ANALYSIS OF EFFICIENCY IN ORGANIC VINE-GROWING FARMS USING ITALIAN F.A.D.N. DATASET

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ABSTRACT

In the recent years there has been in Europe and in Italy also a growth of organic farms with positive effects in increasing the level of income to many Italian farmers as a consequence of an higher price than conventional food which customers are willing to pay and secondly as effect of a direct commercialization of products throughout farmer's market and Internet. The analysis has used a dataset of Italian organic viticultural farms belonging to the Farm Accountancy Data Network (FADN) with the purpose of investigating their levels of technical, economic and allocative efficiency. The FADN is a standardized sample of European farms aimed at assessing the income of agricultural holdings in each member states of the European Union and some impacts of the Common Agricultural Policy towards them. The main findings of this quantitative analysis have pointed out a lower level of efficiency in vine-growing farms able to produce certified quality products than conventional wine ones and a good level of technical efficiency in organic farms. Organic high certified quality farms, producing the Protected Designation of Origin (PDO) wine, have had the poorest level of technical efficiency. Some reasons of this imbalance about the levels of efficiency can be imputed by a low level of agrarian capital and labor force compared to conventional ones which have influenced the level of economic and allocative efficiency on organic high certified quality farms. Same levels of efficiency have been pointed out comparing organic to conventional farms and their products.

Keywords: Farm Accountancy Data Network, economic efficiency, organic farms, Italy, rural districts.

INTRODUCTION

Since the early 1990s there has been a growth of organic farms in all European states due to an increase of the customer's demand of healthy food able in the same time to protect the environment and to improve the farmer's income because of higher prices than conventional food as a consequence of an increase of willingness to pay in consumers towards organic and certified quality food as well (Galluzzo, 2008). The recent data of Agricultural Italian Census in 2010 have stressed as 27% of farmers is concentrated in a range of economic size between 8,000-25,000 euro with an Utilizable Agricultural Surface equal in average to 9.6 hectares (Istat, 2012). In a roughly economic point of view the average Net Income in organic farms is higher than conventional ones, respectively equal to 65.000 € and 42.000 € (Inea, 2013).

Even though recent analysis have underlined a drop in food consumption in two year time 2013-2012 equal to 2% and 3.7% in quantity and in value (Ismea, 2013), for the wine the decline is equal to -7.7% in quantity, even if there has been an increase in value equal to 3.3%. In Italy the consumption of organic food is equal to 1.5% of annual expenditures, with better performance of

growth than the certified quality food, due to a significant development of alternative channels in order to buy these products directly without salesman such as farmers' market, farms specialized shops by organic farm gates in agro-tourisms equal to 2,795 enterprises located mostly in the north and south of Italy (Biobank, 2014); direct sales by e-commerce, groups of local buyers have generated, in particular the former direct channel of sales, a network of solidarity-sustainability-environment protection (Bertizzolo, 2013) in a small scale of rural territories able to guarantee an endogenous and local development in rural areas at risk of marginalization.

Despite the development of new marketing strategies large retail chains are the most common channel to sell organic products in Italy with a level of price which is increased with lower levels than conventional ones (Inea, 2013). In Italy there is a spatial distribution of organic consumption; in fact, organic consumption is predominately concentrated in the centre and in the north east Italian regions (Inea, 2013). More than 60% of purchasing process in terms of organic food takes place in traditional shops specialized in selling organic food equal to 826 units (Biobank, 2014).

In Europe is gathered one third of agricultural organic surface equal to 11 million of hectares (FIBL-IFOAM, 2014) and in some countries located in the Basin of the Mediterranean sea, such as Spain and Italy there has been a significant increase of organic surfaces; in fact, in these states it is concentrated a significant organic surfaces equal to 1.46 million of hectares in Spain and 1.10 million of hectares in Italy 2010 (Inea, 2013).

Despite the economic crises investments in organic farming have increased and in the same time there has been a growth of per capita demand of organic food in particular inside the European domestic market. In Italy every family spends more than 1.5% of annual income buying organic foods and vegetables predominantly in informal channels such as directly buying process in farms or in formal market as mass markets even if the brand and specific labels seem to be the pivotal factor in success due to high level of investments in communication (Torazza, 2009) which a small farmer is not able to set up unless it does not use a direct sale channel in farm.

Analyzing the predominant agricultural cultivations in Italy the statistical data have pointed out in 2012 as the most organic surface consists of forage crops followed by olive orchards and vineyard surfaces equal to 141,000 and 52,000 hectares (Inea, 2013). In the same time the geographical analysis has underlined as the distribution of organic cultivated surface is predominately located in the south of Italy where there is a lower diffusion of wine labeled by certified quality brands compared to other certified quality food such as extra virgin olive oil, cheese, fruit and vegetables.

In general the image in the mind of customers is that the level of income for organic farmers is lower than conventional ones due to specific techniques aimed at improving the quality of production, respecting the environment, instead of strengthening the quantity of production, without having negative impacts on the environment by a low utilization of fertilizers and pesticides. The first and foremost bottleneck of organic farming is tightly linked to a significant impact of these techniques on the economical and technical efficiency of farms which are less productive than conventional ones; hence, they are more demanding and depending on subsides allocated to put into practice organic crops (Kumbhakar et al., 2009) and financed in favor of

European farms by the second pillar of the Common Agricultural Policy. In fact, many Italian regions, giving subsidies to farmers, have improved the level of organic productions in different rural territories with a plenty of positive socio-economic relapses, able to improve the level of farms' income (Camaioni-Sotte, 2009). In 1994-1999 and during the phase of rural development and planning called Agenda 2000 (2000-2006) there has been a significant use of European Community funds to implement and to finance some initiatives in favor of organic crops in farms, put into practice since the MacSharry's reforms in the 1990s, with the effect of stimulating other farmers to convert, to address and to transform their agricultural productions.

AIM OF THE PAPER

The purpose of this study was to investigate, over four year time from 2008 to 2011, the level of technical and economic efficiency in vine-growing Italian farms using the data published in the FADN, acronyms of Farm Accountancy Data Network, which is a standardized dataset able to involve a sample of farms in the European Union aimed at assessing the impact of some actions of Common Agricultural Policy on farmers .

In general one of the most important drivers in the decision process to convert the agricultural production from a conventional model towards an organic one are the technical efficiency, the dimension of farms and in some cases the level of specialization in terms of cultivated crops (Latruffe and Nauges, 2014).

A lot of studies has underlined as the level of efficiency and productivity is linked to the low level in technology and investments in farms, which is typical in organic farms able to produce some consequences on the efficiency of farms (Lansik et al., 2002). In contrast, few studies have detected the first and foremost relationships in organic farming systems comparing them to conventional farms by a quantitative approach, underlining as a result as there was an higher level of technical efficiency in organic farms than in conventional ones due to a different level of inputs (Tzouvelekas et al., 2001; Tzouvelekas et al., 2002).

In microeconomic analysis efficiency is tightly connected to productivity (Papadas, 1991) and some studies in Italy have detected as farm dimension and efficiency are correlated each other (Galluzzo, 2013). In Italy it is harsh to find in literature studies aimed at investigating in a quantitative approach the efficiency using the FADN dataset, comparing organic and conventional systems of farming (Cislino and Madau, 2007) addressing the attention only in favor of few specific herbaceous crops such as cereals (Madau, 2007). The main questions of the paper were:

1) Is it the organic vine-growing crop more efficient than the conventional one?;
2) Is the organic wine production more efficient than the certified quality wine?

METHODOLOGY

The method of assessing the efficiency has been predominately quantitative using the software PIM-DEA. In this paper we have used a non parametric methodology because a parametric method needs a defined function of production and specific assumptions to estimate efficiency.

A non parametric model is able to investigate the level of technical and economic efficiency without using a specific function throughout the DEA (Data Envelopment Analysis).

The efficiency is a ratio between obtained output and used inputs and it is a pivotal tool to define the capability of each Decision Making Units (DMU); in this case the farmer in order to produce a well-define quantity of output have to use a specific combination of input in different cross sections data over the four year time of investigation. In term of productivity if there are two DMUs such as A and B able to produce two levels of output such as y_a or y_b using a specific quantity of input x_a and x_b the productivity is a simple ratio y_a/x_a and y_b/x_b. A model of analysis and estimation of the efficiency at the level of a specific frontier of production has been implemented by the introduction of a non-parametric model called Data Envelopment Analysis or DEA and specific statistical programs in order to assess the efficiency in the primary sector (Farrell, 1957; Battese G.E., 1992; Coelli T., 1996; Charnes et. al, 1978).

The non-parametric linear model throughout the Data Envelopment Analysis has been introduced for the first time in 1978 (Charnes et. al, 1978) and it is useful to estimate the relative efficiency in each Decision Making Units based on different input and output (Hadad et al, 2007) with the purpose, in an approach input oriented strategy, used in this paper, to minimize input used (Doyle and Green, 1994) in vine-growing crops, in the process of production of both organic wine and also certified quality wine.

In this paper we have used a Data Envelopment Analysis methodology because it is a non-parametric model thus, it has not been important to define a specific form of production function, hence each DMU is able to be on the efficient front of a non-parametric function of production or below this function if DMU is not efficient (Papadas, 1991; Maietta, 2007).

The goal of a non parametric input oriented model, such as in our research, or rather DEA linear programming, is to minimize in a multiple-output model the multiple-input in each farm that is a ratio of efficiency which in a mathematical model is written as (Papadas, 1991):

$$\max h = \Sigma_r u_r y_{rjo} / \Sigma_i v_i x_{ijo} \quad (1)$$

subject to

$$\Sigma_r u_r y_{rj} / \Sigma_i v_i x_{ij} \leq 1 \quad (2)$$

$j = 0, 1, ...n$ (for all j)

$u_r, v_i \geq 0$

This model has many possible solutions and u_r* and in v_i* are variables of the problem and they have to be greater to 0 or another small but positive quantity thus, any input and output can be ignored in estimating the efficiency (Bhagavath, 2009; Papadas, 1991). If h is 1 there are not issues because this unit ($DMUh_1$) is more efficient compared to other $DMUh_n$, but whether h is above 1 there are lots of units more efficient than this unique unit ($DMUh_1$) then, every units is tightly linked to input and output making each unit efficient (Bhagavath, 2009). To solve this negative aspect is fundamental to transform the model in a linear one by a linear programming called CCR (Charnes and Cooper 1962; Bhagavath, 2009**)** written in this way:

$$\max h = \Sigma_r u_r y_{rjo} \quad (3)$$

s.t. dual variable
$\Sigma_i v_i x_{ijo} = 100\%$ Z_o
$\Sigma_r u_r y_{rjo} - \Sigma_i v_i x_{ijo} \leq 0$ with j = 0, 1, ...n (for all j) λ_j
$- v_i \leq -\varepsilon$ i = 0, 1,….m and ε is a positive value s_i^+
$u_r \leq -\varepsilon$ r = 0, 1, …t and ε is a positive value s_r^-
In the dual problem proposed by Charnes, Cooper and Rhodes in 1978 it is important to give a dual variable in each constraint in the primary model; this paper has not taken into account in the dual model a constraint able to classify and to discriminate DMUs by the super efficiency called A&P model (Andersen and Petersen, 1993). In mathematical terms the solution of the dual model is:

$$\min 100 Z_o - \varepsilon \Sigma_i s_i^+ - \varepsilon \Sigma_r s_r^- \quad (4)$$

s.t.
$\Sigma_j \lambda_j x_{ij} = x_{ijo}$ $Zo - s_i^+$ i = 0, 1, …m
$\Sigma_j \lambda_j x_{rj} = y_{rj0} + s_r^-$ r = 0, 1,....t
$\lambda_j, s_i^+, s_r^- \geq 0$
λ_j are shadow prices able to reduce the efficiency in each unit lower than 1 and a positive value of λ_j is able to assess a peer group in some inefficient unit. If j is an organic farm inefficient the value of technical efficiency is lower than 1 (Charnes et al. 1978) even if in this paper the value of efficiency is in a percentage hence, 100% is the optimal value.

RESULTS AND DISCUSSION

The McSharry's reforms has codified a new model of agriculture based on the protection of the environment and on a poor use of chemical products in the production of commodities; hence, over the last 20 years there has been a meaningful increase of organic cultivated surface in Italy thanks to the allocation of specific subsidies in order to implement the multifunctionality in the primary sector in order to improve the diffusion of organic farming systems, funds dedicated to less favoured areas and in favour of the rural development (Fig. 1).

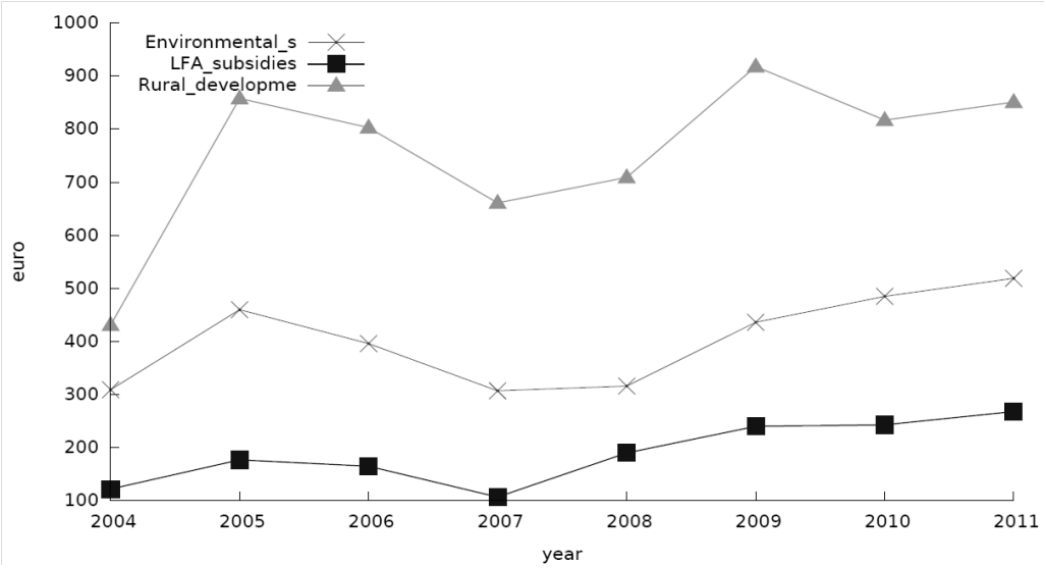

Fig. 1- Growth of financial support and subsides allocated in order to implement rural development in less favored areas (LFA subsides), environmental protection and

multifunctionality by rural development in the primary sector *(Source: our elaboration on data http://ec.europa.eu/agriculture/rica/database/database_en.cfm)*

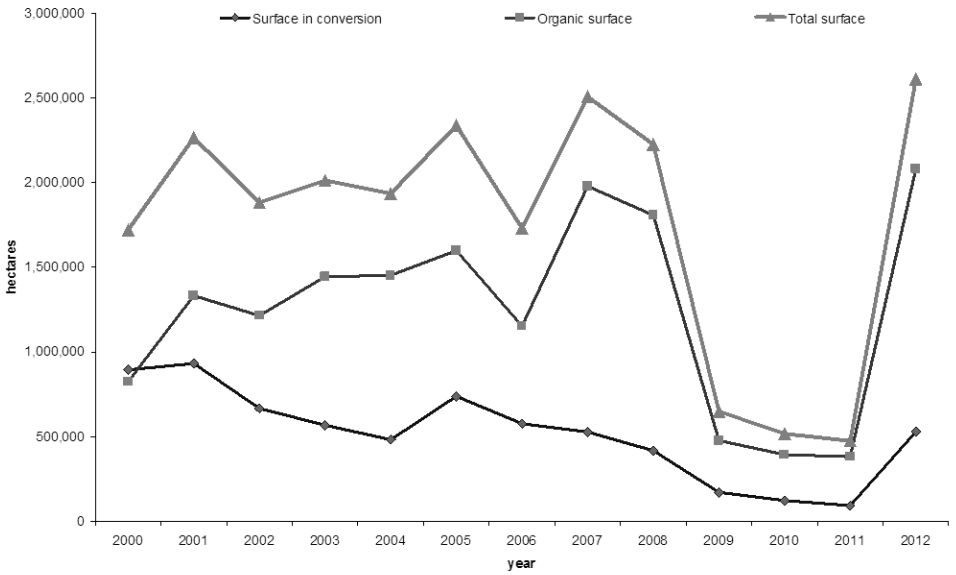

Fig. 2- Evolution of organic agricultural surface in Italy over twelve year time *(Source:www.sinab.it)*

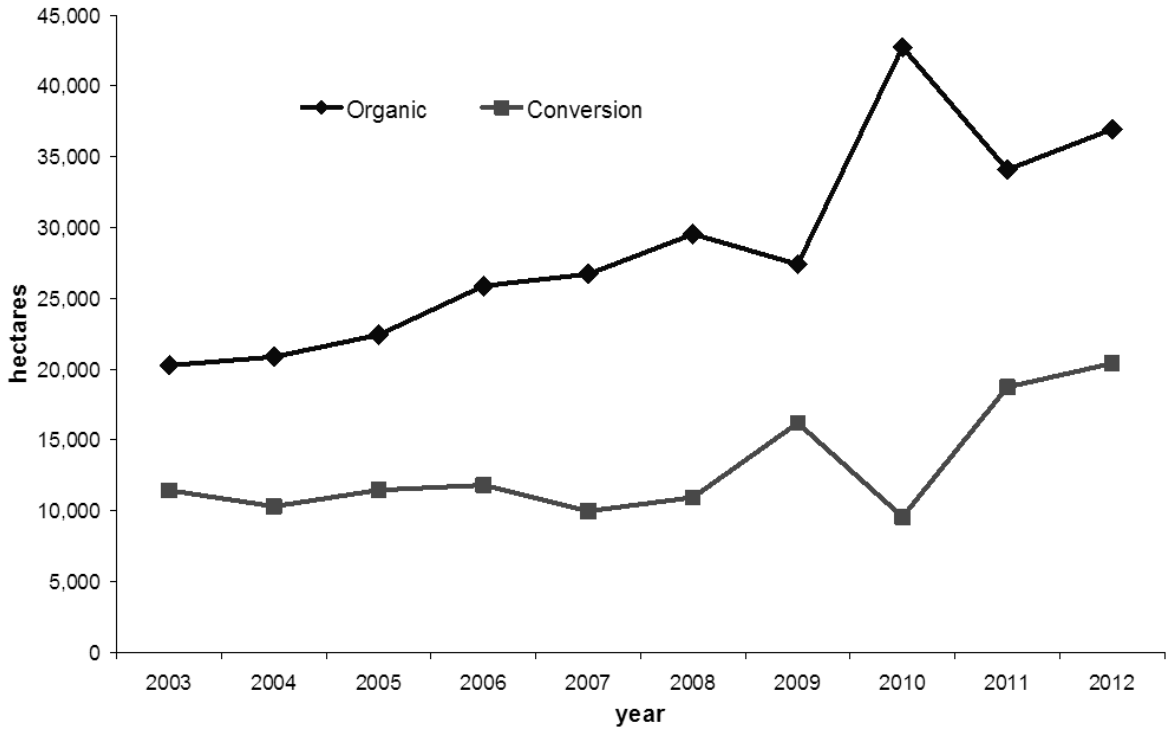

Fig. 3- Organic vine-growing surface in Italy over 11 years *(Source:www.sinab.it)*

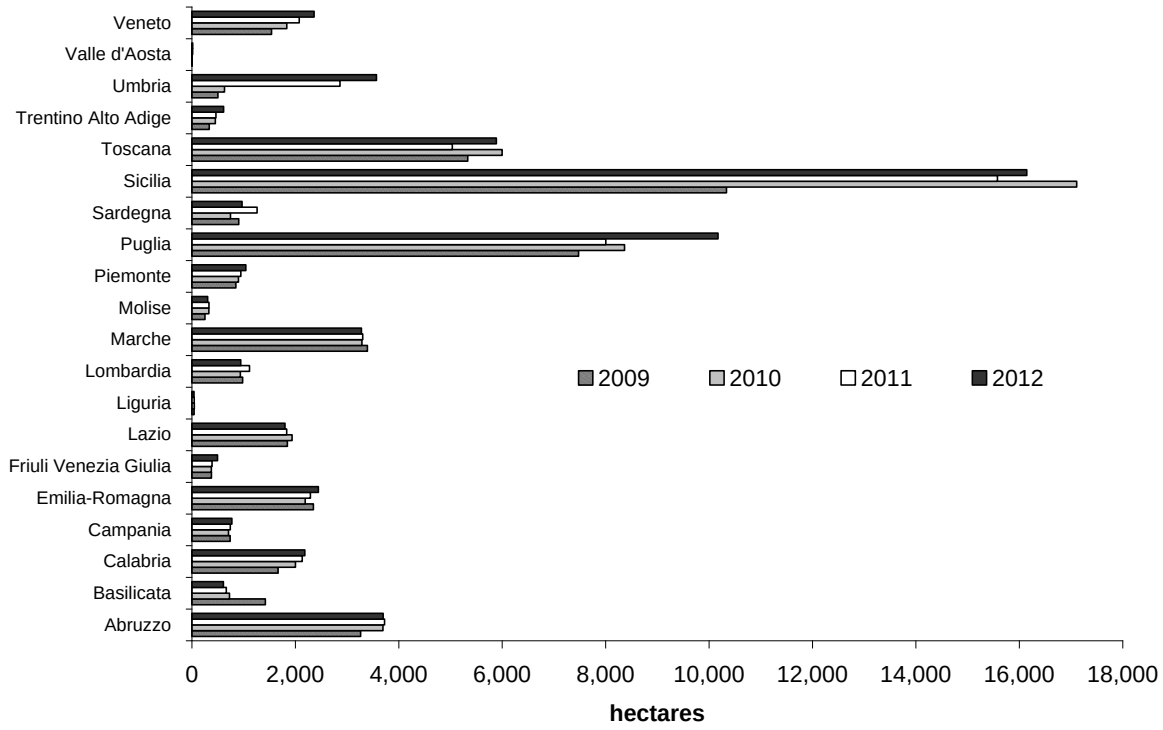

Fig. 4- Hectares of organic vine-growing surface in all Italian regions over the time *(Source: our elaboration on data http://www.inumeridelvino.it/wp-content/uploads/2013/09/BIO-2012-1.jpg)*

Focusing the attention on the organic crops it is possible to underline a consolidation of surface in conversion or transition from a conventional agricultural model towards an organic one, even if the economic crises has had a negative impact in many Italian regions reducing the agricultural cultivated surfaces (Fig. 2) or rather Italian farmers have rethought and changed the management of organic surfaces because of a growth of specific costs.

Comparing the organic surface in vine-growing farms it is possible to point out a predominant development of organic areas with a continuous increase over the time and a peak in 2009 (Fig. 3) tightly linked to a drop of surface in conversion. Despite the economic downturn in all economic sectors the organic crops and the strategies to cope them in investigated organic vine-growing crops have not been affected by economic issues.

Italian regions located in the south of peninsula such as Sicilia and Puglia, with the exception of the Tuscany and Abruzzo in the center of Italy, have underlined a high diffusion of organic vine-growing surface with some fluctuations over the time and an increase in 2012 compared to 2011 (Fig. 4).

Table 1- Average value of efficiency in transformed products organic versus conventional over 5 years *(Source: our elaboration on http://www.rica.inea.it/public/it/accesso_dati.php)*

Conventional product	**Technical efficiency**	**Economic efficiency**	**Allocative efficiency**
Wine	100.00	90.75	90.75
PDO wine	100.00	93.71	93.71
Organic product	**Efficiency**	**Cost Efficiency**	**Allocative Efficiency**
Wine	100.00	99.11	99.11
PDO wine	90.94	58.69	64.49

Table 2- Average value of efficiency in organic and conventional crops over 5 years *(Source: our elaboration on http://www.rica.inea.it/public/it/accesso_dati.php)*

Conventional crop	**Technical efficiency**	**Economic efficiency**	**Allocative efficiency**
Wine	100.00	100.00	100.00
PDO wine	100.00	66.82	66.82
Organic crop	**Technical efficiency**	**Economic efficiency**	**Allocative efficiency**
Wine	100.00	100.00	100.00
PDO wine	71.53	38.56	52.38

The results have pointed out as the conventional productions of wine are in general as technically efficiently as organic products (Tab.1) even if the economic or cost efficiency and allocative efficiency are above 100% in both the analyzed productions with the exception of PDO products than organic wine productions. In contrast, the Protected Designed of Origin (PDO) wine using organic methods of cultivation has a level of technical efficiency lower than 100% due to more constraints than organic products in order to cultivate and to transform vine-growing productions because of strictly rules published by European regulations and national laws in order to obtain high quality productions able to respect the local traditions (PDO) but in the same time able to guarantee high standards in terms of environmental protection (organic). In fact, comparing the cost and allocative efficiency the organic wine products are more efficient than PDO wine with a level of cost efficiency lower than allocative efficiency that implies a more correct and profitably use of factors of production than the management of costs.

Analyzing and comparing the system of cultivation between the organic and conventional vine-growing farms, the study has underlined as the organic vine-growing farmers are as efficient as conventional ones (Tab.2) with the same levels of cost and allocative efficiency. Traditional vine-growing farms specialized in producing a conventional wine have values of technical efficiency higher than vine-growing crops in areas parts of PDO consortiums (100% vs. 72%) where it is allowed to produce certified quality wine. Vine-growing crops used to produce Protected Designed of Origin wine have a level of allocative efficiency higher than economic one due to different level of management of costs linked to the production process than a different allocation of factors of production; hence, it seems important for farmers to implement the level of economic efficiency in terms of direct and indirect costs.

CONCLUSIONS

In general the organic transformed products are more efficiently than the organic crops because of a different use of factors of productions and costs to obtain productions. Organic farms have

underscored a lower level of efficiency than normal farmers underling as some parameters such as the agrarian capital and labor force may be two pivotal variables able to improve the level of economic and allocative efficiency, even if the PDO wine organic farms, due to a small size of the cultivated surface, have underlined a low level of efficiency with some impacts of levels of used input and produced output.

For the future it is fundamental to implement funds and subsides allocated by the European Union in the Common Agricultural Policy towards organic farmers in particular in favour of them living in less favored areas, specifically in upland territories, where is sparsely scattered a significant percentage of farms in order to reduce the marginalization and the out-migration from the countryside. Italian farms should have positive consequences by the introduction of economic incentives correlated with the level of greening, in the new process of rural planning proposed by the European Union, aimed at stimulating the extensification of crops and in reducing the level negative impact on the environment due to more intensive farming system.

Summing up to solve the fragmentation of organic wine production, able to sell the product mainly in farms with a capability of productions lower than 50.000 bottles for year (Rastelli, 2014; ISMEA-IAMB, 2008), it is important to implement some specific contracts such as network contracts, that might be a new form to create a net giving value to the supply chain and strengthening Italian rural districts where shared skills and competence able to reduce the marginalization of the countryside. Italian legislators should improve in Regional Rural Development Plans few strategies in order to develop new kinds of production agreements and Common Market Organizations aimed at merging the first and second pillars of the CAP in a perspective of holistic rural development.

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