. The cross–sectional linear regression method was applied and the econometric model was designed in Table 1, considering the greenhouse gas emissions from agriculture as the independent variable and the agriculture greening expenditure was considered the dependent variable.

Table 1. The results of the cross–sectional linear regression performed in EViews

Estimation Command				
LS GreeningExpenditure C GreenhouseGasEmissions				
Estimation Equation				
GreeningExpenditure = C(1) + C(2) × GreenhouseGasEmissions + ε				
Substituted Coefficients				
GreeningExpenditure = 74.56021 + C(2) × 0.019771 + ε				
Dependent Variable: GreeningExpenditure; **Independent Variable**: GreenhouseGasEmissions				
Method: Least Squares				
Observations: EU-27, **Reference Year**: 2018				
Variable	**Coefficient**	**Standard Error**	**t–statistic**	**Prob.**
C	74.56021	57.50949	1.296485	0.2066
GreenhouseGasEmissions	0.019771	0.002070	9.553005	0.0000
R^2	0.784965	**Mean dependent var**	400.2304	
Adjusted R^2	0.776363	**S.D. dependent var**	508.9083	
S.E. of regression	240.6640	**Akaike info criterion**	13.87587	
Sum squared resid	1447979	**Schwarz criterion**	13.97186	
Log likelihood	-185.3242	**Hannan–Quinn criter.**	13.90441	
F–statistic	91.25990	**Durbin–Watson stat**	2.857815	
Prob (F–statistic)	0.00000			

Source: Author's own representation in EViews

R^2 indicates that 78.49% of the variation of the agriculture greening expenditure is explained by the greenhouse gas emissions from agriculture. In order to mitigate the mechanical increase in the coefficient of determination, Adjusted R^2 validates the model, taking into account that there is a drop only from 78.49% to 77.76% between the coefficient of determination and the Adjusted R^2. The Durbin–Watson statistic, a test for autocorrelation in the residuals of the model, indicates that successive error terms are slightly negatively correlated, because the value corresponding to this statistic is 2.857815. However, the value is considered acceptable, as the number of observations is limited.

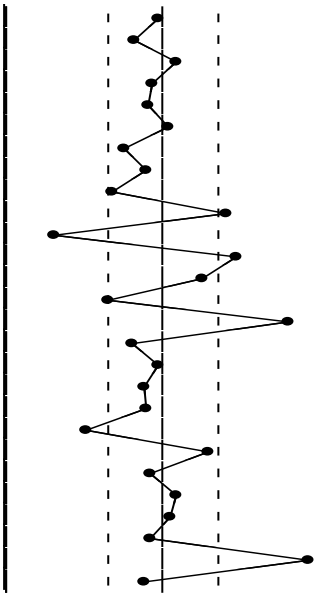
The Student-t values of the parameters are calculated in the t–Statistic column. In the case of this econometric model, the value associated to the independent is below the 0.05 threshold, but 0.20 in the case of the dependent variable. Despite being above the 0.05 threshold, this can be accepted considering that the model only refers to a small group of observations: EU-27. This result signals the fact that generating more

greenhouse gas emissions from agriculture in the case of the EU-27 members involves higher expenditure through CAP for greening the agriculture sector.

Considering the equation of the econometric model, should the greenhouse gas emissions be situated around the mean in the EU-27, 16,472 (1 000 tonnes of CO_2 equivalent), then these explain expenditure for agriculture greening in that respective country of 400.228122 million EUR (calculated: 74.56021 + (0.019771 × 16.472)). The model successfully predicted the agriculture greening expenditure, considering that the EU-27 mean in 2018 was 400.23036 million EUR. The equation of the designed econometric model signals the fact that, through the CAP, sustainable production patterns in agriculture is financed, especially in those countries where the transition to a cleaner agriculture is considered a priority.

Table 2. The residuals and the residual plot of the econometric model

Austria	200.916	223.754	-22.8384
Belgium	141.591	268.268	-126.677
Bulgaria	233.376	182.603	50.7733
Croatia	82.4704	131.743	-49.2722
Cyprus	14.4434	78.9189	-64.4756
Czechia	254.411	235.427	18.9838
Denmark	244.420	407.546	-163.126
Estonia	39.1140	109.442	-70.3284
Finland	154.602	373.900	-219.298
France	2015.33	1746.01	269.322
Germany	1414.44	1882.70	-468.264
Greece	521.450	204.395	317.055
Hungary	379.344	208.109	171.234
Ireland	354.718	592.852	-238.134
Italy	1035.47	498.524	536.947
Latvia	73.6721	206.683	-133.011
Lithuania	137.986	160.865	-22.8793
Luxembourg	9.77344	87.8705	-78.0970
Malta	0.53170	75.9072	-75.3755
Netherlands	196.252	530.660	-334.408
Poland	887.361	696.905	190.456
Portugal	169.206	220.493	-51.2865
Romania	474.579	421.710	52.8693
Slovakia	130.958	102.462	28.4959
Slovenia	39.8166	97.5648	-57.7482
Spain	1394.88	777.064	617.818
Sweden	205.107	283.844	-78.7366



Source: Author's own representation in EViews, raw data source: Eurostat, 2020

Based on Table 2 Germany, Italy and Spain are the most important outliers which cause divergence between the EU-27. These three countries encounter issues in fitting into the linear regression model, as it can be noticed in the residual plot from Table 2. One the one hand, Germany generates more greenhouse gas emissions than it can attract funds for greening its agriculture. On the other hand, Italy and Spain act as role models for sustainable production patterns in agriculture, since they successfully attract more funds for practicing a cleaner agriculture. Another question emerges in this context: should the CAP adjust and limit the amount of funds distributed to countries which generate less greenhouse gas emissions (reported to the EU-27 mean) in order to influence other EU-27 members (such as Germany) to foster sustainable production patterns in agriculture through higher volumes of agriculture greening expenditures?

Conclusions

In today's knowledge society, agriculture still has a crucial role in meeting the goals of sustainable development. Agriculture significantly contributes to capitalizing the national economic potential through harnessing the natural capital's potential.

In the European Union, the Common Agricultural Policy aims to increase agricultural productivity through various methods; to stabilize markets; to ensure fair standard of living for farmers and reasonable prices for consumers – therefore CAP aims at providing food security for the EU citizens, but in a complex manner that ensures sustainable development, the transition toward the green and circular economy, diverse and prosperous in the rural areas. The latter should not be dependent on agricultural activities.

This study aimed at analyzing the evolution of the Romanian agriculture through the lens of the new CAP paradigm, which is much more focused on the need for agriculture to become green and circular. This study's contribution resides in highlighting the major issues related to the effects of the evolution of the Common Agricultural Policy on the Romanian agriculture in terms of accelerating or decelerating the convergence, divergence or imposing a major need for adjustments.

The evolution of the labor productivity in agriculture (EUR per capita) points to the divergence between the Northwestern European countries and those from the Eastern Europe and the Baltics. The most negatively affected countries by the labour productivity gap are Romania (4,955 EUR/capita), Latvia and Poland. Correlating the labor productivity in agriculture with the total utilized agricultural area in the EU-27, more discrepancies are observed. Northwestern European countries such as: Netherlands, Denmark and Belgium are among the most labor-productive countries in the EU-27 in terms of agriculture, yet the total utilized area for agriculture in those countries is below the average of the EU-27 – which is a favorable situation for those countries. The same type of relationship can be observed when considering the CAP direct payments in relation with the labor productivity.

Regarding the sustainable development in agriculture, the link between the greenhouse gas emissions from agriculture and the agriculture greening expenditure through the first pilar of the CAP were analyzed and very few discrepancies were noticed in the EU-27. Because the greenhouse gas emissions from agriculture are highly positively correlated with the agriculture greening expenditure (88.59%), a simple linear estimation model was designed. Based on the coefficient of determination, 78.49% of the variation of the agriculture greening expenditure is explained by the the greenhouse gas emissions from agriculture. Germany, Italy and Spain are the main EU-27 Member States that act as outliers (divergence causes) in the constructed econometric model.

The next financial framework should act as a main vector for delivering convergence in the agricultural sector in the EU-27. Romanian agriculture is facing multiple challenges: catching up to the competitiveness gap and meeting the sustainable development goals.

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Conflict of interests

The authors declare no conflict of interest.

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