Analysis of impact of rural development subsides on cropping specialization in Bulgaria and Romania using FADN data

NICOLA GALLUZZO

ASGEAR (Association of economic and geographical studies of rural areas)
Rieti, Italy
asgear@libero.it

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Abstract. *Bulgaria and Romania are characterized by a higher percentage incidence of rural population than other European nations and a significant diffusion of less favoured areas with limited agricultural surfaces as well. The objective of this paper was to investigate, via a quantitative approach, effects and relationships among funds allocated by the second pillar of the Common Agricultural Policy on cropping specialization. Furthermore, subsidies and other financial supports assigned by specific agricultural and rural policies have had a positive role in areas at risk of marginalization and characterized by out migration issues.*
In the quantitative analysis we used the data published by the European Union in the Farm Accountancy Data Network (FADN) since 2007 to 2012. In Bulgaria, as a consequence of a greater diffusion of large size farms, the financial subsides allocated by the EU, throughout Single Area Payment Scheme and towards crops have been significant in Romania and Bulgaria. Romania has pointed out a positive impact of financial aids paid to less favoured areas in order to reduce the rural marginalization and countryside depopulation.
Keywords: *Farm Accountancy Data Network, less favored rural areas, Single Area Payment Schemes, Kohonen's map*

JEL code: Q15, R14

1.Introduction

Since 2007 Bulgaria and Romania are become part of the European Union. These two countries are characterized by a higher percentage incidence of rural population than other European nations and a significant diffusion of less favoured areas, specifically in Romania, with limited agricultural surfaces. Farmers in disadvantaged rural areas carry out an irreplaceable role in environmental protection strengthening the multifunctionality in these areas, which need of financial subsides aimed in one side at implementing a generational turnover in the countryside and also at changing farm's rural activities throughout incentives towards exogenous actions of financial and credit support allocated by banks (Galluzzo, 2015; Badulesco et al., 2015). The reshaping and shifting of the traditional agrarian model to new diversified activities and crops in small farms managed by a new generation of young farmers should be able to implement their level of investments and efficiency using both financial supports disbursed by the European Union and also by an expansion of their small scale of production in terms of land (Badulesco et al., 2015; Sarris et al., 1999; Hedges, 1999; van der Ploeg and Roep, 2003).

Aftermath the fall of Berlin's wall, there has been a significant transition from a communist agrarian productivist model to a post communist one, which has implied some impacts to small scale farms influencing also decision processes of policy makers in order to face with this socio-economic transformation (Kostov and Lingard, 2002). This transition was particularly severe in some rural areas, far away from the traditional urbanized areas, as a consequence of a low level of investments in innovation in terms of agrarian capital and new technologies (Jordan, 2009). This author has argued as in declining rural areas of Romania and Bulgaria there has been a growth of migration towards rich urban territories as a consequence of the change in the productive model and in poor possibilities and ability of farmers in implementing the level of efficiency and investments. Assessing the allocation of financial subsides allocated by the Common Agricultural Policy, some scholars have argued that these latter have had a different impact on farm efficiency in several European countries (Zhu and Lansink, 2010).

Comparing Romania to Bulgaria the main meaningful characteristic is a high incidence of mountainous areas particularly in the former country (Cunder, 2001; Brower, 2004) even if both states did not put into action any measures in order to incentivise and to protect stayed

behind rural areas by an allocation of specific financial supports before the European Union enlargement in 2006 (Dax, 2001). In fact, considering the level of other typologies of financial subsidies disbursed by the European Union, such as direct payments per hectare, in some new comers member states of the EU it is possible to observe as financial payments in Romania are lower than the average European value (Velasquez, 2008).

Previous studies have demonstrated before the enforcement of Agenda 2000 in many European countries with a deep-rooted agricultural tradition, started over the MacSharry reform, there has been a greater impact of direct payments paid by the first pillar on the gross agricultural revenue with several positive effects on the income distribution among farmers (Keeney, 2000; Frawley and Keeney, 2000). Schmid et al. in 2006 have carried out in Germany a study in order to assess the role of financial subsides allocated by the second pillar of the Common Agricultural Policy, particularly towards less favored areas, in reducing the income inequality in comparison to the subsides allocated in order to incentive the agri-environment actions and direct payments (von Witzke and Noleppa, 2007) pointing out as direct payments have been more efficient than other typologies of financial aids provided by the CAP despite they have had an unequal distribution to small size farms (von Witze and Noleppa, 2006). In fact, Romanian small farms, marked out by low level of income, have benefited partially of direct payment allocated by the CAP than the very large farms generating an unstable distribution of subsidies (Cionga et al., 2008)

Despite Bulgarian and Romanian farms have pointed out a low level of production of public goods and positive externalities in order to protect the environment due to low amount of resources allocated by national and European administrations and a limited level of national agricultural GDP, an implementation of financial supports should be able to increase biodiversity with positive environmental effects (Zahrnt, 2009). Specifically, small farms located in disadvantages rural areas in Bulgaria and in Romania as well, should benefit of agri-environmental payments keeping *in situ* traditional farms and reducing socio-economic marginalization and environment degradation in the countryside (Jitea et al., 2015).

2. Aim of the research

The objective of this paper was to investigate, via a quantitative approach, the effects and relationships among funds allocated by the second pillar of the Common Agricultural Policy on the cropping specialization and farm net income. In fact, Shucksmith et al. in 2005 argued that more specialised are regions in agricultural productions and larger are the agricultural areas higher are premiums and financial subsides, which have had some effects on the geographical and productive specialization in several European countries and particularly in new member states of the EU such as Bulgaria and Romania. Furthermore, aid and other financial supports assigned by specific agricultural and rural policies, such as payments to less favoured territories, have had a positive role in areas at risk of marginalization and characterized by out migration issues (Dax, 2001).

In this quantitative analysis we have used the data published by the European Union in the Farm Accountancy Data Network (FADN) since 2007 to 2012. The goal of this annual standardised survey is to assess the impact of the CAP payments and other initiatives towards farmers.

The main question of the research is: do the subsidies allocated by rural development and by the Single Area Payment Schemes act on the cropping specialization in Romanian and Bulgarian farms? Specifically in Bulgaria, as a consequence of a greater diffusion of large size farms, have been the financial subsides allocated by the EU, in favour of the Single Area Payment Scheme and towards crops more significant than in Romania? This latter country, instead, has pointed out a positive role of financial aid paid to disadvantaged areas on the cropping specialization (cereals and grassland).

The Single Area Payment Scheme, according to the European Commission, is a transitional, simplified support of farmer's income, tailored specifically for the new comers of the European Union, aimed at implementing the level of direct payments dividing, in function of the hectares of utilized agricultural area, the annual financial envelope.

3. Methodology

In this paper we have used a quantitative approach proposed by Kohonen in Self Organizing Maps (SOM) utilizing the open source software Orange Canvas 2.7. The SOMs are able to obtain an unique winner neuron pointing out some main relationships among analysed variables in turn (Kohonen, 2001), such as farm net income and financial subsides allocated by the CAP, in the same identical way as the Principal Component Analysis, reducing the complexity in a dataset and visualizing in an unique map the best neuron and the main relations among variables (Mehmood et al., 2011).

The Kohonen's maps have been more sensitive to highlight the effect of financial subsides disbursed by Common Agricultural Policy in Bulgaria than in Romania and it has pointed out the unique winner neuron, which in the map is a black hexagon, during the time of study in few investigated variables. General speaking, the black and grayish hexagons in the maps are zones where there is the highest level of clustering close to the winner neuron and the white ones are the opposite or rather white hexagons are neurons far away from the winner neuron (Kohonen, 2001).

In general Self-Organizing Maps are particularly useful to estimate in time series the structure and the evolution of detected variables obtaining an unique parameter summarizing different aspects and visualizing different clusters (Kasky and Kohonen, 1996; Mehmood et al., 2011). The main advantage of SOMs is to obtain a pattern able to classify homogenous clusters preserving their dissimilarities (Kohonen, 1984). The Kohonen's maps are based on a method of unsupervised learning process in a limited sized space provided that the topological properties of an input space or stimulus come from the outside (Kohonen, 2001). The SOM is a neural network where each artificial output neuron is arranged in grids based on a lower dimension in connection to all neurons of input (Haykin, 1999). Each input or stimulus is connected to other neurons of the output by a weight vector assessed in order to define the position of a centroid in the space (Lucchini, 2007). Weights assigned to the neurons are initialized either as random numbers or as small values sampled uniformly from a subspace crossed by two wider eigenvectors main components hence, initial weights are a good approximation of the weights in the SOM (Kasky and Kohonen, 1996).

The network in the SOM is characterized by a pattern in two layers, one layer is made up by input and the other layer commonly called Kohonen's layer is constituted by output (Kohonen, 2001). The neurons of the two layers are completely connected to each other, while neurons of the output layer are linked to different output neurons (Kohonen, 1984). In the layer of output neurons there is an unique winner neuron which takes all; hence, as a consequence of a system of interactions of lateral inhibitions and excitations in function of the distance from the winner neuron some neurons close to the winner are exited and other neurons, more distant from the winner neuron, are inhibited generating a function similar to a Mexican hat (Kohonen, 1984). In this simplified competitive network the winner neurons have a value equal to the value 1 if the input neurons are close enough to the Best Matching Unit (BMU) and 0 otherwise. The magnitude and the level of excitation or inhibition of different weights in neurons are a function of their geometrical distance between neurons on the lattice generating a typical function like a Mexican hat whose values are included in a range from 0 to 1 (Kohonen, 1984; Kasky and Kohonen, 1996). The intensity of the approach process decreases over time and it is in function of the distance of neurons from the BMU (Kohonen, 2001).
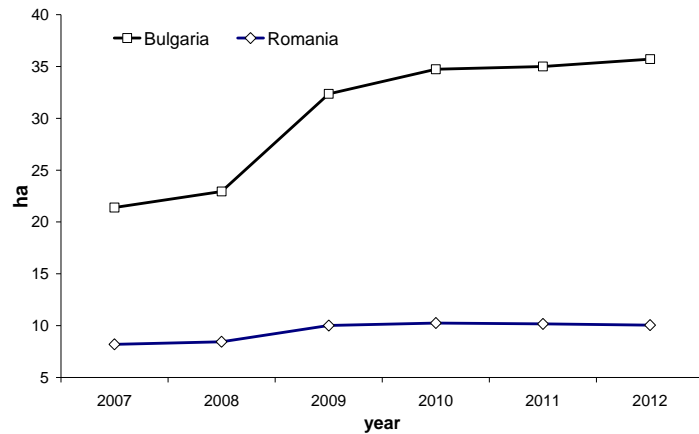
Fig. 1- Total agricultural surface in the FADN dataset over the time *(Source: our elaboration on data http://ec.europa.eu/agriculture/ricaprod/database/database_en.cfm)*
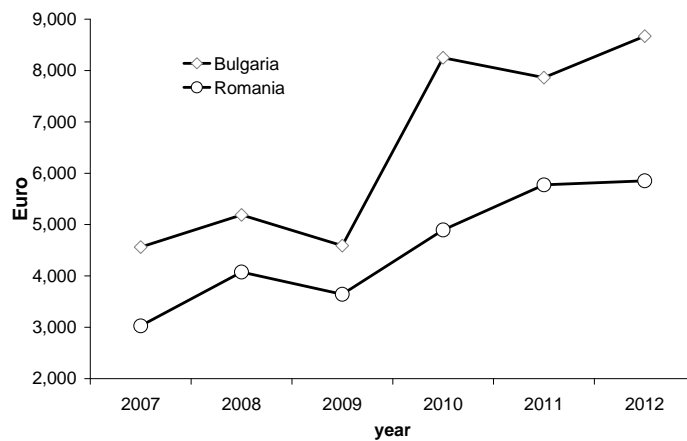

Fig. 2- Farm Net Income in investigated states over six year time *(Source: our elaboration on data http://ec.europa.eu/agriculture/ricaprod/database/database_en.cfm)*
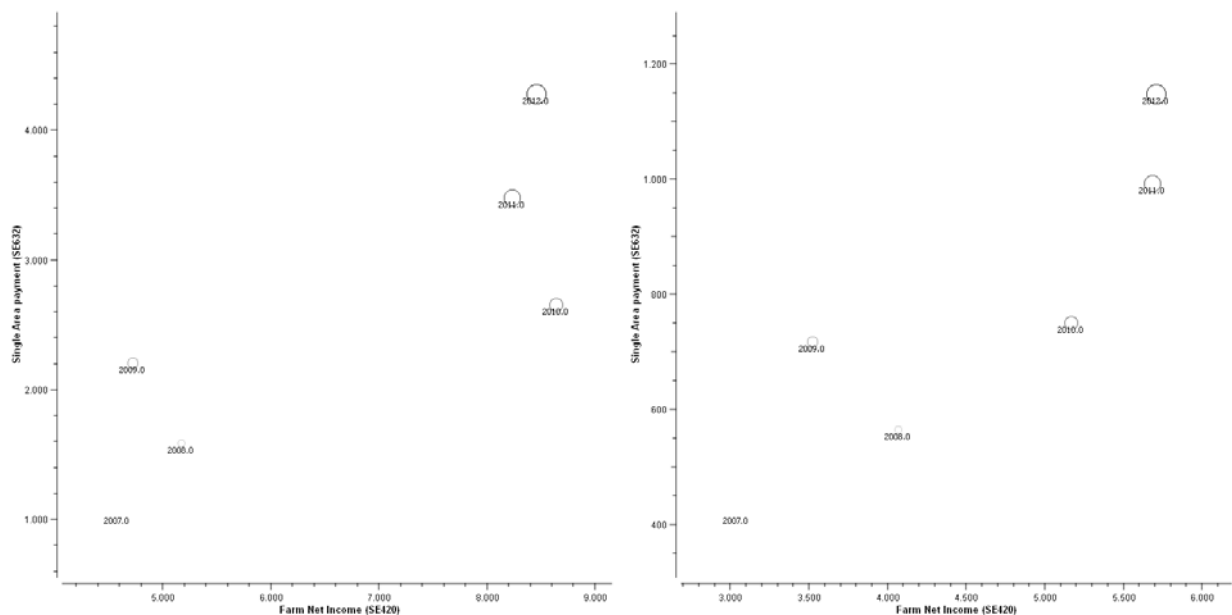

Fig. 3- Different correlations between the level of SAPS and Farm Net Income in Bulgaria (left) and Romania (right). *(Source: our elaboration on data http://ec.europa.eu/agriculture/ricaprod/database/database_en.cfm)*
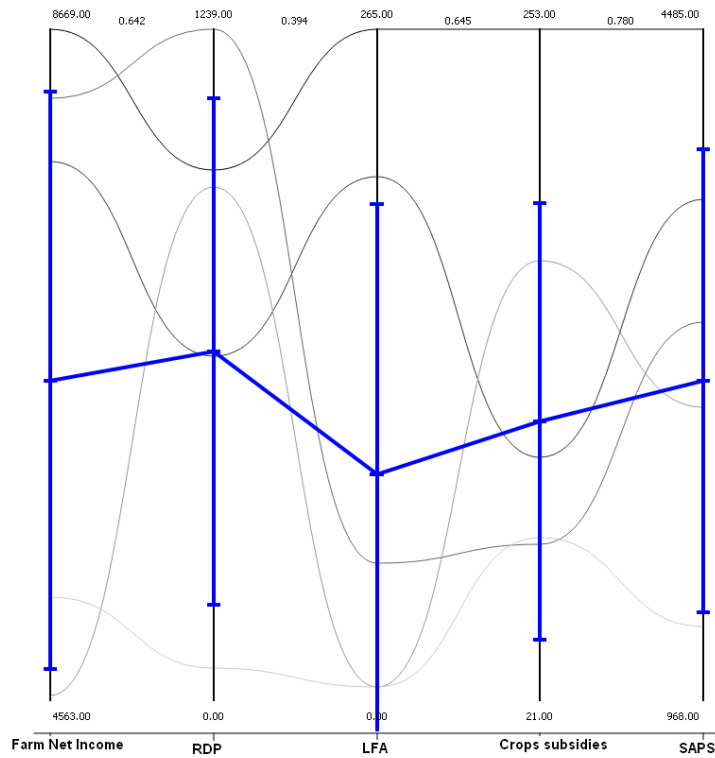
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Fig 4- Main correlations about variables in the analyzed Bulgarian FADN dataset *(Source: our elaboration on data http://ec.europa.eu/agriculture/ricaprod/database/database_en.cfm)*
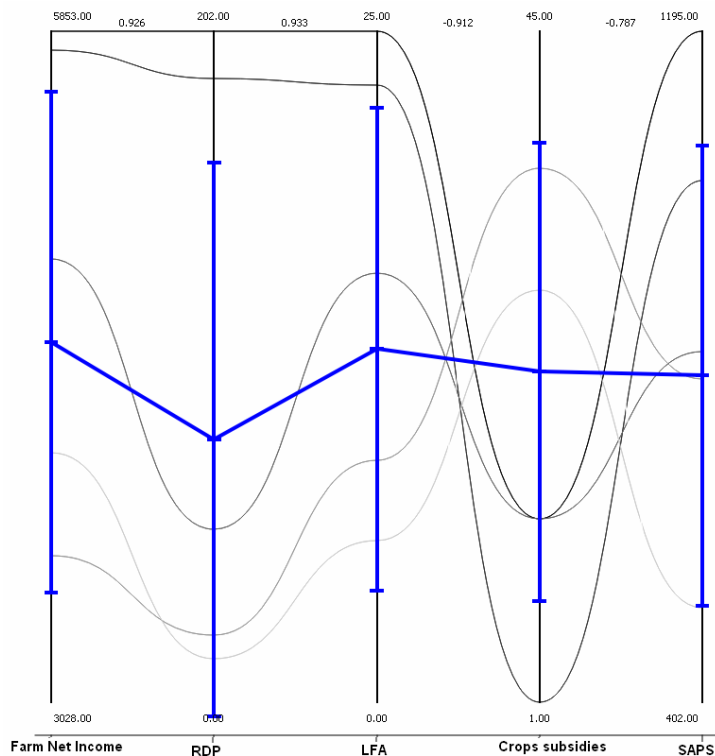

Fig 5- Main correlations about variables in the analyzed Romanian FADN dataset *(Source: our elaboration on data http://ec.europa.eu/agriculture/ricaprod/database/database_en.cfm)*
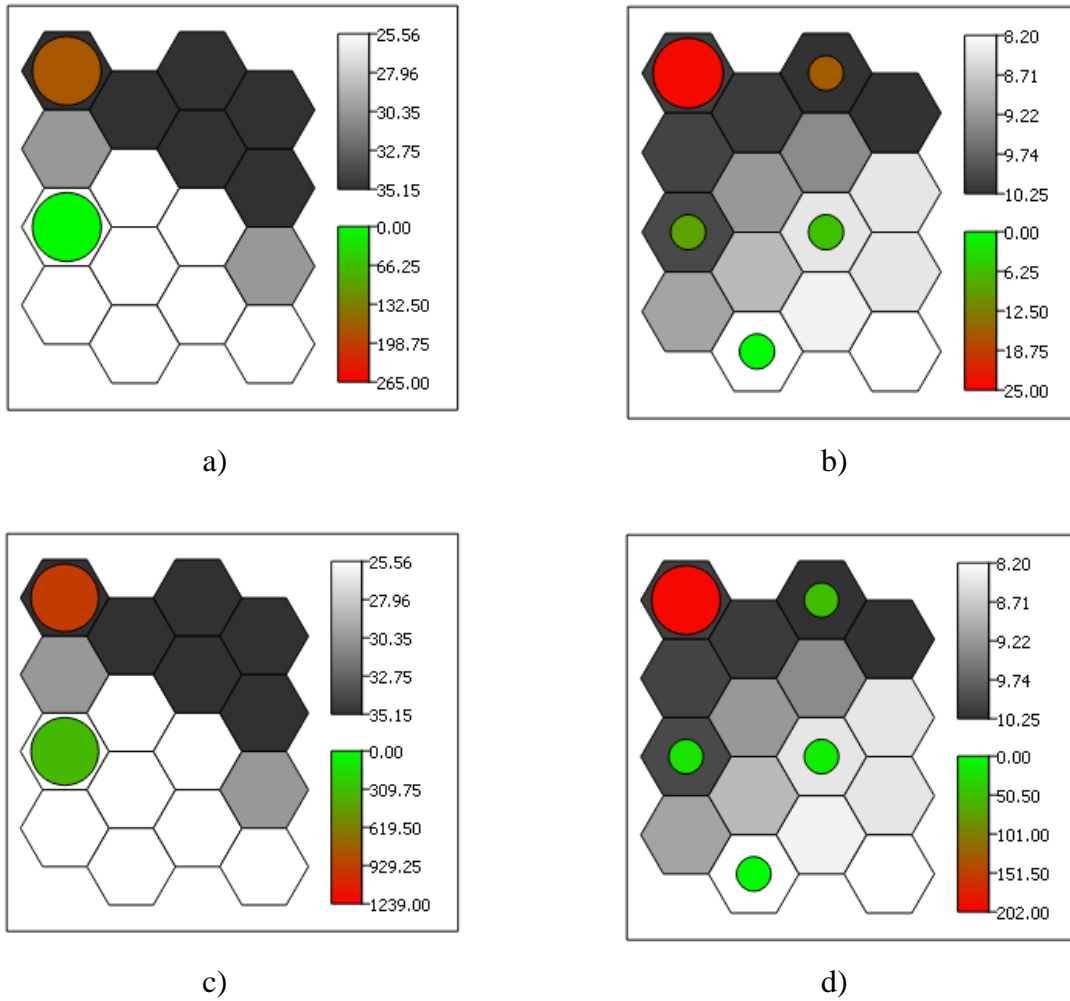
a)

b)

c)

d)

Fig. 6- Relationships among total agricultural surface (black scale) and payment to less favoured rural area or LFA (coloured scale) in Bulgaria (a) and in Romania (b) and among total agricultural surface and financial subsides allocated by the II pillar of the CAP in Bulgaria (c) and in Romania (d). *(Source: our elaboration on data http://ec.europa.eu/agriculture/ricaprod/database/database_en.cfm)*
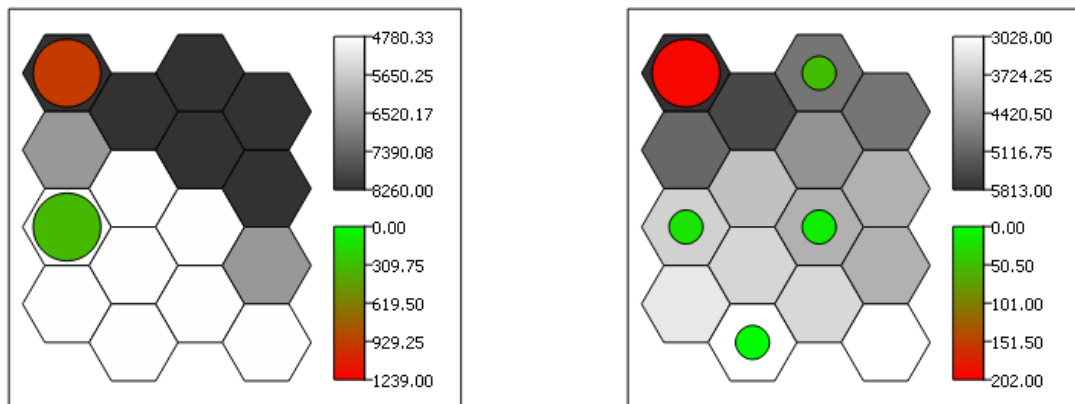

Fig 7- Main results in SOMs correlating Farm Net Income (black scale) and payments disbursed by the Rural Development Plan (coloured scale) in Bulgaria (on the left) and in Romania (on the right). *(Source: our elaboration on data http://ec.europa.eu/agriculture/ricaprod/database/database_en.cfm)*

4. Results and discussion

Findings of the evolution of the total agricultural surface has pointed out as Romanian farmers have smaller size agrarian surface than Bulgarian ones and since 2008 there has been a significant arising of the surface, which leveled off in 2010, with a value above 30 hectares, that is one third of agrarian surface found out in Romania (Fig.1). Focusing the attention on the Farm Net Income it arose constantly in both states even if, considering the poor dimension of Romanian farms, outcomes were better in Romania than in Bulgaria (Fig. 2).

The main relationships among Farm Net Income and Single Area Payments Scheme (SAPS) have stressed a direct correlation and an increase over the time of study, even if the Bulgarian farmers have got higher level of SAPS than Romanian ones (Fig. 3).

The analysis of relationships among variables in Bulgarian FADN dataset has pointed out a direct correlation between Farm Net Income and total financial subsides allocated by the Common Agricultural Policy and between financial aids disbursed towards disadvantaged areas and financial payments allocated in the Rural Development Plan (Fig. 4). The highest result of correlation has been stressed between the variables total financial subsides allocated to crops and SAPS.

In Romania the FADN dataset Farm Net Income correlates directly to the total amount of subsidies allocated by the CAP (Fig.5); an indirect correlation has been found between the variables total subsidies on crops and Single Area Payments Scheme. The highest result of correlation has been stressed between the total financial subsides allocated by Common Agricultural Policy and payments in favor of disadvantaged rural areas.

In Bulgaria the farms with highest level of usable agricultural surface have highlighted the highest level of direct payments in favour of disadvantaged areas hence, in general, findings in Self-Organizing Maps have pointed out as small size farms have received poor amounts of financial subsides (Fig. 6a); Romanian farms have stressed as an increase of usable agricultural surface has implied an implementation of direct payments towards farms located in disadvantaged areas (Fig. 6b).

Total financial supports paid by the second pillar of the CAP in National Rural Plans have been correlated to farms characterized by large agrarian surfaces both in Bulgaria and also in Romania (Figg. 6 c-d).

The main relationships between Farm Net Income and financial subsides allocated by the Rural Development Plan initiatives have pointed out over five year time of investigation a direct correlation to the farm size (Fig. 7), corroborating the hypothesis argued by Shucksmith et al. in 2005.

A most positive direct correlation has been found in Bulgarian farms and also in Romanian ones considering the variables cereals crops and financial subsides allocated by the Single Area Payment Scheme (Figg. 8 a-b). The forage cultivations in Romanian FADN dataset has stressed a more significant diffusion than Bulgarian areas in terms of grayish hexagons in Kohonen's maps even if in general high amount of subsidies paid by Single Area Payments Scheme are in favour of farms with large forage surfaces (Figg. 8 c-d).

In Bulgarian farms part of the FADN dataset the level of Single Area Payments doubled the amount allocated by the EU towards Romanian farms even if in few cases small permanent surfaces have benefited of a poor amount of Single Area Payments (Figg. 8 e-f). Fruit and vegetables areas in the FADN dataset have pointed out in Kohonen's maps in Bulgaria a direct correlation between large agrarian surface and high amount of Single Area Payments paid; in Romania some small farms with a surface cultivated with vegetables and fruits have benefited of SAPS close to 1,200 euros per hectare otherwise the average value was below 700 euros per hectare (Fig. 8 g-h).
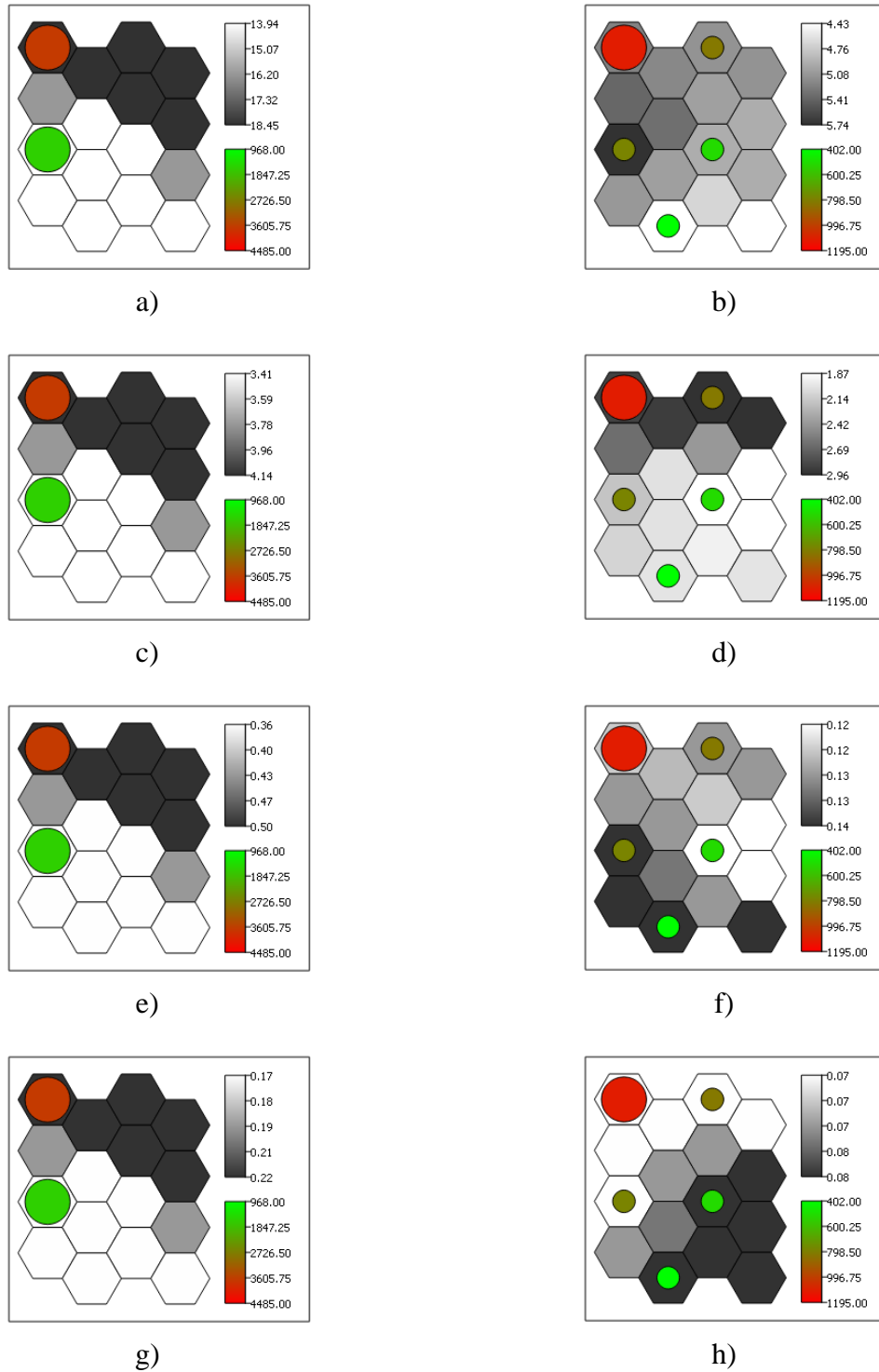
Fig. 8- Kohonen's maps comparing the variables cereals crops and Single Area Payments Schemes (SAPS) in Bulgaria (a) and Romania (b), forage surface and SAPS in Bulgaria (c) and Romania (d), permanent crops and SAPS in Bulgaria (e) and Romania (f), fruit and vegetables and Single Area Payments Schemes in Bulgaria (g) and Romania (ha). *(Source: our elaboration on data http://ec.europa.eu/agriculture/ricaprod/database/database_en.cfm)*

5. Conclusions and final remarks

Despite the short term of investigation and the first and foremost peculiarities of Bulgarian and Romanian farms, findings have pinpointed a positive but differentiated role of

aids and financial supports disbursed by the European Union in order to solve territorial inequalities and in promoting a different territorial agricultural specialization of these two countries.

In general the size of farm is pivotal in influencing rural disparities and for the future the actions of national and European authorities should be addressed to small farms, predominantly scattered in Romania, to reduce the marginalization of stayed behind rural areas fostering the diversification of farm's activity by rural tourism or other activities with a nexus to the countryside.

Summing up, a direct correlation has been detected between the Single Area Payments Schemes and crop specialization even if, as a consequence of the shrinking of SAPS funds, it should be pivotal to stimulate significantly direct payments in favour of disadvantaged rural territories. This last aspect is fundamental in Romanian farms located in the north and in the south of the country, having these regions a huge diffusion of farms with small agrarian surface, which are at severe risk of rural out migration due to level of income for labor unit not efficient and lower than 5,000 euros.

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