THE EVOLUTION OF THE RELATIVE POSITION OF 15 EU MEMBER STATES REGARDING ORGANIC AGRICULTURE

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Abstract: The negative environmental impact of modern agricultural practices, the increased use of non-renewable resources and the long-term productivity of high external inflows in cultivation systems has led many governmental and non-governmental organizations to take various initiatives in order to promote the adoption and expansion of more sustainable agricultural technologies such as the organic agriculture. The purpose of this study is to investigate the degree of organic agriculture practices adoption in 15 EU member states during 1998-2008. To succeed in this purpose, the methods of Data Analysis, Factorial Correspondence Analysis and Hierarchical Classification were used. The research results showed that although organic agriculture is implemented in all member states of the EU, there are many deviations among them concerning the degree of adopting. Moreover, findings revealed that Austria, Sweden and Finland were the countries with the highest performance concerning both their degree of adopting organic agriculture practices and the rates of holdings that integrated into the organic agriculture program.

Key words: organic agriculture, data analysis, factorial correspondence analysis, hierarchical classification.

Introduction

Organic agriculture has increasingly been drawing the attention of both producers and consumers, as it aims at the creation of a sustainable cultivation system; this system has the advantage of powering and protecting nature and its landscapes as well as of reducing the environmental damage caused by the existing cultivation practices (Pacini et al., 2003; Oxouzi, 2008) that have harmed biosystems through high chemical inflows.

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Today, organic agriculture is a realistic and feasible proposal within the bounds of a new agricultural model, in a constantly changing and competitive environment. It is a typical case of adopting new technologies and innovations that can lead to a qualitative differentiation of the agricultural production (Pantzios et al., 2002) and it is also considered to be a model that can possibly enhance viability in agriculture (Padel et al., 2002).

The purpose of this study is to analyse the evolution of the relative position of 15 EU member states, as regards their degree of adopting organic agriculture, so as to detect the application of organic agriculture practices in these member states. The analysis is based on two indicators, the rate of areas (‘Areas under Organic Management’) and the rate of agricultural holdings (‘Holdings under Organic Management’) under organic management in every EU member state in order to draw the necessary conclusions concerning the relative position of the EU members during 1998-2008.

### Material and Methods

Factorial Correspondence Analysis and Hierarchical Classification were the methods used for studying the application of organic agriculture practices in the 15 EU members during 1998-2008 (Benzecri, 1980). Data were analysed using Chic Analysis software v.1.0 (Markos et al., 2010).

Table 1. Areas under organic management (%).

| Country | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---------|------|------|------|------|------|------|------|------|------|------|------|
| A       | 8.4  | 8.41 | 8.64 | 11.3 | 11.6 | 12.9 | 13.53| 14.16| 13   | 13.4 | 15.9 |
| B       | 0.8  | 1.4  | 1.61 | 1.45 | 1.74 | 1.71 | 1.66 | 2.1  | 2.3  | 2.6  |
| DK      | 3.5  | 6.0  | 6.51 | 6.65 | 6.19 | 5.76 | 5.62 | 5.3  | 5.4  | 5.6  |
| FIN     | 5.4  | 6.3  | 6.73 | 6.6  | 7.0  | 7.2  | 7.31 | 6.52 | 6.4  | 6.5  | 6.6  |
| FR      | 0.8  | 1.1  | 1.23 | 1.4  | 1.7  | 1.7  | 1.8  | 2.03 | 2.0  | 2.1  |
| D       | 2.4  | 2.64 | 3.2  | 3.7  | 4.1  | 4.32 | 4.52 | 4.74 | 4.8  | 5.1  | 5.4  |
| EL      | 0.45 | 0.61 | 0.72 | 0.89 | 0.83 | 0.7  | 0.84 | 0.9  | 1.0  | 1.1  |
| I       | 3.9  | 5.94 | 6.76 | 7.94 | 8.0  | 6.86 | 6.22 | 8.4  | 9.0  | 9.1  | 7.9  |
| L       | 0.6  | 0.8  | 0.81 | 1.71 | 2.0  | 2.0  | 2.49 | 2.51 | 2.8  | 2.6  | 2.7  |
| NL      | 1.15 | 1.15 | 1.42 | 1.94 | 2.19 | 2.17 | 2.49 | 2.49 | 2.5  | 2.5  | 2.6  |
| P       | 0.8  | 1.2  | 1.31 | 1.8  | 2.2  | 3.17 | 5.42 | 6.34 | 7.3  | 5.9  | 6.6  |
| E       | 1.1  | 1.4  | 1.3  | 1.66 | 2.28 | 2.84 | 2.87 | 3.2  | 3.7  | 3.2  | 4.5  |
| S       | 4.1  | 5.5  | 5.2  | 6.3  | 6.09 | 6.8  | 6.8  | 6.27 | 7.1  | 9.9  | 10.8 |
| UK      | 0.5  | 1.2  | 3.33 | 3.96 | 4.22 | 4.42 | 4.39 | 3.9  | 3.8  | 3.6  | 4.6  |
In this study, two indicators are used so as to identify the degree of adopting this alternative production system. More specifically, this study examines the evolution of the relevant position of 15 EU member states (during 1998-2008) as regards their degree of adopting organic agriculture, based both on the total number of areas (1st variable: ‘Areas under organic management’ = number of hectares under organic management to the country’s total number of hectares-computed as %) and on the total number of agricultural holdings (2nd variable: ‘Holdings Under Organic Management’ = the number of holdings under organic management to the country’s total number of agricultural holdings-computed as %) (Tables 1 and 2). Both variables are studied, however, individually or additionally so as to obtain a full and much more inclusive analysis of the phenomenon.

Table 2. Holdings under Organic Management (%).

| Country | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---------|------|------|------|------|------|------|------|------|------|------|------|
| A       | 8.80 | 7.31 | 8.42 | 9.30 | 9.20 | 9.50 | 11.30| 11.49| 11.80| 11.70| 11.80|
| B       | 0.70 | 0.82 | 0.83 | 1.03 | 1.23 | 1.10 | 1.37 | 1.37 | 1.40 | 1.50 | 1.70 |
| DK      | 3.50 | 4.92 | 6.40 | 5.58 | 5.88 | 6.10 | 5.50 | 6.04 | 5.80 | 5.90 | 5.70 |
| FIN     | 5.50 | 6.60 | 6.60 | 6.40 | 6.80 | 6.60 | 6.00 | 6.12 | 5.70 | 5.70 | 5.70 |
| FR      | 0.90 | 1.20 | 1.37 | 1.55 | 1.55 | 1.70 | 1.71 | 2.03 | 2.00 | 2.10 | 2.30 |
| D       | 1.80 | 1.95 | 2.93 | 3.28 | 4.00 | 3.92 | 4.00 | 4.38 | 4.60 | 4.90 | 5.20 |
| EL      | 0.52 | 0.61 | 0.65 | 0.82 | 0.75 | 0.75 | 1.02 | 1.81 | 2.90 | 2.90 | 2.90 |
| I       | 0.20 | 0.71 | 0.69 | 0.69 | 0.70 | 0.70 | 0.60 | 0.74 | 0.80 | 0.80 | 0.90 |
| I       | 1.70 | 2.12 | 2.21 | 2.44 | 2.14 | 2.00 | 1.70 | 2.59 | 2.60 | 2.60 | 2.60 |
| L       | 0.90 | 0.97 | 1.70 | 1.60 | 2.00 | 2.30 | 2.44 | 2.95 | 3.00 | 3.30 | 3.50 |
| NL      | 0.80 | 1.18 | 1.49 | 1.42 | 1.70 | 1.50 | 1.32 | 1.71 | 1.80 | 1.80 | 1.70 |
| P       | 0.10 | 0.18 | 0.18 | 0.22 | 0.25 | 0.30 | 0.30 | 0.49 | 0.50 | 0.60 | 0.60 |
| E       | 0.60 | 0.97 | 1.11 | 1.29 | 1.47 | 1.30 | 1.40 | 1.45 | 1.60 | 1.70 | 2.00 |
| S       | 3.30 | 3.80 | 3.70 | 4.01 | 3.94 | 4.20 | 3.90 | 3.93 | 3.20 | 3.80 | 4.90 |
| UK      | 0.62 | 1.29 | 1.53 | 1.17 | 1.74 | 1.70 | 1.72 | 1.60 | 1.90 | 1.90 | 1.90 |

It is also important to underline the fact that secondary data sources were also used in order to obtain the necessary information; these sources came from Willer and Yussefi (2000, 2005, 2007) in cooperation with the FiBL (Research Institute of Organic Agriculture), the SOEL (Foundation Ecology an Agriculture) and the IFOAM ((International Federation of Organic Agriculture Movements) for the 15 EU member states.

The states’ encoding appears as follows (Table 3): the initial data table consists of 15 rows corresponding to the 15 EU member states and 11 columns that contain data for the eleven years of the period studied (1998-2008).

Each of the 11 columns is then subdivided into 3 columns-properties. The first column includes 33% of the 15 member states that have the lowest performance,
the second column 34% with the medium performance, and the third column includes 33% of the countries that represent those with the highest performance.

Table 3. Encoding of the 15 EU member states.

| A: Austria | DK: Denmark | FR: France | P: Portugal | IRL: Ireland |
| B: Belgium | E: Spain    | FIN: Finland | L: Luxembourg | S: Sweden |
| UK: United Kingdom | I: Italy | EL: Greece | NL: Netherlands | D: Germany |

Consequently, the initial table of 15X11 dimensions is now transformed to a logic table 0-1 of 15X33. The cells of the new table no longer contain quantitative values but values 0 and 1 instead. The value 1 is recorded in case of a presence of a property, whereas the value 0 is noted in case of an absence of a property. Each row of the logic table will be isobaric and will contain 11 times the value 1 that is once for each year studied (Figure 1).

Figure 1. Transformation of the data table to a logic table 0-1.

Logic tables indicate the properties of the items in contradiction with the initial tables, where the items are characterised by variables (Papadimitriou, 2007). In this logic table, the methods of Factorial Correspondence Analysis and Hierarchical Classification are applied. These methods are applied three times to three logic tables: firstly, to a logic table (15X33) concerning the degree of adopting organic agriculture; secondly, to a logic table (15X33) concerning the holdings under organic management and, finally, to a logic table of 30X33 that represents an aggregated data table and provides a more inclusive analysis of the phenomenon.

Results and Discussion

Areas under organic management

The initial data concerning this variable refer to rates of hectares integrated in the EU organic agriculture program. The Ascending Hierarchical Classification used in the logic table 0-1 of 15X33 dimensions led to the dendrogram shown in Figure 2.
In this dendrogram, there is a clear distribution of data into three clusters of states. Firstly, it is easy to distinguish node A where states characterised by relatively low level values are included. This cluster consists of Belgium, the Netherlands, France, Ireland and Luxembourg. According to the results of the Hierarchical Classification, these states are highly characterised by relatively low rates of areas under organic management in the years of 1999, 2002 and especially during 2003-2008.

The Node B is subdivided into 2 additional clusters that contain the states with relatively medium and high values, as regards the degree of adopting organic practices. The first cluster of the Node B contains the states of Germany, Denmark, the United Kingdom, Spain and Portugal, which are highly characterised by relatively medium values during 1999-2008. The second and last cluster of states includes those with relatively high values, as regards the rate of areas under organic agriculture during the whole period studied (1998-2008). These states are Austria, Italy, Finland, Sweden and Greece.

The results of the Factorial Correspondence Analysis verify the aforementioned clustering of the countries. According to these results, the states with relatively low performance cover the upper left side of the plane and they are
remote from those with relatively high performance on the first factorial axis. Finally, the two aforementioned clusters are opposed to the cluster of states with relatively medium performance on the second factorial axis (Figure 3).

Holdings under Organic Management

Apart from the degree of organic agriculture adoption, the agricultural holdings under organic management are also studied for a deeper view of the phenomenon. Accordingly, the initial data tables contain values corresponding to the rates of holdings that were integrated into the organic agriculture program.

The same methods are applied to the corresponding logic table 0-1 of 15X33 dimensions; the results are shown in Figures 4 and 5. According to the dendrogram of the Hierarchical Classification (Figure 4), it is easy to first distinguish the composition of the cluster with the high performances that includes the states of Austria, Denmark, Finland, Sweden and Germany, that is, the 5 states with the highest performance of all. The rest of the countries are divided into the cluster with the low performances, where Belgium, Ireland, Portugal, Greece and Spain are included and to the cluster of medium performance that includes France, Luxembourg, Italy, the Netherlands and the UK.

![Dendrogram](image)

**Figure 4. Results of the H. Classification.**

All 15 member states of the three clusters are highly characterised by the corresponding property during the whole period studied (1998-2008).

According to the location of the member states on the factorial plane (Figure 5), there is a high opposition of the states with the highest performance (Austria, Denmark, Finland, Germany and Sweden) to the rest of the states on the 1st factorial axis. In addition, there is a clear opposition on the second factorial axis between the states with low performance (Belgium, Spain, Greece, Ireland and Portugal) and those with medium performance (France, Italy, Luxembourg, the Netherlands and the UK).
It is worth mentioning that all 15 member states are highly characterised by the corresponding properties of the cluster they belong to during the whole period studied (1998-2008).

Concentrated Analysis

The unification of the two initial tables of 15X11 dimensions led to a single aggregated data table of 30X11, which is then transformed to a logic table of 30X33 – as mentioned in the chapter of ‘Methodology’ – where the same statistical methods are applied.

Given that the interdependence of variables is very important to statistical analysis, the clusters that resulted from the individual variables analyses are replaced by new clusters resulting from the analysis of both variables studied. The phenomenon is, therefore, fully described and the properties of the two variables participate isochronously in the analysis that produces the final result.

The major difference between the new table and the first two tables analysed in the previous chapters is that the new table contains 30 rows instead of 15, the member states participating with two rows instead of one; the first row contains the rates of hectares (a: area under organic management) and the second one the rates of holdings under organic management (h: holdings). The interpretation of these results may seem more complicated; however, the researcher is, in this way, given the advantage of a more inclusive view of the phenomenon, as the interaction of the two indicators studied provides the final results.

The results of the Hierarchical Classification in Figure 6 show that the states of Austria, Denmark and Finland are those with the highest performance concerning both their degree of adopting organic agriculture practices and the rates of holdings integrated into the organic agriculture program. The states of Italy, Sweden, Greece and Portugal participate in the cluster of countries with high general performances due to their high rates of hectares under organic management.
On the other hand, Belgium, France and Ireland are the three countries with the lowest performance of all. These countries do not seem to be very interested in adopting organic agriculture practices. The Netherlands, the UK, Portugal, Spain and Greece participate in the cluster of low general performances because of the relatively low rates of holdings under organic management.

The results of the hierarchical classification show that the indicator of areas under organic management affected significantly the formation of the cluster with the highest general performance; whereas the indicator of holdings under organic management affected significantly the formation of the cluster with the lowest general performance.

The factorial map (Figure 7) verifies the specific location of the 15 member states in space. The first factorial axis indicates the existing opposition between the cluster of high general performances and the other two clusters, whereas the second factorial axis indicates the opposition between states with low general performances and those with medium general performances.

On the factorial map, some single cases are also distinguished, giving the opportunity for further comments. Greece is located in the cluster of low general performances as far as the rates of holdings (ELh) are concerned and in the cluster of high general performances as far as the rates of hectares under organic agriculture are concerned (ELa). However, Greece seems to be a little remote on the plane from the rest of the countries that constitute the cluster of high general performances. The rates of hectares under organic management show that Greece is in fact characterised by high performance over the last six years of the period studied (2003-2008).

Portugal is characterised by medium values as regards the adoption of organic practices (Pa) during most of the years studied. However, in the years of 2005, 2006 and 2008, Portugal is highly characterised by high level values and, as a consequence, this state enters the cluster with high general performance.
Finally, the concentrated results, according to the Hierarchical classification, show that Sweden has been included in the cluster with the medium general performance as regards the rates of holdings under organic management (Sh). As proved by the individual analysis described in the previous chapter, Sweden’s results concerning the holdings are really satisfying. This result is not fully verified by the factorial plane, where Sweden is located between the clusters with medium and high general performance. The location of Sweden in this cluster results from the interaction of the two indicators studied.

It is also important to mention that the countries of the cluster with medium general performances are highly characterised by medium properties during 2001-2008, whereas the countries of the rest of the clusters are highly characterised by the corresponding properties during the whole period studied.

Conclusion

The purpose of this study is to analyse the evolution of the relative position of 15 EU member states during 1998-2008, as regards their degree of adopting organic agriculture, based on the use of Data Analysis, Factorial Correspondence Analysis and Hierarchical Classification Methods. More specifically, both the rate of areas (‘Areas under Organic Management’) and the rate of agricultural holdings (‘Holdings under Organic Management’) under organic management were studied in order to detect the degree of adopting this alternative production system.

According to the results of the study, Austria, Sweden and Finland were the countries with the highest performance concerning both their degree of adopting organic agriculture practices and the rates of holdings that integrated into the organic agriculture program. Italy and Greece also seem to show high rates concerning the areas under agriculture management and they are included, as a consequence, in the cluster of countries with the highest performance.
On the contrary and according to the study’s results, Ireland and Belgium have not shown great interest in adopting organic practices during 1998-2008 and, therefore, they belong to the countries with negative performance.

It is worth underlining that the countries like France and the Netherlands, which are traditionally the first to innovate, do not seem to adopt significantly this sustainable production system. As a result, these countries belong to those with the lowest rates of areas under organic management.

Nowadays, even though organic agriculture is launched in all member states of the EU, there are many deviations among them concerning the degree of adopting this alternative production system. The EU has recognised organic agriculture as a realistic choice for a new model of agricultural production. After taking into consideration the demands of consumers for safer and environmental friendly products, the Union has redefined its goals in the Common Agricultural Policy (CAP) and from now on it provides greater motives for producing organic products.

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Received: September 30, 2011
Accepted: January 26, 2012
The evolution of the relative position of 15 EU member states regarding organic agriculture

RAZVOJ RELATIVNOG POLOŽAJA 15 ZEMALJA ČLANICA EVROPSKE UNIJE U POGLEDU ORGANSKE POLJOPRIVREDE

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Rezime

Negativan uticaj modernih poljoprivrednih praksi na okolinu, povećana upotreba neobnovljivih resursa i dugoročna produktivnost visokih spoljašnjih priliva u obradive sisteme vodi ka tome da mnoge vladine i nevladine organizacije preduzmu različite inicijative kako bi unapredile usvajanje i ekspanziju održivijih poljoprivrednih tehnologija kao što je organska poljoprivreda. Cilj ovog istraživanja je da se ispita stepen usvajanja prakse organske poljoprivrede u 15 zemalja članica Evropske unije u periodu 1998-2008. Kako bi se uspelo u ovoj nameri, korišćene su metode analize podataka, faktorske korespondencijske analize i hijerarhijske klasifikacije. Rezultati istraživanja su pokazali da, iako se organska poljoprivreda primenjuje u svim zemljama članicama Evropske unije, postoje mnoga odstupanja među njima u pogledu stepena njenog usvajanja. Štaviše, rezultati su pokazali da su Austrija, Švedska i Finska zemlje sa najvišim performansama imajući u vidu kako njihov stepen usvajanja prakse organske poljoprivrede, tako i stopu gazdinstava koja su se integrisala u program organske poljoprivrede.

Ključne reči: organska poljoprivreda, analiza podataka, faktorska korespondencijska analiza, hijerarhijska klasifikacija.

Primljeno: 30. septembra 2011.
Odobreno: 26. januara 2012.

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