Bulgarian Journal of Agricultural Science, 20 (No 4) 2014, 727-733
Agricultural Academy

AGROFORESTRY ACTIONS IN ITALY: AN ECONOMIC ANALYSIS USING THE EUROPEAN DATABASE FADN

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Abstract

GALLUZZO, N., 2014. Agroforestry actions in Italy: An Economic analysis using the European database FADN. *Bulg. J. Agric. Sci*., 20: 727-733

In Italy over the last 20 years there has been a growth of afforestated surfaces stimulated by activated measures financed by the second pillar of Common Agricultural Policy. The impact of funds allocated by the European Union to promote agroforestry and other actions about rural development has been investigated throughout the dataset Farm Accountancy Data Network (FADN). Using a quantitative approach, or rather a multiple regression model on the time series of the FADN, it has been possible during more than 20 years to evaluate the role of financial supports both towards the rural development and also specifically on the growth of afforestation in Italy, which may be pivotal to farms to promote multifunctionality and to lessen the rural depopulation. Another quantitative paradigm has found out, as there are not relationships of causality between the variable afforestated surfaces and funds allocated to promote the rural development as well. The analysis of efficiency has been the most and foremost aspect to estimate during three different seven-year time of implementing of Rural Development Programs if there has been a negative change in economic and technical efficiency in Italian farms.

Key word: rural development funds, multiple regression model, Italian afforestated surfaces, efficiency, Granger causality, multifunctionality, rural depopulation

Introduction

In the European Union over the last 30 years the Common Agricultural Policy has undergone the most and foremost significant transformations due to a new productive model and a modern ecological behavior in farmers, who are not only considered single units of production of European agricultural commodities, but farmers are became dweller and active agents of rural space protection, in its planning, in order to increase the level of involvement of rural communities in rural development programs and in lessening social exclusion as well (Galluzzo, 2012a; Galluzzo, 2010; Murray, 2010; O'Hara, 1998).

Since the late 1960s, when the Common Agricultural Policy (CAP) has been set up, the goals of European legislators were to guarantee an adequate level of income towards farmers and to achieve a self sufficient level of agrarian productions with the opposite effect to create an overproduction of commodities impossible to sell off and able to absorb much of the European financial budget (Vieri, 1994; Cunha and Swinbank, 2011). As a result of international agreements, during the Uruguay round of the GATT, the European Union decided to change its agricultural policy strategy focusing its efforts to change the paradigm of production of European farmers from a productivist model to a post-productivist one (Ilbery, 1998); hence, the European Commission has put in place the reform proposed by the European Commissioner MacSharry with the aim to reduce the cultivated surface both by interventions of set aside and also by afforestation actions, with a key consequence in the socio-economic development and environment protection of rural areas (Galluzzo, 2012b).

Agriculture is considered a sector able to produce positive externalities, or rather positive effects towards environment, urban areas and rural territories thus, the agroforestation is one of the new functions assigned to the primary sector to ensure the multifunctionality in terms of socio-economic development of rural areas, which positive aspects in reducing marginalization and rural depopulation and also in expanding multiple activities as part of the pivotal process of diversification and protection of rural space and rural communities (Kinsella et al. 2000; Van der Ploeg et al. 2002; Michelson, 2001).

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The agroforestry is one of the most important path to protect less favored rural areas and it is also, according to what stated during Doha round, the pivotal tool to lessen the climate change and to reduce agrarian overproduction in the EU; hence, in the Rural Development Programs and specifically in the second Pillar of the Common Agricultural Policy, it is able to better the natural environment, using a significant percentage of the European budget with positive effects on the landscape and in its protection throughout other agro-environment measures (Thenail et al. 2009; Brouwer and Silvis, 2010; Dupraz et al. 2010; Hill, 2012). The development of agroforestation has allowed to diversify the farmer's profitability, to protect environment through the cultivation of plants, scattered in small portions of Italian farms, able to produce intangible goods in terms of positive externalities and niche products such as truffle by using mycorrhizated plants (Galluzzo, 2013).

Since the 1960s to analyze the impact of economic decisions, made by the European Union (EU) on rural development, the European Commission has arranged the Farm Accountancy Data Network (FADN), which is a dataset for evaluating both the income of farmers and also some impacts of the CAP on a sample of farms representative of different European nations. FADN dataset is useful to estimate with a quantitative approach and for a long time the role and effect of political decisions about the agroforestry and rural development actions put into place by the European Union. In Italy it is not so common to find out, if not to the exclusion of confined geographical areas, quantitative researches to assess the impact of agroforestry actions and allocated financial support and subsides paid by the EU (Tassone et al., 2004). In other European countries landowners have not been in favor of the set aside of cultivated surface throughout the afforestation, due to a long time effort to cope a fair management of these surfaces, which shall necessarily benefit from the funds allocated by the EU to alleviate negative issues of management (Kassioumis et al., 2004) and to increase in the same time agroforestry by reducing the cultivation of commodities crops (**Arabatzis,** 2005). In other European States, located in the basin of Mediterranean sea, such as Portugal the agroforestry is the most and foremost tool to solve difficulties in degraded surfaces even if, these interventions have not implied significant outcomes in social and economic terms due to a not complete cooperation and involvement of local stakeholders or, specifically during the nineties at the beginning of Mac Sharry's reform, to an unsatisfactory level of subsidies paid by EU tightly linked to several agronomical and management commitments (Riera, 1995; Carvalho et al., 2002).

In Italy since the 1990s there has been an increase of funds allocated by the European Union to promote the afforestation in particular in rural less favored areas where strips of arborous plants have been fundamental both in agrarian hydraulic arrangements and also in the consolidation of slopes, becoming typical elements of agricultural landscape of plains and hills (Sereni, 1962). However, afforestation has been considered a downside subject to a strong drop as a result of agricultural mechanization but, during the last 20 years, there has been an increase of funds allocated by the European Union, which have increased from 251 million of euro, over the late nineties, to 1,635 million during the time 2000-2006; in these last 6 years (2007-2013) the total assigned funds has been 2,430 million of euro even if the 22% of this amount is allocated to finance the long-time measures carried out in the nineties (Vagnozzi and Giarè, 2000; Cesaro, 2002; Pettenella, 2009).

Aim of the research

The aim of this paper is to evaluate, using a quantitative approach or rather a multiple regression model, since the nineties and over the last 20 years after the MacSharry's reform, the impact on Italian farms of different funds and subsides allocated by the European Union in the second pillar of Common Agricultural Policy to promote actions of agroforestry throughout the standard dataset FADN, made by a sample of farms. In this analysis it was possible also to estimate if there has been causality between afforestation and rural development funds and after all throughout a quantitative paradigm the economic efficiency in the sample of the Italian farms.

Methodology

To investigate some parameters and the pivotal relationships among the dependent variable afforestated surfaces in all Italian regions, forming part of the FADN dataset, it has used a quantitative model based on a multiple regression model; the regressors have been estimated by the Ordinary Least Square over 20 years since the early nineties using the software GRETL. To analyze if there is heteroskedasticity on standard errors it has used White's Test on the error terms (Gujarati, 2003) and the model of multiple regression, in which it has been included and estimated all analysed economic and rural variables, in its algebraic form of matrix, can be represented in this explicit form (Veerbek, 2006):

$$y = X\beta + u, \quad (1)$$

where y and u are vectors with n-dimensions and X has dimension n x k and β are parameters or regressors, u is statistic error using the basis assumptions about multiple regression model (Verbeek, 2006; Gujarati, 2003.

The Granger causality test is a test useful to investigate if in time series of data there are some relationships or rather

whether a variable is due by another one thus; it is a simple tool to forecast some relationships in terms of causality and not in terms of correlation (Granger, 1969; Gujarati, 2003; Veerbek, 2006). Granger 1969 argued that in a time series X there is a Granger-cause towards another time series Y using some statistical tests such as t and F about lagged values of X and with lagged values of Y, hence those X values provide statistically significant information about future values of time series Y; the null hypothesis, that means no Granger causality, is rejected if and only if there are not lagged values of an explanatory variable that have been retained in the regression. The Granger causality is based on a F-tests on all regressors in the model and on the statistical significance in all parameters β if these regressors are equal to zero and in the same time null hypothesis is false; whether is null hypothesis is accepted parameters are not significant, thus there is not relationships among the analysed variables (Granger, 1969).

The last part of this research has investigated the efficiency using a Data Envelopment Analysis methodology, by the software PIM-DEA, which is a non-parametric model; thus, it is not fundament to define a specific form of production function and each Decision Making Units (DMU) is able to be on the efficient front of a non parametric function of production (Farrel, 1957) with the aim to estimate the relative efficiency in each DMU based on different inputs and outputs minimizing used input (Charnes et al. 1978).

Results and Discussion

The FADN sample showed in Italy in the early years of programming of Rural Development Programs, specifically over the accomplishment of agro-environmental measures, a significant spread of agrarian and forestry surfaces although, in the period 2000-2006 and in the next time of rural development plan 2007-2013, there has been a sharp drop in cultivated surface replaced by re-afforestated surfaces (Figure 1). Since the 1960s the FAO statistical database has pointed out in Italy a drop both of agricultural land and also of arable land (Figure 2), although in this the latter case there has been an halving of arable areas due to rural depopulation, an increase of afforestated surfaces and other permanent crops that in a contained manner have offset the reduction of arable land (Figure 3).

In the European countries the FADN dataset has showed stability in afforested areas which fall below 1000 m^2. The comparison of the data of the agrarian surface no longer used to implement the production of commodities and also not subject to set-aside has pointed out a direct relationship with the actions of agroforestry and in Italy this statistical data has been positioned far higher than the European average of

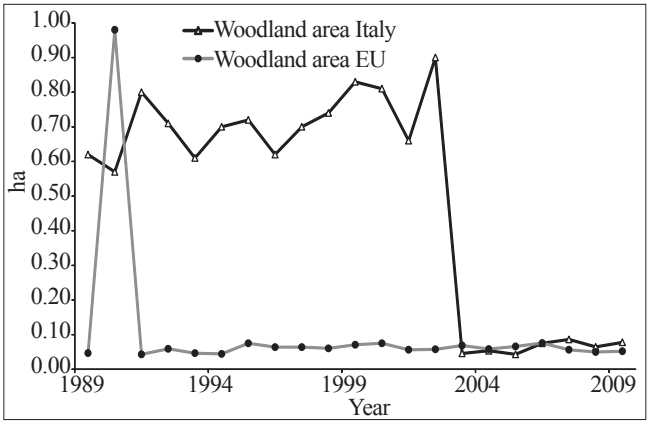

Fig. 1. Evolution of woodland surfaces in the FADN dataset
(Source: our elaboration on data http://ec.europa.eu/agriculture/rica)

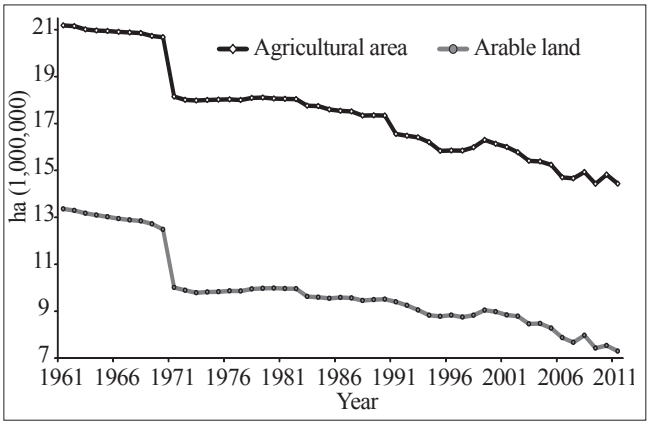

Fig. 2. Main changes in Italian agriculture over 40 years
(Source: our elaboration on data http://faostat3.fao.org/home/index.html)

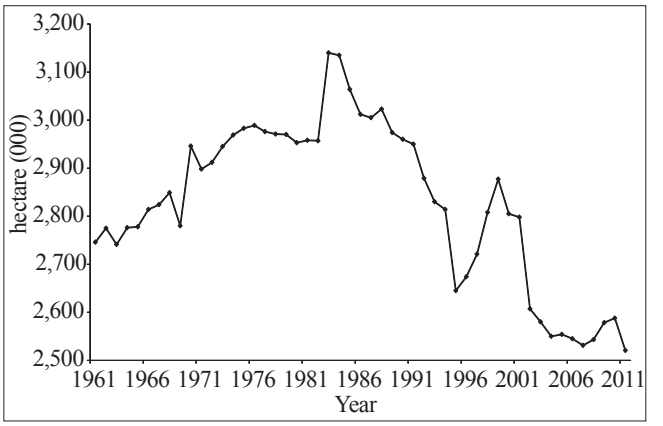

Fig. 3. Time series of permanent crops in Italy
(Source: our elaboration on data http://faostat3.fao.org/home/index.html)

FADN dataset (Figure 4); even if there has been a drop since 2000 tightly linked to a decline of orchards in Italy and in all European countries. The farms of the FADN sample have sought to reduce cultivated areas even if the agroforestry has involved only a tidy portion of farms tightly linked to the production of niche products such as truffle, which is located close to the enterprises and with the purpose both to satisfy family needs and also to promote the pluriactivity. Over three year time (2008-2010) the dataset FADN in Italy pointed out as a financial support was pivotal to increase the set aside surface, suitable for agroforestation, with a surface over 12 hectares and a level of gross margin for each hectare lower than 5 euro fundamental but not enough to offset the loss of income and the production of externalities with an appropriate support (Figures 5 and 6).

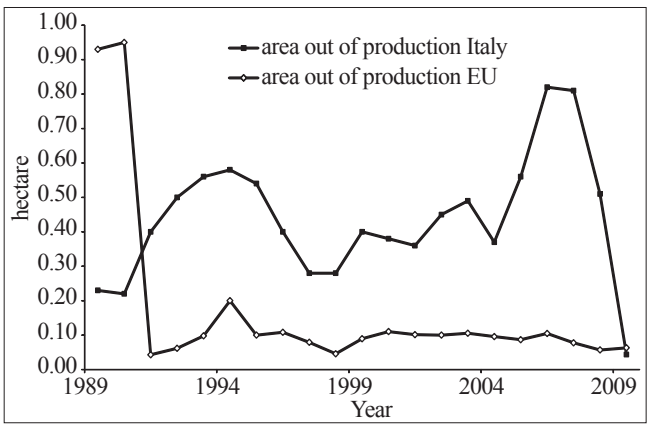

Fig. 4. Evolution of areas out of production in the FADN dataset
(Source: our elaboration on data http://ec.europa.eu/agriculture/rica)

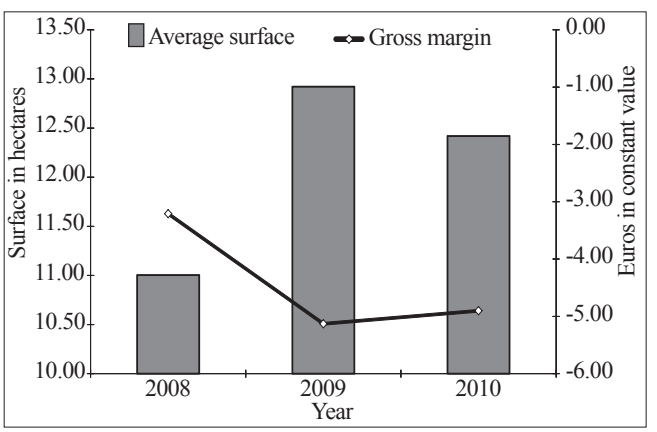

Fig. 5. Italian set aside surfaces with allocated funds
(Source: our elaboration on FADN dataset http://www.rica.inea.it/public/it/area.php)

The multiple regression models showed a good adaptation of it to the data with a value of R^2 and adjusted R^2 equal to 0.98 and 0.96; the quantitative approach has been able to explain a good part of the variability of the model. The analysis of the multiple regression model applied in the twenty years 1989-2009 on FADN database has pointed out that the surface subjected to agroforestry has been affected in a direct and statistically significant way the independent variables net farm income, funds allocated for rural development, cultivated surface able to obtain by the EU set-aside funds; furthermore, the model has highlighted as the dependent variable afforestated surface is strictly correlated to the independent variables not cultivated surface, set-aside funds, national support towards agricultural crops and specific costs in order to support afforestation (Table 1). An indirect correlation has been found out between the dependent variable afforestated surface and the independent variables such as increase in compensatory payments and total output produced by farmers; European Community funds paid about measures of set aside and to foster not cultivated surfaces have acted indirectly on the agroforestry. Decoupled payments and financial support to other crops allocated by each Member State of EU in terms of national amount of the CAP have acted in an indirect and statistically significant way on the dependent variable afforestated surface. To evaluate the impact of funds able to promote the rural development, the farms' profitability in terms of net income on the growth of agroforestry, one has used an another multiple regression model which has pointed out as there has been a direct role of EU funds on rural development and an inverse relationship between the variable profitability (in terms of farm income) and agroforestry (Table 2). In this case, however, the values of R^2 and adjusted R^2 showed values of 0.75 and 0.72 that have meant a discrete adaptation of the model to the data

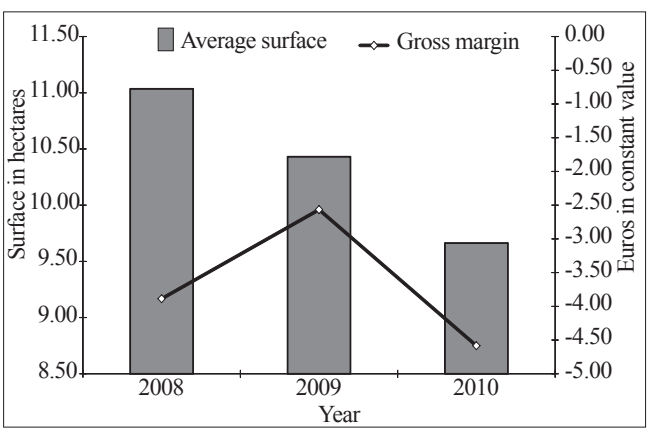

Fig. 6. Italian set aside surfaces without allocated funds
(Source: our elaboration on FADN dataset http://www.rica.inea.it/public/it/area.php)

The analysis of Granger causality, after making a prior testing with the Vector Auto Regressive model (VAR), has revealed, according to Dichey-Fuller test for unit root, such as the time series of the dependent variable afforestated surface and the independent variable funds allocated to promote rural development are not stationary. The test for the unit-root test on residuals have not proved correlations without the rejection of the null hypothesis of existence of unit root that has not been rejected, hence the test has pointed out a coincidence between variables surface put under agroforestry and rural development funds.

The analysis of economic efficiency over the time has underlined as in the first time of rural development program 1994-1999, when the MacSharry's reform was put into place, there was a high level of efficiency, above 94%, compared to the second period, 2000-2006 below 90%, and to the third period (2007-2009) when the efficiency was also under the value of 90% (Table 3).

The walnut and chestnut cultivations may be a critical factor of economic and farm management success to deal with several issues in agroforestry actions in rural areas (Table 4).

Table 1
Main results of parameters and relationships among the dependent variable afforestated surfaces in the multiple regression models *(Source: our elaboration on data FADN)*

Independent variables	Coefficient	Standard error	t value	p-value
Constant	0.829553	0.0418792	19.8082	<0.00001 ***
Other permanent crops	-11.8433	0.646658	-18.3145	<0.00001 ***
Compensatory payment	-0.302513	0.0213808	-14.1488	<0.00001 ***
Rural development funds	0.000351447	6.46112e-05	5.4394	0.00097 ***
Total output	-1.39174e-05	6.50726e-06	-2.1387	0.06976 *
Set aside subsides	-0.302437	0.0213944	-14.1363	<0.00001 ***
Area out of production	-55.7521	3.78726	-14.7210	<0.00001 ***
Farm Net Income	2.86457e-05	1.33125e-05	2.1518	0.06843 *
Decoupled payment	-9.53912e-05	1.83693e-05	-5.1930	0.00126 ***
Agricultural_fa	55.7743	3.74579	14.8899	<0.00001 ***
Set aside surface	55.0719	3.77848	14.5751	<0.00001 ***
Forestry subsides	0.0787224	0.0113604	6.9295	0.00023 ***
Subsidies to crops	0.302708	0.0213676	14.1667	<0.00001 ***
Other crops subsides	-0.302588	0.0213014	-14.2051	<0.00001 ***

Significance levels: * P< 0.05; ** P< 0.01; *** P< 0.001

Table 2
Relationships in the multiple regression model among the dependent variable afforestated surface and allocated funds *(Source: our elaboration on data FADN)*

Independent variables	Coefficient	Standard error	t value	p-value
Constant	1.40001	0.0960992	14.5684	<0.00001 ***
Rural development funds	0.000449082	0.000181316	2.4768	0.02341 **
Farm Net Income	-6.51345e-05	9.0782e-06	-7.1748	<0.00001 ***

Significance levels: ** P< 0.01; *** P< 0.001

Table 3
Main results of economic and technical efficiency over the time of study *(Source: our elaboration on data FADN)*

Period	Scale efficiency	CRS efficiency	CCR efficiency
Average	92.93	96.98	90.22
1994-1999	98.28	97.72	96.06
2000-2006	88.43	95.78	84.62
2007-2009	87.14	96.49	84.22

Table 4
Main economic results of some tree crops in Italy over the time 2008-2010 using FADN dataset
(Source: our elaboration on data http://www.rica.inea.it/public/it/area.php)

Cultivation	Average surface	Gross marketable production	Specific costs	Machining on commission	Gross margin
Chestnut	4.86	2,462.33	124.70	26.94	2,339.63
Blueberry	0.42	32,939.40	2,526.62	0.00	30,571.75
Blackberry	0.22	27,502.96	4,219.55	0.00	26,845.87
Walnut	4.71	10,503.58	691.35	201.19	9,812.23
Red currant	0.33	28,301.89	3,364.83	0.00	26,828.56

Conclusion

After the MacSharry's reform there has been an increase in Italian agro-afforestated surfaces which have usefully benefited from funds and other financial supports allocated by the European Union. However, after a moment of development in the early nineties of agroforestry, in the latest stages of rural development program there has been a scarcity both in terms of farmers and also in terms of actions put into place to promote a growth of agrarian afforestated surface, which has leveled off the average value in the EU due to an entrainment of the previous actions carried out in the 1994-1999 because they are deemed by farmers very demanding and economically affordable.

In Italy, agrarian areas excluded from the agricultural production are effectively replaced by the agro-afforestated surfaces and in the next rural development program the European Union is determined to encourage the greening thus, farming is the main core to recognize to the primary sector its role of public good able to protect environment by multifunctionality. The FADN dataset has been undoubtedly very useful to estimate effects and consequences of actions of agroforestation on Italian farms that have tried to diversify their productive specialization by using their acreage with mycorrhizated plants by truffles with the goal to protect areas rural areas against the hydro geological instability in hilly areas, where are situated the most percentage of afforestated areas. To sum up, for the future it would be desirable to the farmers to guarantee, through the allocation of specific financial supports, the model both of rural and environment protection and also of planning of its development by a growth of a social capital in terms of interactions among all stakeholders in rural areas.

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Received June, 22, 2013; accepted for printing February, 2, 2014.