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POTENTIALITIES AND UNCERTAINTIES OF NOVEL AGROFORESTRY SYSTEMS IN THE EUROPEAN C.A.P.: FARMERS' AND PROFESSIONALS' PERSPECTIVES IN ITALY

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Agroforestry systems are traditional land use practices widely evident in different agro-ecological environments. In Mediterranean areas they comprised the most important cultural models until the introduction of modern industrialised agriculture. Further, the Common Agricultural Policy (CAP) of the EU has dramatically promoted agricultural monocultures, with detrimental effects on agroforestry systems. Consequently, both tree presence across agricultural lands and the associated biological diversity have been progressively reduced. Recent research activities have highlighted interesting potentialities of modern agroforestry systems (silvo-arable systems) based on the intercropping of high quality timber species with arable crops. At present, CAP recognises agroforestry as sustainable land use practice and the current Rural Development Plans (RDP) are promoting novel agroforestry systems at farm level through the measure 2.2.2. The overall aim of the paper was to assess the potential interest in establishing and adopting silvo-arable agroforestry systems at farm level. In order to reach this aim, the paper combined two different surveys: i) an on-farm survey was utilised to investigate farmers' point of view concerning the adoption of silvo-arable systems in their farmlands in Central and Northern Italy; ii) an e-mail survey addressed to professional technicians, working as consultants in two Italian Regions (Umbria and Veneto), was utilised to evaluate their professional experience dealing with agroforestry and their attitude to promote agroforestry systems according to the measure 2.2.2 of the RDP. The results highlight the potential interest of farmers in establishing silvo-arable systems, although management constraints and economic uncertainty may strongly limit their effective adoption. From the point of view of the professionals, a lack of extension and training activities concerning agroforestry practices inhibits farmers' participation in the measure 2.2.2. Finally, the contrast between measure 2.2.2 and the current CAP, based on the Single Farm Payment, is discussed.

Key words: silvo-arable systems; on-farm survey; EU policy; participative approach; rural development.

Parole chiave: sistemi silvo-arabili; indagini aziendali; Politica UE; approccio partecipativo; sviluppo rurale.

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1. INTRODUCTION

Agroforestry consists of various groups of mixed and complex land use systems involving trees, arable crops and livestock. These systems have traditionally formed important elements of the rural landscape. Examples of traditional

agroforestry systems still dominate rural landscapes in marginal Mediterranean areas; while, under more suitable site conditions (plan and fertile areas), trees have often been removed and monocultures have drastically replaced mixed systems (BERTOLOTTO *et al.*, 1995; EICHHORN *et al.*, 2006; PISANELLI *et al.*, 2006).

This evolution has also been promoted by the prevailing orientation of the Common Agricultural Policy (CAP) of the European Union. The CAP has never recognised the peculiar status of agroforestry systems, instead supporting herbaceous or tree monocultures with specific grants. The main funding mechanism of the current CAP, the Single Farm Payment (SFP, Reg. CE 1782/2003), provides annual grant for farmers according to the net agricultural area (NAA). This mechanism may negatively affect the persistence of agroforestry trees because they may reduce NAA according to the area covered by canopy projection.

The decline of traditional agroforestry systems has strongly contributed to agro-ecosystem simplification and compounded global problems such as a shortage of good quality timber, soil erosion, biodiversity decline, water contamination with phytonutrients and agrochemicals, landscape alteration (PARIS *et al.*, 2009). In contrast, the main advantages of agroforestry systems deal with the yield diversification and the production of a short term return on land while the planted trees are still small (EICHHORN *et al.*, 2006). Appropriate management practices and a suitable combination of trees and crops may optimise the use of spatial, temporal and physical resources by avoiding competition between woody and herbaceous components (JOSE *et al.*, 2004). Research has shown that mixed systems can be more productive than monocultures, especially if trees obtain resources that would otherwise be unavailable to the herbaceous crops (CANNELL *et al.*, 1996).

European research has recently focused mainly on silvo-arable systems (SAFE project, Silvo-arable For Europe: <http://www.ensam.inra.fr/safe/english/index.htm>). Silvo-arable systems consist of widely spaced trees intercropped with annual or perennial crops. These systems can dramatically increase overall productivity and profitability in comparison with tree and crop monocultures (GRAVES *et al.*, 2007). Additionally, silvo-arable systems have shown important environmental benefits such as control of soil erosion and nutrient leaching, increased carbon sequestration and improve-

ment of landscape biodiversity (PALMA *et al.*, 2007).

The European Union has very recently adopted such positive findings and the current Rural Development Plans (RDP, Reg. CE 1698/2005) recognise the positive impact of silvo-arable systems on farming systems, including the possibility to establish, with public subsidies, the practice according to the measure 2.2.2.

Nevertheless, the application of measure 2.2.2 may be in conflict with the Single Farm Payment (SFP). In fact, according to the Reg. CE 1782/2003, the SFP is accounted in relation to the effective crop area. Consequently, the presence of agroforestry systems reduces the effective net agricultural area (NAA) and, consequently, also the amount of SFP decreases. The overall aim of the paper is to assess the potential interest in establishing and adopting silvo-arable agroforestry systems at farm level. In order to reach this aim, the following specific objectives were pursued:

1. to assess farmers' awareness of silvo-arable systems and to understand farmers' perception of potential benefits and constraints connected to the establishment of the practices into the farmland;
2. to evaluate the knowledge and interest concerning agroforestry and silvo-arable systems of professional technicians responsible to apply the measure 2.2.2 of RDP at Regional level;
3. to highlight the contrast between the application of the measure 2.2.2 and the SFP regulation.

2. MATERIALS AND METHODS

The study combined different surveys. Firstly, an on-farm survey was utilised to investigate farmers' points of view concerning the adoption of novel silvo-arable systems in their farmland. Secondly, an e-mail survey addressed to professional farm advisory technicians was utilised in order to evaluate their professional experience dealings with agroforestry and their attitude to promote agroforestry systems ac-

cording to the Measure 2.2.2 of the RDP. Finally, the reduction of SFP due to the presence of trees in agroforestry systems was simulated considering some case studies in Central Italy (Umbria and Lazio regions).

2.1. On farm survey

The survey was carried out in sample rural areas located in Central (Umbria, Marche, Toscana and Lazio Regions) and Northern (Lombardia and Veneto Regions) Italy. A total amount of 40 farmers were randomly selected and interviewed face to face during the period December 2003 - March 2004. The questionnaire was organised in different sections with the aim to investigate the following items: description of the farming systems, farmers' knowledge and perception of agroforestry systems, farmers' interest to establish silvo-arable systems.

2.2. Professional technicians survey

A questionnaire was submitted by email to a random selection of professional technicians who are consultants for the application of Rural Development Plans at regional level. The survey was carried out in summer 2010 and was focused on Umbria and Veneto Regions, the regions where the Measure 2.2.2 was applied and calls were launched. A total amount of 27 professional technicians responded to the questionnaire.

2.3. SFP and agroforestry systems: study cases

In order to assess the impact of agroforestry systems on SFP, different examples of agroforestry systems were considered (linear systems and scattered trees). SFP reduction due to the tree presence was calculated in relation to the tree density of the agroforestry systems. The simulation was performed considering the criteria established in the Reg. CE 1782/2003.

3. RESULTS

3.1. On-farm survey

The average age of the interviewed farmers was about 50 years and most of them identified one of their children as a possible successor

for managing the farm. Cereals and permanent woody crops (olive trees – *Olea europea*, and vineyard – *Vitis vinifera*) represent the most common agricultural practices in the surveyed farms, especially in Central Italy. Trees are usually present on farms (scattered or lined up in hedges and rows along field boundaries). A small number of farmers, located in Northern Italy on the plain, manage forest plantations for timber production (with walnut – *Juglans regia*, wild cherry – *Prunus avium*, black locust - *Robinia pseudoacacia*, and *Paulownia* spp.).

Farmers showed a divergent knowledge and awareness of the agroforestry concept. Only 35% of the interviewed farmers indicated that they knew about agroforestry systems; 35% of the respondents associated agroforestry systems to the tree planting on farmland; 30% of the farmers had no specific knowledge of agroforestry. Although about one third of the farmers asserted that silvo-arable systems have few benefits, most of them perceived these systems as an opportunity to obtain high quality timber production and, thus, they consider agroforestry as a possible option to diversify and integrate farm income as the main productive benefits (Figure 1).

Moreover, farmers believed that agroforestry systems have a positive environmental impact, in particular in terms of air and water quality, biodiversity preservation and landscape value. On the other hand, according to farmers' evaluation, the major constraints of agroforestry systems are the following: the yield depression of intercrops; a lack of available labour; management complexity; and obstacles to the mechanisation of the cultural practices due to the presence of trees into the fields (Figure 2).

Most of the farmers would be interested in establishing silvoarable systems in their farm lands. Timber and fruit production would be the main productive aims of the hypothetical silvo-arable systems. According to the farmers' opinion, the most suitable species to be used in agroforestry systems would be walnut, cherry, oaks (*Quercus* spp.), olive trees and other fruit species; and the intercropped herbaceous species would preferably be cool season annual

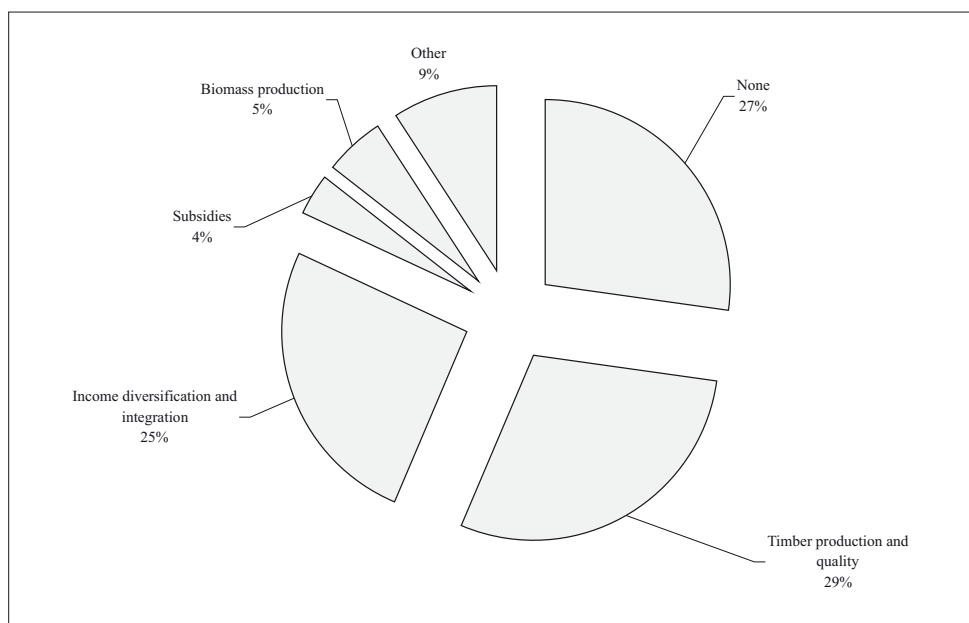


Figure 1 – Farmers' perceptions of the main benefits of novel silvoarable systems.

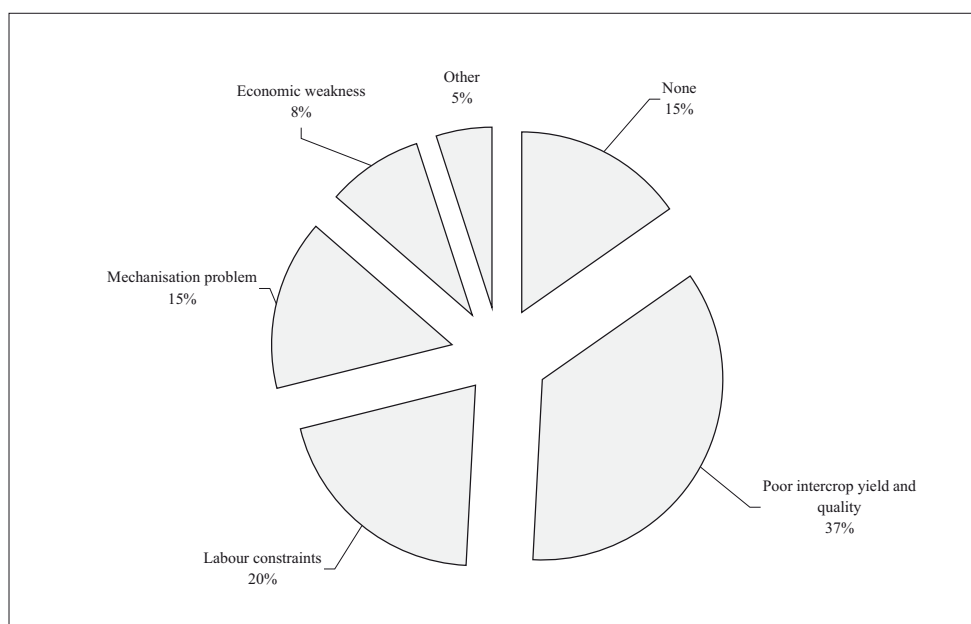


Figure 2 – Farmers' perception of the main disadvantages of novel silvoarable systems.

crops. This solution is based on the desire to reduce the competition for soil moisture and solar radiation between trees and intercrops. In fact, most of the chosen trees shed their leaves in late autumn and winter, with tree budburst initiating in late spring. These periods are also

characterized by abundant precipitation and mild temperatures, in most of the climatic conditions of Italy; these conditions allow the growth and development of the cool season intercrops without detrimental shading by the tree canopy.

Because of the investment costs and the uncertainties of an economic return, almost all the interviewed farmers asserted the need to obtain public subsidies for the establishment of silvo-arable systems and argued that the economic contribution should cover at least 50% of the investment costs.

3.2. Professional technicians survey

Most of the interviewed professional technicians was less than 40 years old (66%) and had less than 10 years of working experience (63%) dealing with consultant activity at farm level. The total farm area in which the professionals carried out consultancy activities ranged between less than 5 hectares up to more than 50 hectares, (about 35% of the farms are between 25 and 50 hectares and 32% are more than 50 hectares). The dominant pattern of the surveyed farms include herbaceous crops (37% of the farms), permanent tree cultivation with olive trees and vineyards (37% of the farms), fodder crops in combination with breeding (19% of the farms) and breeding (7%).

According to the surveyed professionals, 45% affirmed that they have already developed experiences in establishing agroforestry systems, while the remaining

55% has never promoted such systems at farm level. Furthermore, 70% of the professionals affirmed their knowledge of measure 2.2.2 and all those interviewed argued that agroforestry systems are cultural models appropriate to the characteristics of the territory in which they are operating. They asserted that the most promising systems should include linear systems (edges and rows) and silvo-arable systems for timber production. The most suitable species included valuable broadleaves such as walnut and wild cherry, or fast growing species like hybrid poplars (Figure 3). They argued that the choice of the species should be done according to the site conditions, such as sufficient soil moisture or irrigation availability, and the soil quality.

However, 54% of the respondents affirmed that agroforestry systems are not profitable for farmers and that public grants would be necessary in order to make these practices attractive for farmers. In addition, 69% of the interviewed professionals asserted that the presence of agroforestry systems in farm land reduces the available net agricultural area (NAA) and, thus, the total amount of the SFP grant would be reduced.

Finally, 90% of interviewed professionals

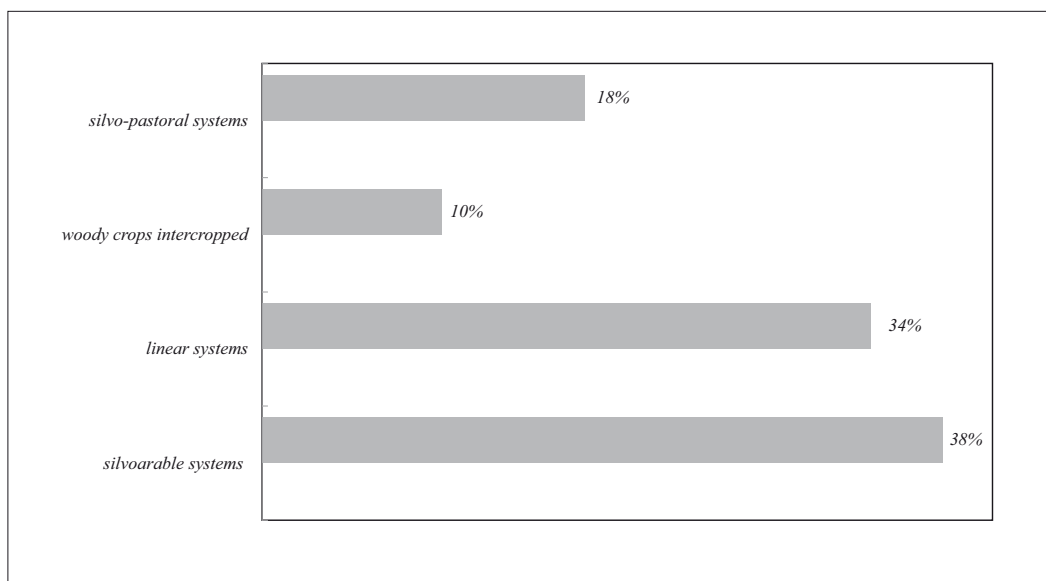


Figure 3 – Most promising agroforestry systems according to the interviewed professionals.

recognized that the actions of Public Administrations for the promotion of measure 2.2.2 fell far short of what was needed, and asserted that more extension activities should be necessary.

3.3. Study cases for assessing the impact of agroforestry systems on the SFP

The study cases were focused on both linear systems (hedges or rows in the field boundary) and scattered trees. According to the Reg. 1782/2003 criteria, the SFP is reduced if a linear system is more than 2 m wide. In case of scattered trees, the criteria are the following:

reduction is applied; ii) tree density between 50 and 100 trees/ha: the NAA is reduced by 100 m² per ha; iii) tree density higher than 100 trees/ha: NAA is reduced by 5 or 10 m² per tree according to its dimension. According to those criteria, the incidence of agroforestry systems on the SFP calculated in selected study cases is shown in Table 1.

In case of a novel walnut silvoarable system, established by applying the Measure 2.2.2, planting 50 trees ha⁻¹, after 20 years of tree growth, it would have a reduction by 18% of the SFP grant; after 40 years, the hypothetical harvesting time of the plantation, the SFP reduction would be by 57% (Figure 4).

Table 1 – Study cases of the reduction of Single Farm Payment (SFP) due to the presence of agroforestry trees in the arable lands.

Field area (ha)	Agroforestry system	Dimension	Density	Expected SFP (€year ⁻¹)	Effective SFP (€year ⁻¹)	SFP reduction (%)
1.86	Linear system	104 x 5-8.5 m	56 m/ha	540	522	3.43
1.66	Linear system	104 x 3-4 m	65 m/ha	386	380	1.78
2.21	Linear system	173 x 5.5-14 m	78 m/ha	760	714	6
18.31	Scattered trees	84 trees	5 trees/ha	3103	3103	0

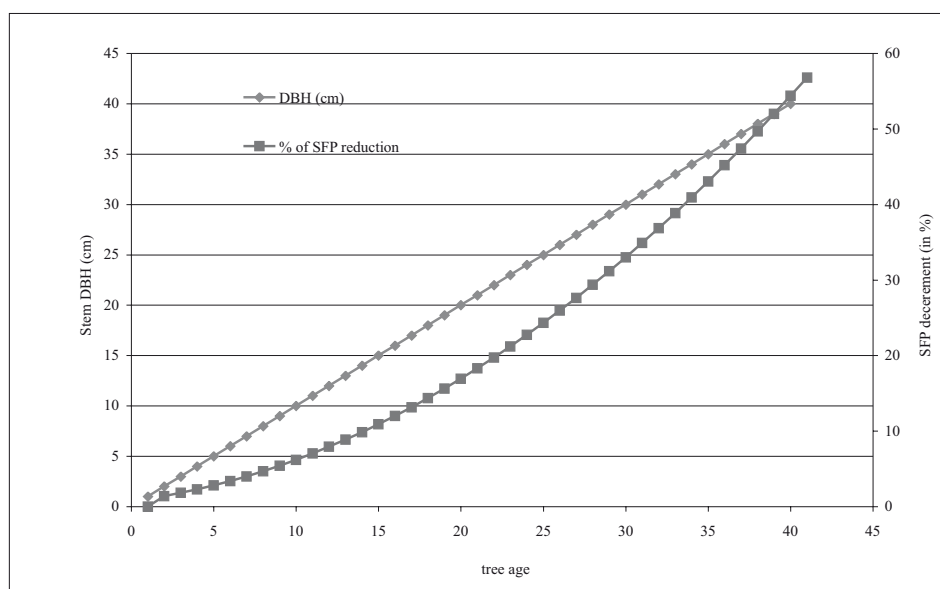


Figure 4 – Novel silvo-arable systems with walnut (*Juglans regia* L.) at 50 trees/ha. Simulation of the walnut growth (stem diameter - DBH) and reduction of the Single Farm Payment (SFP) throughout the rotation cycle of the trees.

4. DISCUSSION

The research results highlighted both constraints and potentialities for the adoption of silvo-arable systems at farm level within the current CAP in Italy.

The survey allowed a better understanding of farmers' perception and knowledge of agroforestry systems and the identification of the main factors affecting the interest in establishing silvo-arable systems in different environmental and socio-economic contexts across Italy.

The farmers' positive perception is recognised to be an important step of the technology adoption process (FRANZEL *et al.*, 2002). The majority of the investigated farmers have demonstrated knowledge of the concept of agroforestry systems, in particular in relation to traditional systems that were common in Italy before the wide adoption of modern industrialised agriculture. Recently, as a consequence of the CAP reform and to the introduction of plantation forestry on agricultural soils (in particular since the application of the Reg. CEE 2080/92), farmers have become more familiar with the presence of timber trees on arable lands and now they recognise the environmental functions and economic profitability of trees.

Nevertheless, farmers identified several constraints to the establishment of modern silvo-arable systems. The market risk, the limited income perspectives, the high investment costs and the intercrop yield depression due to the decreasing of the useful cropping areas represent the main economic constraints. Moreover, the mechanisation problems due to the tree presence on the fields, the farm fragmentation and small farm area, the management complexity, the lack of available labour and the lack of knowledge are the main technical problems.

Farmers suggested several research themes that should be developed in order to improve the feasibility of silvo-arable systems. These research themes should promote a more efficient management of the practices (choice of the species in relation to site conditions, genetic improvement of planting materials),

the dissemination of knowledge (strengthening the collaboration between research centres and agricultural stakeholders through more efficient local extension services) and the building of enhanced supply chains (identification of market perspectives throughout the development of integrate chain involving research centres, industries, farmers and public institutions). Some of those constraints have been removed by CAP, now recognising that trees and crops are compatible with modern agriculture as the SAFE project stated (DUPRAZ, 2005).

The survey addressed to the technicians evidenced that most of the farmers' consultants know about agroforestry, although most of them have never promoted and suggested these systems to the farmers. The survey highlighted that most of the professionals know about the measure 2.2.2 but its application is strongly limited mainly because a lack of promotion at the institutional level (training and extension activities). Moreover, the negative impact of agroforestry trees on the net agricultural area and the resultant reduction of SFP grant amount may discourage farmers from planting trees on arable lands. This problem is not at all clearly addressed in the current CAP. There is no clarity regarding the calculation of the net agricultural area eligible for CAP grants throughout the entire rotation cycle of the agroforestry systems.

5. CONCLUSIONS

Currently, multifunctionality is a prerequisite of modern agriculture. Agro-ecosystems must be able to provide a wide range of benefits and services, enabling and reinforcing social, ecological and economic functions of land use systems. Landscape diversity, air and water quality, human employment, food safety and quality represent the most important values of rural areas.

Although this study has highlighted a dramatic contradiction between current CAP and Rural Development Plans, future perspectives of agroforestry systems may be encouraging.

Silvo-arable systems, in particular, represent a potential interesting option for farmers aiming to differentiate their productive objectives. CAP has evolved during the last 20 years, crop and tree monocultures are still the dominating supported land uses, but now it is also recognized the peculiar status and value of agroforestry systems. The Reg. CE 1698/2005 affirms that *Agro-forestry systems have a high ecological and social value by combining extensive agriculture and forestry systems, aimed at the production of high-quality wood and other forest products. Their establishment should be supported.* It must be remarked the important role of the research activity, such as the implementation of the SAFE project, in supporting this sentence. In fact, one of main objective of the SAFE project was to suggest unified European policy guidelines for implementing agroforestry and, it seems, that this deliverable was successfully reached.

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RIASSUNTO

Potenzialità ed incertezze di sistemi agroforestali innovativi nella PAC europea: il punto di vista degli agricoltori e dei tecnici professionisti

I sistemi agroforestali sono pratiche tradizionali di uso del suolo ampiamente diffuse in diversi contesti agro-ecologici. Nelle aree mediterranee questi sistemi hanno rappresentato i più importanti modelli culturali fino all'avvento della moderna agricoltura industrializzata. In seguito la Politica Agricola Comune (CAP) dell'UE ha fortemente promosso la diffusione di un'agricoltura di tipo monocolturale, generando effetti deleteri sui sistemi agroforestali. Come conseguenza, sia la presenza di alberi nei terreni agricoli che la biodiversità biologica ad essi associata si sono progressivamente ridotte. Recenti attività di ricerca hanno evidenziato le interessanti potenzialità di sistemi agroforestali moderni (sistemi silvo-arabili) che si basano sulla coltivazione congiunta (*intercropping*) di specie forestali a legno pregiato e di colture arabili. Ad oggi

la PAC riconosce l'*agroforestry* come pratica sostenibile di uso del suolo, e gli attuali Piani di Sviluppo Rurale (PSR) stanno promuovendo la diffusione di nuovi sistemi agroforestali a livello aziendale attraverso la misura 2.2.2. L'obiettivo generale del presente contributo è stato quello di valutare il potenziale interesse nell'adozione e nella realizzazione di sistemi agroforestali silvo-arabili a livello aziendale. Per raggiungere questo obiettivo, il contributo ha combinato due diverse indagini: i) una indagine condotta a livello aziendale finalizzata ad indagare il punto di vista degli agricoltori in merito all'adozione di sistemi silvo-arabili nelle loro aziende in Italia centro-settentrionale; ii) una indagine condotta via email dedicata ai professionisti della consulenza attivi in due regioni italiane (Umbria e Veneto), finalizzata a valutare la loro esperienza professionale sull'*agroforestry* e la loro attitudine a promuovere lo sviluppo di sistemi agroforestali attraverso la misura 2.2.2 del PSR. I risultati evidenziano il potenziale interesse degli agricoltori nel realizzare sistemi culturali silvo-arabili, sebbene limiti gestionali e incertezza economica limitino fortemente la loro effettiva adozione. Dal punto di vista dei professionisti, la mancanza di attività formative e informative sulle pratiche agroforestali inibiscono l'adesione degli agricoltori alla misura 2.2.2. Infine il contributo discute il contrasto che si è ricreato tra la misura 2.2.2. del PSR e i pagamenti unici aziendali previsti dall'attuale PAC.

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298 bianca