Bulgarian Journal of Agricultural Science, 19 (No 5) 2013, 903-911
Agricultural Academy

AGROFORESTATION ACTIONS FINANCED BY THE EUROPEAN UNION AND LEVEL OF INCOME IN ITALIAN RURAL AREAS

N. GALLUZZO
Asgear Association of Economic and Geographical Studies on Rural Areas, Rieti, Italy

Abstract

GALLUZZO, N., 2013. Agroforestation actions financed by the European Union and level of income in Italian rural areas. *Bulg. J. Agric. Sci.,* 19: 903-911

Many Italian regions have allocated through Rural Development Plans subsides to farmers to improve the level of agroforestation with the aim to reduce rural depopulation, getting better farmer's income, and also to protect environment. Some quantitative studies have pointed out the role, function of public grants, and subsides to implement rural development by afforestation, supported by European Union funds, solving many social issues tightly linked to marginalization in rural territories. The purpose of this paper has been, using a multiple regression model, to investigate in all Italian regions if during the time 2000-2006 and over the following seven year period 2007-2013 there have been some relationships among independent variables such as afforestated surface, workforce in the primary sector and public funds allocated by the European Union about agroforestation and the dependent variable income of farmers. The main results over the first time of investigation have demonstrated as agroforestation in rural areas is pivotal to get better the living condition in the countryside and it has underlined the fundamental function of public funds to guarantee a fair rural development, reducing rural depopulation and increasing the production of positive externalities. During the second part of the analysis on Italian Rural Development Plans, the drop in funds and subsides allocated by the second pillar of the Common Agricultural Policy has brought about some effects on rural development. The second stage of this paper has analyzed in 2000 and 2012 the productive efficiency using an output-oriented function able to maximize the output in terms of farmers' income combining different level of input. For the next time 2014-2020, it is pivotal to implement agro-environment measures able to improve the agroforestation and multifunctionality reducing the marginalization of rural space and the depopulation in the countryside and getting better the efficiency of allocated funds about agroforestation.

Key words: rural areas, Rural Development Plan, multifunctionality, productive efficiency

Introduction

Since the early 1990s, the European Union has completely changed the role and function of Common Agricultural Policy (CAP); thus, the European Commission has planned a new function of farmers in the international agricultural stage. The farmer is became the most and foremost pillar to guarantee a protection of rural space producing some positive externalities able to reduce both rural depopulation and socio-economic marginalization in the countryside and able to safeguard environment. During the 1960s and the 1980s, the main feature of the CAP was to guarantee farmers' production, through a high price of commodities, assuring to farms a steady level of income by an intervention price higher than that on the international market, which was more effective and efficient to stimulate plentiful yields, by using enormous amounts of fertilizers and pesticides. The consequences were an overproduction of millions of tons of agricultural commodities such as wheat, corn, soya and milk, a reduction of international prices, produced by a massive supply with a depressive and distortion effect towards poor countries, an increase in costs tightly linked to the management of Common Agricultural Policy and an inhomogeneous assignment of items in the European Community budget as well. More than 50% of the European Union budget has been taken up by a primary sector; hence, direct payments to the farmers were not more economically sustainable both for international community and also for the EU. Some commer-

E-mail: asgearn@libero.it

cial constraints and trade agreements arranged and signed in the 1990s during the Uruguay round among the European Union and other different members of General Agreement on Tariffs and Trade (GATT) entailed a cut by 24% of export subsides and a reduction of tariffs with the consequence to decouple subsides paid to the farmers (Vieri, 2001). The outcome not more supportable of this stance of the European Union, with the aim to protect European agriculture supporting the price of commodities in domestic market, was a development that can not be postponed of a new reform of CAP, called MacSharry's reform, whose aim was to improve an integrated approach to get better standard conditions in the countryside and, in the same time, to pay subsides able both to set aside cultivated areas, with the purpose to lessen agricultural overproduction, and also to plan and to support economically a new idea of farm capable to protect the environment and to produce externalities by the multifunctionality (Shucksmith et al., 2005). In the early 1990s, the European Commission proposed three Regulations to change the structure of Common Agricultural Policy (Cunha and Swinbank, 2011). One of these Regulations, the EU Regulation 2080 published in 1992, defined some actions to improve the agroforestation or agroforestry in rural areas and to solve the issue of economic and financial compatibility of these measures of agro-environment scheme with the new proposals and targets established in the CAP reform approach and during GATT agreements (Vieri, 1994). In the European Union, during Agenda 2000, over 2000-2006, measures to promote the afforestation in rural territories had an incidence in percentage of total CAP expenditures equal to 10.2% of a total amount of 297.740 million of Euro financed by the UE Regulation 1257/1999 (Frascarelli, 1999). During Agenda 2000, a new specific concept of rural development was proposed to implement the multifunctionality called by the European Council the European model of agriculture (Cunha and Swinbank, 2011). Agenda 2000 has divided the Common Agricultural Policy in two pillars with a different sphere of action: the first pillar is about the decoupled aid to support agricultural productions, instead the second pillar has defined some principles and guidelines to improve the rural development through the multifunctionality and other agro-environmental actions such as the agroforestation.

The most and foremost consequence of this change and review in the Common Agricultural Policy structure and in its economic-financial function was to modify the role and function of farmer. In particular, the small farm is turned into a pivotal tool to protect the rural space reducing, by a diversification of agrarian activities and by an integrated approach towards other stakeholders in the countryside, the depopulation of rural space through a financial support assigned by the second pillar of the CAP based on actions and measures able to guarantee the multifunctionality in the primary sector. The consequence has been to develop and implement an integrated approach to solve socio-economic marginalization in the countryside directing financial and political efforts to set up amenities able to reinforce the sense of belonging to a rural community. Hence, during the time the role of primary sector is completely changed due both to a different role of the countryside and to a new function of farmers to protect the environment and to get better socio-economic standard living conditions. The afforestation has been important in order to reduce the pollution, to cut down overproduction issues in the European Union and to promote many recreational activities in the countryside. This transformation in the primary sector has had many effects on the model of production promoted by the European Union and by farmers. In fact, European agriculture has moved from a productivist model towards a post productivist model (Ilbery and Bowler, 1998) characterized by farmers able to offer some specific features both in terms of quantity and quality of agrarian productions and also in terms of differentiated ecological activities. Hence, the countryside it is not only a place specialized to produce commodities but it is become a place able to produce services and to solve socio-economic exclusion and rural marginalization. The multifunctionality has been a positive reaction and consequence after the transition from the productivist agricultural model to the post productivist paradigm and the multifunctionality has had a pivotal role on supporting economically and sociologically rural communities. The multifunctionality has also been a compelling tool to protect environment, generating a new green consciousness in urban territories towards the primary sector (Galluzzo, 2009); thus, the foremost effect of the post productivity model has been to assign to agriculture a function of public good able to cope positive externalities with the ambition to reduce the marginalization of rural territories in several European countries (Galluzzo, 2012a) and in particular in some of them located in mountainous and hilly areas where the afforestation has been important to protect the rural space against hydro-geologic deterioration and to develop a mixed system of production between agriculture and forest through other integrated agricultural productions as mushrooms and truffle, agro-tourism and rural craft made goods.

The main consequences of the rural development after the MacSharry's reforms have been a growth of awareness by public institutions on recognizing to the farmers a role in protecting rural space, giving grants and subside through actions such as afforestation and diversification of production in the primary sector. This has implied for farmers to plan and put into practice different activities to keep safe the

rural space both in environmental terms and also in socio-economic terms, with the consequence to increase the sense of belonging to a rural community, thus farmers, thanks to a new bottom-up approach, can not be excluded by processes of local governance (O'Hara, 1998).

The main role of a combined rural development approach has been to get better general living conditions in rural and in urban areas, both satisfying local needs (Wilsom and Whitehead, 2012) and allowing an holistic protection against climate change, by afforestation actions, in a new model of European agriculture. The aim of the European agricultural model has been to provide a well balanced and integrated development in the countryside, specifically after the reinforcement of rural and environmental issues due to a transition towards a post productivist agricultural model (Heley and Jones, 2012; Cunha and Swinbank, 2011). In particular, the agroforestation, by different actions put into place since the 1990s by the European Union, has produced positive impacts on the transition from an agrarian productivist model to a post-productivist one, reducing negative effects of overproduction, and changing the landscape in some Italian farms, where it is possible to find many arboreous cultivations close to the farms and tightly linked to Italian ethnographic traditions in the countryside. In fact, during the last 20 years, some actions of afforestation in plane agrarian areas were located in small portions of farm's surface cultivated with chestnut, walnut and other traditional Italian crops with the purpose to hand down them over the time such as a milestone of Italian rural landscape (Galluzzo, 2012b).

Aim of the paper

Many Italian regions, allocating subsides to farmers, during Agenda 2000 and the Rural Development Plan 2007-2013, have improved the level of agroforestation in different rural territories with a plenty of positive socio-economic relapses, able to improve the level of farms' income (Camaioni and Sotte, 2009).

In poor areas the environmental protection and a well balanced exploitation of agricultural natural resources are the most important factors to produce a fair level of income and an equitable socio-economic sustainability, thus the afforestation may be a positive tool to reduce poverty in rural areas, both by a development of recreational activities in the countryside and also by a diversification of agrarian production, with the consequence to support a partial justification of economic allocation through public financial actions, in terms of funds and subsides, paid by the European Union (Scherr, 2000). Some quantitative evidences have pointed out the role and function of public grants and subsides to implement rural development by afforestation, supported by European Union funds, solving many social and economic issues (Kassioumis et al, 2004) with a drop of marginalization in the countryside and a decline of rural depopulation.

The aim of this paper was to investigate and to value, using a quantitative approach, by a multiple regression model, some effects of public incentives on private afforestation (McCarthy et al., 2003) and on standard living conditions in the countryside; hence, the pivotal goal of this research was to investigate which variables have had an important role to improve the level of income in rural areas and whether actions to implement the agroforestation in country territories have had some positive interactions on the level of wealth in the primary sector comparing, in all Italian regions, the effect of afforestation actions financed by Rural Development Plans, over the six year time from 2000 to 2006 and during the following seven year from 2007 to 2013, and the level of income in Italian rural areas. A multiple regression model has been useful to explain the main and foremost interrelationships among the dependent variable income of farmers, which is a proxy variable to analyze general living conditions in the countryside, and independent variables such as amount of subsides paid by the European Union to improve afforestation actions in rural areas, afforestated surfaces and workforce employed in the primary sector (Table 1).

The second stage of this paper has estimated, comparing two years 2000 and 2012, the productive efficiency in all Italian regions using an output-oriented approach with the aim to maximize the output in terms of farmers' income combining different level of input made by the amount of subsides paid by the European Union to improve afforestation actions, afforestated surfaces and workforce employed in the primary sector.

Table 1
Definition of variables used in the quantitative multiple regression model

Variable	Definition of Variable	Value/Measure	Type of variable
AS	Afforestated surface	(000) hectares	Independent
WPS	Workforce in the primary sector	(000) of workers	Independent
RDPA	Amount of funds about afforestation	(000) €	Independent
IPS	Income in the primary sector	(000) €	Dependent

Methodology

To estimate the parameters and the different interrelationships among independent and dependent variables it has used a quantitative approach by a model of multiple regression. The multiple regression models through the Ordinary Least Square (OLS) has estimated parameters able to have some interactions on the level of farmer's income in the countryside after the allocation to farmers of European Union funds tightly linked to the afforestation. The estimation of the parameters has used the open source software GRETL 1.8.6. In its algebraic form of matrix, the multiple regression models can be so expressed (Verbeek, 2006):

$\mathbf{y} = \mathbf{X}\beta + \varepsilon$

where **y** is a dependent variable and ε is the error but both are vectors with n-dimensions

X is an independent variable which has dimension n x k.

In analytical terms, the model of multiple regression in its general formulation can be written in this way (Asteriou and Hall, 2011; Baltagi, 2011):

$y = \alpha_0 + \alpha x_1 + \beta x_2 + \gamma x_3 + \delta x_4 + \varepsilon_{jt}$

α_0 constant term

x_1, x_2, x_3, x_4 independent variables

$\alpha, \beta, \gamma, \delta$ estimated indicators or parameters of the model

ε_{jt} term of statistic error.

To make easier the comparison of statistical data about farms'income (dependent variable) and amount of funds allocated specifically by Italian Rural Development Plans to promote agroforestation (independent variable) and to reduce the variability in the dataset, it has been utilized in the multiple regression model the logarithmic transformation of some variables, such as farm's incomes and grants and subsidies allocated by European Union about agroforestation. In analytical terms the quantitative model of regression used in this paper has been:

$\ln IPS = \alpha_0 + \alpha AS + \beta WPS + \gamma \ln RDPA + \varepsilon_{jt}$

α_0 constant term

IPS stands for farms' income

AS is afforestated surfaces

WPS stands for labour force in the primary sector

RDPA is funds allocated by Italian Rural Development Plans to promote agroforestry actions in all Italian regions

α, β, γ estimated parameters of the model

ε_{jt} term of statistic error.

Basis assumptions, to use a multiple regression model, are (Gujarati, 2011; Verbeek, 2006):

a) Statistic error ε_i has conditional average zero that is $E(u_i \mid X_i) = 0$;

b) (X_i, Y_i), $i = 1,...., n$ are extracted as distributed independently and identically from their combined distribution;

c) (X_i, ε_i) have no fourth moment equal to zero;

d) there is not correlation among regressors and random noise thus, the value between β expected and β estimated is the same.

The productive efficiency in terms of an output-oriented function able to maximize the output has been estimated using the Data Envelopment Analysis to consider some features of each Decision-making unit (DMU) or Italian regions in 2000 and in 2012. The aim of this productive efficiency analysis has been to maximize the superior frontier of production (Z) using a fair amount of input and output technically efficient (Maietta, 2007) that in mathematical terms is written:

$g(x) = \max \{y|(x, y)\ Z\}$

g(x) is the function of production

y is the output

x is the input

Z is the combination technically efficient of input and output

The effect of an output-oriented function, according to Debreu-Farrell, has implied to take into account the slakes, which are instead not efficiently in an input approach, thus function of output-oriented efficient is contained in the isoquant curve (Maietta, 2007).

Results and Discussion

During the 1990s, immediately after the MacSharry's reform, and over the phase of rural development and planning in the primary sector called Agenda 2000, there has been a significant use of European Community funds to implement and to complete financially some initiatives, put into practice over MacSharry's reform in the 1990s, with the effect of stimulating other farmers to convert, to address and to transform their agricultural model of production towards a new model of European agriculture respectful of environment and the countryside.

The main results of time series of Italian Agricultural Census published by Istat (National Institute of Statistic) have pointed out a significant drop of farms, which have decreased by 48% from 1982 to 2010 and by 32% comparing the dataset of Italian Agricultural Census 2010-2000 (Figure 1). The effect of this fall of in farmers over ten years has been a growth by 2 hectares on the average cultivated surface (5.5 hectare vs 7.9). Comparing the statistical data of the Census, the most significant decrease there has been over the time 1982-2010, instead from 2000 to 2010 the agricultural cultivated surface has dropped by 2.5%. The funds and subsides allocated by the European Union to promote the afforestation over the 1990s and during the Italian Rural Development Plan 2000-2006 have had positive effects on Italian farms. In fact, the statistic data of the sixth Italian Census of Agriculture published by Istat has reported an afforestated surface of 101,630 hectares, 10,000

farmers specialized on cultivating poplar and more than 2.8 millions of hectares with wood scattered in different plane and hilly agrarian areas (Istat, 2010). During the time of observation, from 2000 to 2010, the statistical data of Italian Agricultural Census has underlined an increase in dimension of cultivated surfaces with arboreous plants and forest and a sharp growth of farmer's income due to a development of different recreation activities as agro-tourism and farmer's market and also a growth of actions and initiatives to protect environment such as the development of a biomass supply chain using the short rotation coppice or the short rotation forestry. The analysis over a long time since the 1970s has pointed out a steady growth of afforestated surface able to cover in Italy more than 9 million of hectares and unfortunately a meaningful incidence of setting fire surface; in fact, Italian surface destroyed by fire has been above 20,000 hectares every year (Figure 2).

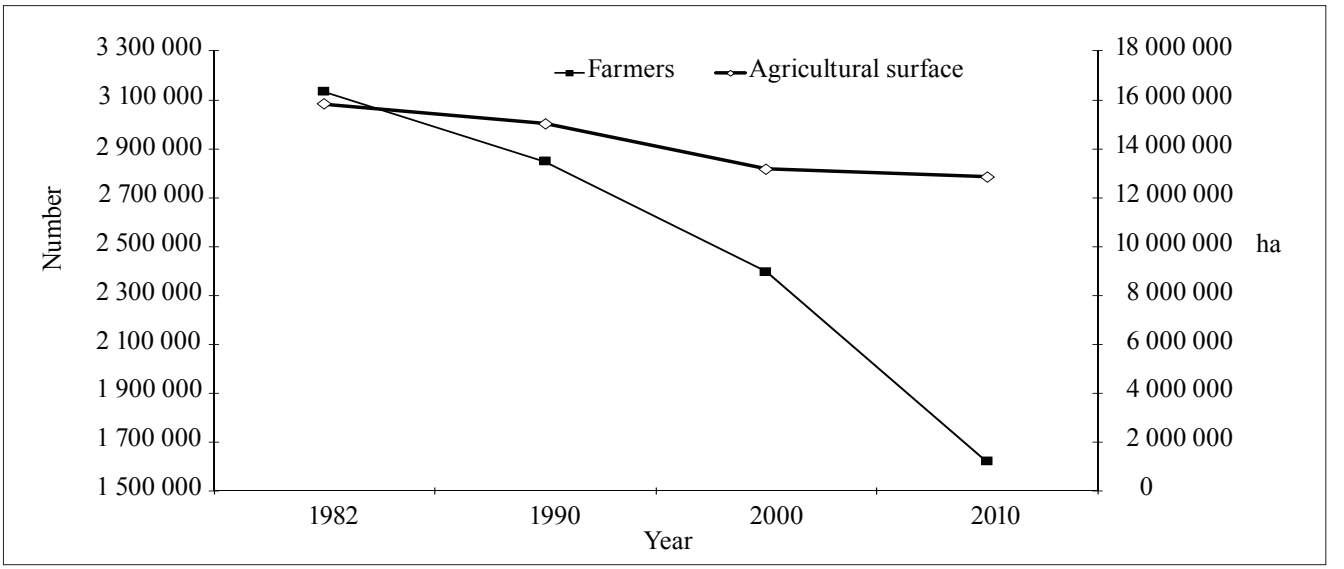

Fig. 1. Agricultural cultivated surface (AUS) and farmers in Italy
(*Source:* our elaboration on data www.istat.it Census of Italian Agriculture different years)

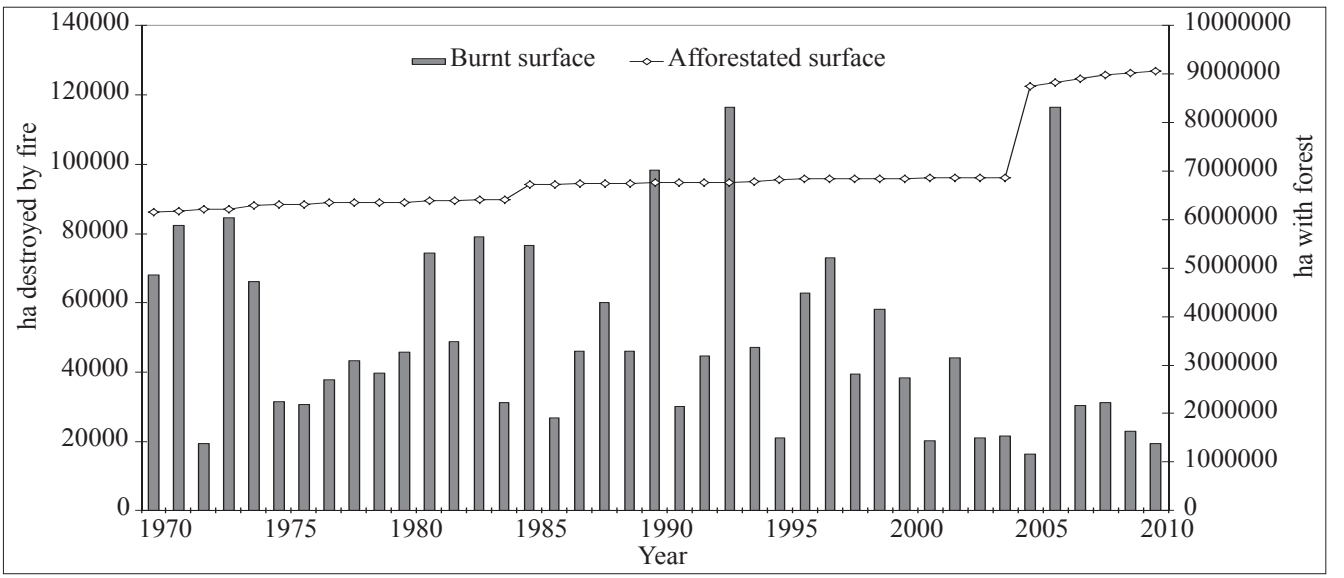

Fig. 2. Time series of afforestated surface in Italy and burnt surface by fire
(Source: our elaboration on data www.istat.it*)*

In general, the amount of European Community funds allocated by Italian Rural Development Plans to improve afforestated surfaces or other environmental actions, tightly linked to agroforestry measures, has been almost the same both during the time 2000-2006 Agenda 2000 and over the seven year time 2007-2013 (1 875 520 000 € vs 1 860 000 000 €). To describe briefly in an indirect way the impact of funds and subsides assigned by the European Union on some Italian farms to promote the afforestation it has used the dataset of FADN, which is the acronym of Farm Accountancy Data Network and it is a sample of the European Union farms used to analyze the impact of Common Agricultural Policy on rural development and on direct payments. After the MacSharry's reform in the 1990s, the main results have pointed out an increase of woodland areas near to an average value of 1 hectare and a drop on total surface out of production that is below 0.5 hectare (Figure 3). The data of the sample of Italian farms analyzed by FADN has pointed out a growth of subsides paid to improve the afforestation in rural areas, in particular by the Rural Development Plans since 2007 and a fall of subsides allocated to compensate less favored areas in rural territories by the pillar 2 of Common Agricultural Policy (Figure 4).

The statistic dataset of Istat has underlined as over the time of observation three Italian regions only have enhanced the afforestated surface and two of these are located in the north of Italy where there has been a significant percentage of agricultural areas covered by forests (Figure 5). During the investigated period of time the level of income of Italian farmers is increased by 7% and the analysis of multifunctionality by the development of rural districts, which is a proxy variable both of multifunctionality and also of an integrated pluriactivity in rural territories, has pointed out a significant growth of them; in fact, in Italy there were only 10 rural districts in 2000 and 10 years later there were more than 90 scattered in the centre and north of Italy (Galluzzo, 2008; Istat, 2012).

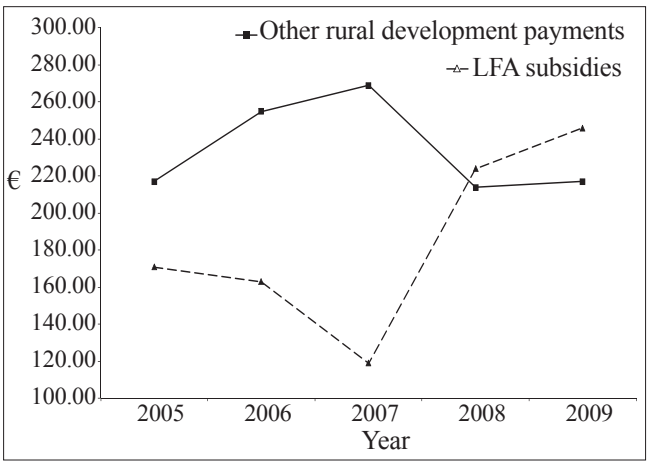

Fig. 4. Subsides and grant paid for hectare by EU to Less favored areas and to promote afforestation on a sample of FADN Italian farms

(*Source*: our elaboration on data www.ec.europa.eu/agriculture/rica/database/database_en.cfm)

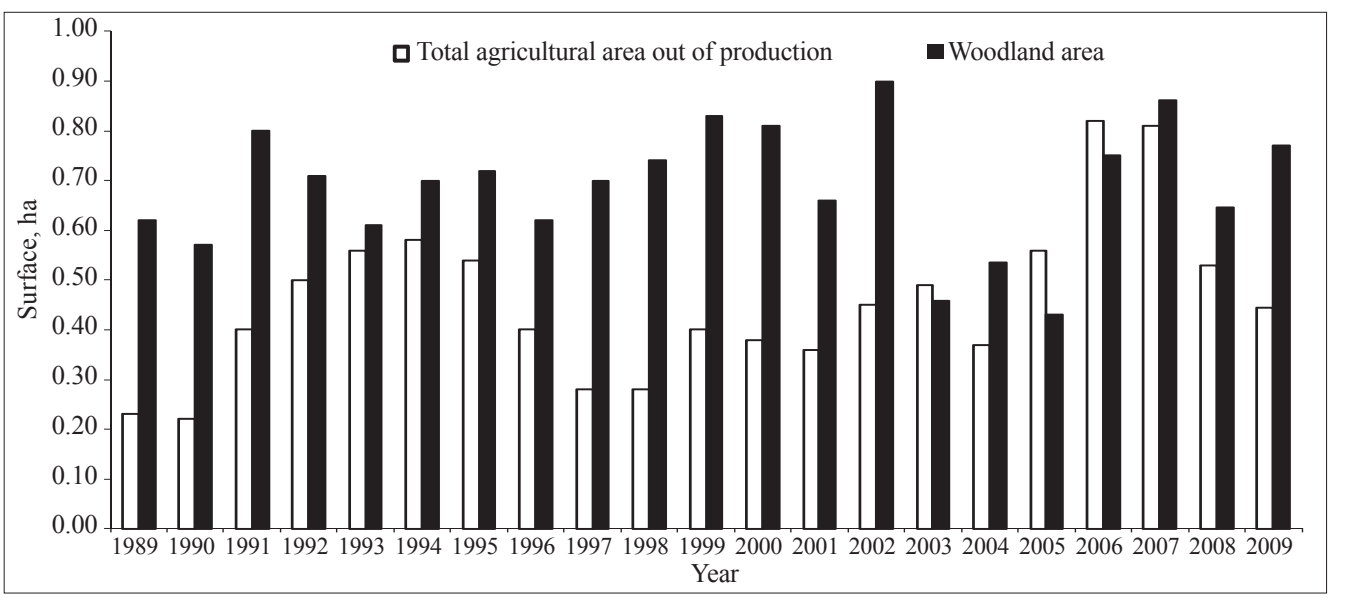

Fig. 3. Impact of woodland surface and agricultural surface out of production of a sample of FADN Italian farms

(Source: our elaboration on data www.ec.europa.eu/agriculture/rica/database/database_en.cfm*)*

The multiple regression models, during the Agenda 2000 time, has pointed out a direct correlation among the independent variables afforestated surface, workforce in the primary sector and public funds allocated by the European Union to improve afforestation actions through the Italian Rural Development Plans and the dependent variable level of income in the rural areas (Table 2). This has demonstrated as actions of improvement in rural areas by afforestation are pivotal to get better the living condition in Italian rural territories and it has underlined the fundamental function of public funds to guarantee a fair rural development, reducing rural depopulation and increasing the production of positive externalities as well. The value of R^2 and adjusted R^2 has pointed out a good consistency of the multiple regression model able to explain and to value 85% of variance. The coefficient of determination R^2 and the adjusted R^2 have pointed out a value of 0.85 that means the regression model fits well the statistical data and the adjusted R^2 (0.80) demonstrated also the model is a good prediction and a good explanation of the regression model on the total variation.

The multiple regression model, during the Rural Development Plan 2007-2013 time, has underlined a direct correlation among the independent variables afforestated surface and workforce in the primary sector and the dependent variable level of income in Italian agriculture, instead the multiple regression model has pointed out as the independent variable public funds allocated by the European Union to promote afforestation actions did not have any effect in the quantitative model to improve the level of farmer's income (Table 3). The value of R^2 and adjusted R^2 have pointed out a good consistency of the model able to value and to explain more than 81% of variance.

The productive efficiency in terms of output-oriented function able to maximize the output, using the Data Envel-

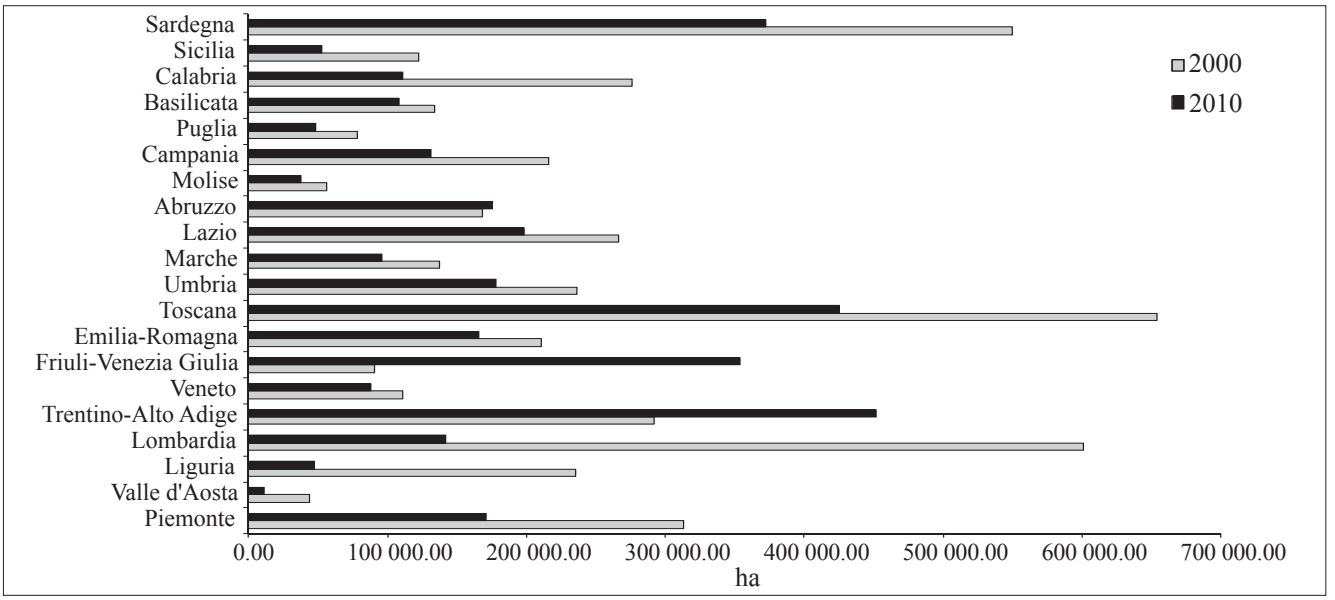

Fig. 5. Surface with forest in different Italian regions
(Source: our elaboration on data www.istat.it Census of Italian Agriculture 2000 and 2010*)*

Table 2
Main results of multiple regression model in 2000
(Source: our elaboration on data www.istat.it Census of Italian Agriculture 2000 and 2010 and European Union www.europa.eu*)*

	Coefficient	Standard error	t value	p value	Significance
Constant	6.02597	2.65402	2.2705	0.03569	**
AS	9.09917e-07	4.35335e-07	2.0902	0.05107	*
WPS	1.37922e-05	3.02844e-06	4.5542	0.00025	***
ln RDP	0.379301	0.154105	2.4613	0.02417	**
F (3, 18)	31.39295		P-value (F)	2.30e-07	

*P < 0.05, **P < 0.01, *** P<0.001

opment Analysis, has pointed out in 2012 a strong drop in efficiency in 12 Italian regions out of 20 and an increase of productive efficiency in 6 regions in which there has been a growth in financial support to promote the agroforestation (Figure 6). In general the analysis of efficiency in terms of output-oriented function has had a high value in mountainous Italian regions, in which both the public administrations have allocated a lot of financial supports and also the percentage of afforestated surface is above national average. Nevertheless, some Italian regions have had a shortage in funds to promote afforestation actions, due to political decisions about strategies and priorities of rural development, the analysis has pointed out in them an high efficiency to maximise the output and this has implied against the odds a paramount opportunity to allocate and to manage poor financial resources to increase the afforestation in rural areas.

Conclusion

To sum up, the agroforestation in Italy has been a positive tool to increase the pluriactivity in Italian farms, to get better the multifunctionality in the primary sector and also to protect rural space enhancing the level of income in rural territories. The multifunctionality and environmental protection are two main aspects required by a new generation of demanding European citizens towards the countryside and farmers. Moreover, the agroforestation is a plug for a complete, endogenous and integrated mosaic of development of rurality through the diversification of rural activities thanks to agro-tourism, certified quality food and rural districts. Nowadays, in several Italian regions located close to mountainous and hilly areas, people have changed their behavior towards farmers, who are not more a link of agro-

Table 3
Main results of multiple regression model in 2010
(Source: our elaboration on data www.istat.it Census of Italian Agriculture 2000 and 2010 and European Union www.europa.eu)

	Coefficient	Standard error	t value	p value	Significance
Constant	13.2457	1.53704	8.6177	<0.00001	***
AS	1.61131e-06	4.97278e-07	3.2403	0.00481	***
WPS	2.3725e-05	3.01689e-06	7.8641	<0.00001	***
ln RDP	-0.0421794	0.0873549	-0.4829	0.63536	n.s.
F (3, 17)	29.50195		P-value (F)	5.79e-07	

*** P < 0.001

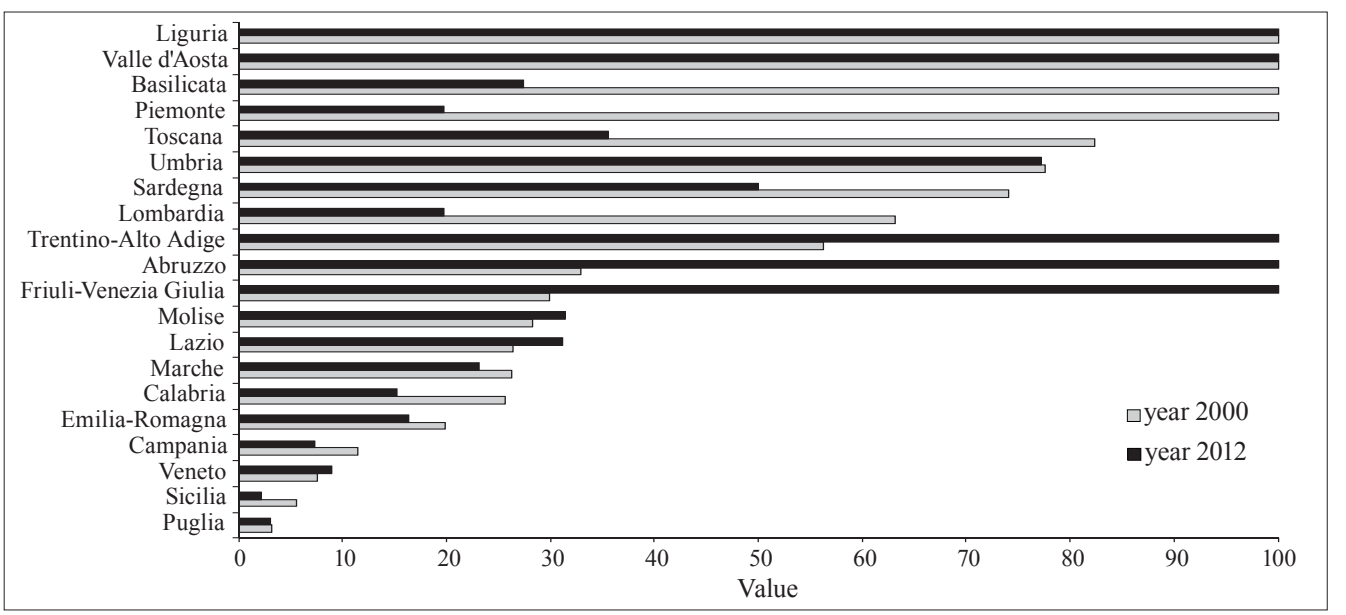

Fig. 6. Main results of output-input efficiency in all Italian regions
(Source: our elaboration on data www.europa.eu and www.istat.it)

industrial chain able to produce commodities, but they are the most and foremost pillars to protect environment and to preserve rural areas. In fact, quite often, citizens are very demanding towards farmers and public institution in order that the latter allocates funds with the purpose to finance actions to implement environment protection against pollution and other ecological issues such as landslide. The agroforestation measures financed by the European Union, associated with other interventions to promote rural development through the second pillar of CAP, have given to the farmers a specific role in preserving rural space both in terms of production of environmental protection services and also in terms of socio-economic development in the countryside.

For the next time of Rural Development Plan, from 2014 to 2020, it seems foremost to promote the disbursement by the European Union of incentives, funds and grants to promote actions of afforestation on rural spaces with the aim to develop and to reinforce towards farmers the role of recreational factor and of ecological and environmental pillar in the countryside. Thus, its is paramount to reduce some constraints about the maximum number of planted trees on hectare of cultivated surface to obtain subsides and to raise the amount of payment useful to compensate long time investments put in place by agroforestation.

In conclusion, actions of afforestation have had positive effects in the development of rural areas even if farmers and other stakeholders, taking an active part in Italian rural development, need a reduction in bureaucratic aspects to carry out easily a holistic and shared project of rural development and to reduce the rural depopulation.

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Received February, 2, 2013; accepted for printing September, 2, 2013.