Effectiveness of the GAEC cross compliance standard *Protection of permanent pasture: prohibition to convert permanent pasture into arable crops* in avoiding habitat deterioration

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Abstract

By the end of the 19th and beginning of the 20th century new developments in agricultural technology caused an intensification of the agricultural practices. Species adapted to the diversity of structures or resources of high naturalistic value farmlands, like permanent pasture, cannot survive under increasingly high intensity agricultural management. The Italian MD n.30125 dated 22/12/2009 (Standard 4.1) defines, among the measures for the protection of permanent pasture and avoidance the deterioration of habitats, the prohibition to convert permanent pasture into arable crops and to till with the exception of agricultural practices related to the renewal and/or thickening of the sward and to the drainage water management. Permanent pastures biodiversity performs key ecological services and if correctly assembled in time and space can lead to agroecosystems capable of sponsoring their own soil fertility, crop protection and productivity. The vegetative cover of permanent pasture prevents soil erosion, replenishes ground water and controls flooding by enhancing infiltration and reducing runoff. The changes of land use or some practices change insect community and vegetation diversity. Physical disturbance of the soil caused by tillage increases risk of erosion and reduces the recycling of nutrients and proper balance between organic matter, soil organism and plant diversity. Is necessary a habitat preservation policy because after a change, even a return to past management would not completely re-establish the complex structure of habitats.

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Introduction

Rural Europe offers a great diversity of cultural landscapes that reflects many centuries of dynamic interaction between people and their natural environments (Plieninger *et al*., 2006; Bignal and McCracken, 2000). The traditional agricultural management, established during agricultural expansion, has generated many habitats now important for biodiversity (Bignal and McCracken, 2000). During the last fifty years, because of the intensification of the agricultural practices, the habitats that actually have been preserved in order to protect the biodiversity in Europe have lost most of their characteristics and their related living organisms (Vazzana and Lazzerini, 2007). Most grassland landscapes in Europe represent habitat where rare plants and animal species will be considered depending directly or indirectly from grazing use. Some grassland vegetation types, linked to grazing use, can host some endemic rarities (Caballero *et al*., 2009). Species adapted to the diversity of structures or resources of high naturalistic value farmlands cannot survive under increasingly high intensity agricultural management (Firbank, 2005; Chamberlain *et al*., 2000). By the end of the 19th and beginning of the 20th century new developments in agricultural technology caused a marked decline in extensively pasture management (Ellenberg, 1996). This intensification was recently accelerated under the Common Agricultural Policy (CAP) (Muhlenberg and Slowik, 1997) based until the 80's on supporting price policy and on agricultural productivity protection. Mac Sharry reforms of 1992 and later on the Agenda 2000 introduced a different policy based on the maintenance of low-input and more sustainable agriculture. The Regulation (EC) 1782/03 introduced for the first time the concept of *Cross Compliance*. It means that the income subsidy is only available in its full amount if the farmer meets certain environmental requirements (Good Agricultural Environmental Conditions - GAEC). In particular this Regulation recognized the positive environmental effect of permanent pasture. The measures in that Regulation aimed at encouraging the maintenance of existing *permanent pasture* to avoid a massive conversion into arable land. The Regulation (EC) n. 1120/2009 defines permanent pasture a land used to grow grasses or other herbaceous forage, naturally (self-seeded) or through cultivation (sown), and that has not been included in the crop rotation of the holding for five years or longer. The Italian MD n. 30125 dated December 22nd, 2009 applies the Council Regulation (EC) n.73/2009. Particularly the Annex II standard 4.1 defines, among the measures for the protection of permanent pasture and avoidance the deterioration of habitats, the prohibition to convert permanent pasture into arable crops and to till with the exception of agricultural practices related to the renewal and/or thickening of the sward and to the drainage water management.

The aim of this paper is to assess the effectiveness of this Rule in accordance to the recent bibliography.

State of the art

Permanent pasture protection, occurred in the last years thanks also to the EC policy, contributed to increase of the pasture surface in Italy (Figure 1); before 2003 there has been a sensible reduction up to 3,336,405 ha (Table 1). The presence of a permanent herb layer brings about a higher biodiversity and soil protection in pasture compared to other agricultural land uses. Then, degradation of habitat, due to the changes in land use connected with tillages, is characterized by a worsening of structure and biological quality of the soil (Van Eekeren *et al*., 2008; Toderi *et al*., 2005) and by a reduction of biodiversity. Biodiversity is important because it produces many ecological services being given by all species of plants, animals and micro-organisms existing and interacting within an ecosystem (Van der Meer and Perfecto, 1995). Recent land use changes have rapidly reduced the biodiversity of agricultural landscapes (McNeely *et al*., 1995). Abandonment, as well as specific management treatments have major impacts on species richness and composition (Poschlod *et al*., 2005). Some authors (Korneck *et al*., 1996; Van der Meijden *et al*., 2000), have documented the effects of changes in land use monitoring continuously flora and fauna. Restoration habitats after conversion to more managed agricultural systems often does not produce the species richness and composition associated with original communities (Poschlod *et al*., 2005; Bakker and Berendse, 1999). Only 12 species of grain crops, 23 vegetable crop species and about 35 fruit and nut crop species are normally used in the world's agricultural lands (Fowler and Mooney, 1990); Italian flora includes 7634 *taxa*, 1021 of which are endemic (Conti *et al*., 2005), many of them are linked to pasture ecosystems (Arrigoni and Di Tommaso, 1991; Scoppola *et al*., 2005). Kleijn *et al*. (2009) compared plant species diversity among 130 grassland and 141 arable fields in six European countries. He found that plant species richness was significantly negatively related to land use intensification in both field types and that this is largely the responses of rare species. Although no many studies have been done about it, it results obviously that converting permanent pasture in other land uses could cause a reduction of vegetal species and habitat degradation (Figures 2 and 3). It's not necessarily true that a return to past management could bring to a past vegetation composition, although over a long time scale, as Firbank *et al*. (2000) showed in their model of vegetation change. In England and Wales, 97% of enclosed unimproved grassland was lost until 1984 (Fuller, 1987), and only 1-2% of the cover of permanent lowland grassland now supports plant communities of high conservation value (Blackstock *et al*., 1999). This loss and degradation of British grassland has been attributed to agricultural intensification during the twentieth century (Fuller, 1987; Hopkins *et al*., 2000). These habitat changes have been associated with population declines in species from a range of taxonomic groups, including farmland birds (Chamberlain *et al*., 2000), vascular plants (Rich and Woodruff, 1996) and various insect groups (Asher *et al*., 2001; Critchley *et al*., 2003). Great numbers of species of plants and insects depend on such semi-natural grassland.

The loss of vegetal biodiversity can directly affect abundance and diversity of insects. Agricultural landscape composed of a large set of plant species, such as permanent pasture, can lead to the creation of multiple habitats of reproduction, feeding and sheltering for a number of beneficial arthropod species (Altieri, 1994). In grassland habitats, insect diversity can be affected by habitat management. The changes of land use or some practices may change the associated insect community through deep alterations of plant growth, plant architecture and vegetation diversity (Kruess and Tscharntke, 2002; Strong *et al*., 1984; Huntly, 1991). Some types of management like low-intensity grazing

Table 1. Share of land uses in total utilized agricultural areas in Italy.

Year	Utilized agricultural area (UAA) Arable land	Grasslands and permanent pastures	Permanent crops	Total
1990	8,106,753	4,106,080	2,733,760	14,946,593
1993	8,124,978	3,917,765	2,693,305	14,736,048
1995	8,283,397	3,758,216	2,643,835	14,685,448
1996	8,332,306	3,747,206	2,673,594	14,753,106
1997	8,251,925	3,860,167	2,721,013	14,833,105
1998	8,329,223	3,828,739	2,808,130	14,966,093
1999	8,385,853	3,727,121	2,883,557	14,996,531
2000	7,297,406	3,418,084	2,346,766	13,062,256
2003	7,317,204	3,336,405	2,462,202	13,115,811
2005	7,075,224	3,346,951	2,285,671	12,707,846
2007	6,969,257	3,451,756	2,323,184	12,744,196

Source: ISTAT 2007.

Figure 1. Permanent pasture in Sardinia (Italy).

Figure 2. Plant species diversity in a permanent pasture (Sardinia, Italy).

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are often associated with biological diversity in anthropogenic habitats such as grasslands (Tscharntke and Greiler, 1995; Wettestein and Schmid, 1999). Various plants, weeds for crops, play an important ecological role by hosting and supporting a complex of beneficial arthropods that aid in suppressing pest populations. Many species of insects, found in these habitats, are beneficial as natural control agents against pests; others are important in the diet of wild birds (Thomas and Marshall, 1999).

Different land use kinds play different effects on the soil biological quality. Unlike what happened in untilled permanent pasture, some authors (Fromm *et al*., 1993; Yeates *et al*., 1998; Lamandè *et al*., 2003) have demonstrated a negative impact of ploughing on soil biotic component. Comparing four different agricultural managements (permanent grassland, two temporary ley-arable crop rotations and permanent arable cropping) Van Eekeren *et al*. (2008) saw that biological soil quality was significantly higher in permanent pasture.

The number of earthworms measured in permanent arable cropping treatment resulted lower than 88% compared to the permanent grassland treatment. Also Low (1972) observed that in arable crop the number of earthworms was about 11-16% of what measured in pasture. Likewise (Van Eekeren *et al*., 2008), the number of nematodes and bacterial and fungal biomass measured in permanent arable cropping was 52%, 65% and 80% respectively, compared with what observed in the permanent pasture treatment. The outnumbered nematodes observed in permanent grassland was due to a higher herbivorous nematodes number related to a greater number of roots observed at a depth of 10 cm, that probably provide better the food to sustain nematodes. Moreover, in ley-arable crop rotation major functions of soil *biota* are reduced or lost; restoration of soil biota and its functions in ley phase is only temporary, due to the following arable phase of crop rotation. So, soil quality, considered as a combination of physical, chemical and biological properties, is strictly related to the use of the soil and to the type of agricultural management (Lal, 1993; Caravaca *et al*., 2002). Impact of different soil tillage practices on soil quality is higher than that of other agronomical practices.

In a research carried out in the South of Italy, Marzaioli *et al*. (2010), observed lower values of microbiotic and nutritional parameters than other natural or semi-natural uses in almost all the tilled systems. Tillages cause a physical disturbance that is a crucial factor in determining soil biotic activity and species diversity in agroecosystems, because at least 15-25 cm of the stratified surface soil horizons are replaced with a more homogeneous one concerning its physical characteristics and residue distribution (Figure 4).

These practices cause a negative reduction of the density of species that inhabit agroecosystems: for a productive and ecologically balanced soil environment is necessary the recycling of nutrients and proper balance between organic matter, soil organism and plant diversity (Hendrix *et al*., 1990; Altieri, 1999). The vegetative cover of permanent pasture prevents soil erosion, replenishes ground water and controls flooding by enhancing infiltration and reducing runoff (Perry, 1994; Altieri, 1999). Several authors have studied the effect on the soil generated by tillage/untillage describing the possible negative results on the erosion due to the cropping with traditional techniques in slope areas (Bazzoffi *et al*., 1987; Boschi *et al*., 1984; Chisci *et al*., 1985; Rossi Pisa *et al*., 1989). In the North of Sardinia (Porqueddu and Roggero, 1994) losses of soil caused by erosion have been measured around 0.2 t ha-1 year^{-1} in a untilled pasture, while in a continuously tilled field around 5 t ha^{-1} year^{-1}. Moreover, runoff coefficient in pasture resulted always lower than 2%; otherwise, tilled treatment showed values around 23%. This confirms that sward reduces successfully the run-off speed, as other authors observed (Zanchi, 1978; D'Egidio *et al*., 1981). In general, the tillage practices cause a worsening of the structure, chemical and biological properties of the soil (Oldeman, 1994; Lal, 1993) (Figures 5 and 6).

Figure 3. Species density reduction in another land use in relation to permanent pasture (Sardinia, Italy).

Figure 4. Permanent pasture degraded by ploughing for 4 years (Sardinia, Italy).

Figure 5. Erosion in a permanent pasture ploughed after 8 years of no-tillage (Sardinia, Italy).

Figure 6. Tilled soil in permanent pasture. Evidence of raising erosion (Sardinia, Italy).

Synthetic response in terms of quantity and/or quality

Permanent pasture ensures floristic diversity and ecosystem complexity, which are particularly susceptible to management arrangements. The conversion of these systems to other uses would reduce the amount and diversity of the individuals composing them with consequent habitat degradation.

Also the use of soil tillage techniques in this type of habitat leads to a reduction of the soil biological quality and an increased risk of erosion.

Conclusions

Currently, natural and semi-natural habitats such as permanent pastures are biodiversity reserves and play an important role as ecological corridors in a landscape dominated by farmland and abandoned land. Conservation of these high natural value systems is related to the intensity of anthropic pressure on land and thus its management system. Other land use results in a reduction of biodiversity and as consequence in habitat degradation.

Biodiversity in fact, performs key ecological services and if correctly assembled in time and space can lead to agroecosystems capable of sponsoring their own soil fertility, crop protection and productivity (Toderi el al., 2005). Furthermore, permanent pasture provides protection and soil conservation due to a permanent sward, which reduces the action of the rain, decreases run-off speed, directly and indirectly improves soil structure (Talamucci, 1984).

In the Mediterranean basin, pastures are mostly confined to the mountainous and hilly areas with shallow soils, steep slope, stoniness and rocky outcrops (Porqueddu and Roggero, 1994). The lack of soil tillage in permanent pasture leads to soil structure evolution and supports flora and fauna development increasing the biological quality. A change of permanent pasture in other land use represents a loss of biodiversity, and in general causes a degradation of habitats.

Habitat preservation policy urges, since after a never change a return to past management would not re-establish completely the complex structure of habitats (Firbank *et al*., 2000).

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