

**ENVIRONMENTAL INDICATORS FOR FARMLAND HABITATS:
THE SITUATION IN ITALY**

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-- Plenary Session 2 --

Ecosystem/Habitats Impacted by Agricultural Activities

Tuesday 6 November 2001

Paper presented to the:

**OECD Expert Meeting on Agri-Biodiversity Indicators
5-8 November 2001
Zürich, Switzerland**

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ABSTRACT

The aim of this paper is to define and quantify environmental indicators for farmland habitat in Italy. Based on OECD works and recent developments by the Joint Working Party in the area of agri-environmental indicators, we classify agricultural habitat in three main categories: intensive, semi-natural and uncultivated (natural or man-made) habitats located within, at the border and adjacent of agricultural areas. We discuss the importance of using an appropriate index to quantify the total agricultural land area and compare habitat indicators over different periods of time. For each habitat category, we propose additional or alternative indicators that may contribute to better represent Mediterranean regions and agri-ecosystems. We compare the definition of semi-natural habitat to alternatives criteria (high nature value farmland habitats, low input agricultural systems, extensive agricultural production systems, etc.) and indicate which might be the most appropriate criterion to quantify indicators for agri-environmental policies evaluation. The critical issue of the minimum dimension of uncultivated (natural or man-made) habitat within farmland ecosystems is also discussed. In line with the OECD approach, we quantified each indicator for the territory of Italy at different periods (from 1970 to 1995), underscoring problems related to data constraints caused by the insufficiency of available national statistics and the use of alternatives instruments of habitats quantification (aerial photos and satellite images).

Keywords: indicators, agri-environmental policy, agricultural habitat, wildlife habitat, ecosystems, Italy.

1. Introduction

In past decades interest in environmental protection increased vis-à-vis agricultural habitats and biodiversity. The main reasons for this are probably the general development of conservation attitudes towards nature in the face of the increasing impact of human activities over time, the increase of leisure activities and the increase of funds for nature conservation. Consequently, environmental and agri-environmental policies have been developed to protect natural resources on agricultural land and to involve farmers in the process of nature protection and improvement (EC and Birdlife, 1994; Dixon, 1994).

One of the main issues in the definition and realization of these policies is understanding which are the main sources of impact produced by agricultural activities on the environment and which are the most important species and habitats to protect or improve. In order to reach an understanding of the cause of major impacts we need to closely examine the problem, to photograph the situation, to understand the agricultural system and territory and its evolution over time. Indicators represent a useful synthesis for describing agricultural systems; they also represent tools to help policy-makers to define and ameliorate environmental and agri-environmental policies.

Recently we have witnessed the development of study and research in the area of environmental indicators. The work of IUCN (1993), UNEP (1995), FAO (1999), EUROSTAT (1999), EC (2001) and OCDE (2001) are examples of this and provide a point of reference in the subject. This paper intends to focus on environmental indicators for farmland habitat following the OCDE approach and, in particular, recent developments by the Joint Working Party in agri-environmental indicators following the meeting of York. The JWP defined three main categories of farmland habitats: intensive, semi-natural and uncultivated (natural or man-made) areas. This will also form the structure of the present paper wherein each habitat category will represent a specific paragraph. We discuss the definition of each habitat category on the basis

of the Italian situation and data available, then quantifying each indicator for the Italy in different periods (from 1970 to 1995).

2. Intensively farmed agricultural habitats

2.1 Definitions and quantification

“Intensively farmed areas are artificial habitats subject to regular disturbance of the soil and dominated by annual and perennial crop species, ... these areas are commonly treated with fertilizers and pesticides and subject to farm management practices, such as ploughing, sowing, weeding, and harvesting” (OECD, 2001). Even if there is not a commonly accepted definition of this habitat, its identification and distinction from the other two categories of agricultural habitats seems quite simple and straightforward.

Although these areas have a reduced value for wildlife, with priorities instead focussed on production activities, they do provide the habitat for various components of biodiversity (vascular plants, invertebrates, small mammals and birds), while in some geographic areas they play a determinant role for certain wildlife species (migratory birds, hares, pheasants, partridges, etc.). Moreover, the emergency produced by past and present biodiversity reduction evidenced in several studies (Tucker and Heath, 1994), points out the urgent need for improved study, understanding and classification of territories where intense agricultural activities are present in order to define parameters and indicators for differentiating territories and crops in terms of their different impact or importance to biodiversity and wildlife.

Up until now the evaluation and quantification of these territories have been performed mostly using official statistics taken from the agricultural census and, to a lesser extent, through aerial photos and satellite images interpretations (Corine Land Use classification and other land use maps)². The agricultural census has been designed to quantify agricultural activities and farmlands; therefore, some details are present to so as to make distinctions within the cultivated areas of the agricultural habitat.

Official statistics defines three main types of cultivation within the total agricultural land area (t.a.l.a.): arable crops, permanent crop (fruit crops) and permanent forage crops (permanent meadows and pastures). In a first rough distinction we include arable crops and fruit crops in the group of intensive agricultural habitats and permanent forage crops in the group of semi-natural agricultural habitats (Table 1).

² This is true in recent times in Italy (2000) where the digitised maps commonly available have minimum units of 25 hectares (Corine Land Use maps) or 2.25 hectares (other land use maps available only for certain regions).

Table 1 - National and Agricultural Land Area

Main categories of land use, areas (000 hectares), percentage on total agricultural land area and total national land area (Italy 1970-1997)*

	1970			1975			1980			1985			1990			1997**		
	he	% (1)	% (2)	he	% (1)	% (2)	he	% (1)	% (2)	he	% (1)	% (2)	he	% (1)	% (2)	he	% (1)	% (2)
Arable Crop Area	9 455	53.3	31.4	9 273	52.9	30.8	9 400	53.5	31.2	8 949	52.4	29.7	8 899	52.8	29.5	8 252	55.6	27.4
<i>Improved Forage Crop Area</i>	2 774	15.6	9.2	2 752	15.7	9.1	2 859	16.3	9.5	2 859	16.7	9.5	2 397	14.2	8.0	2 333	15.7	7.7
Permanent Crop Area	2 916	16.4	9.7	2 968	16.9	9.9	2 953	16.8	9.8	3 064	17.9	10.2	2 960	17.6	9.8	2 721	18.3	9.0
Permanent Pasture Area	5 313	29.9	17.6	5 204	29.7	17.3	5 126	29.2	17.0	4 980	29.1	16.5	4 868	28.9	16.2	3 860	26.0	12.8
Total Agricultural Land Area	17 740	100	58.9	17 517	100	58.1	17 562	100	58.3	17 094	100	56.7	16 839	100	55.9	14 833	100	49.2
Forest	6 169	20.5	20.5	6 306	20.9	20.9	6 354	21.1	21.1	6 429	21.3	21.3	6 750	22.4	22.4	6 843	22.7	22.7
Other area (3)	3 251	10.8	10.8	3 220	10.7	10.7	3 057	10.1	10.1	2 777	9.2	9.2	2 602	8.6	8.6	1 551	5.1	5.1
AGRIC. & FORESTAL LAND AREA	27 160	90.2	90.2	27 043	89.8	89.8	26 973	89.5	89.5	26 300	87.3	87.3	26 191	86.9	86.9	23 227	77.1	77.1
UNPRODUCTIVE AREA (4)	3 036	10.1	10.1	3 083	10.2	10.2	3 152	10.5	10.5	3 828	12.7	12.7	3 925	13.0	13.0	n.a.	0.0	0.0
TOTAL NATIONAL LAND AREA	30 124	100	100	30 126	100	100	30 127	100	100	30 128	100	100	30 128	100	100	30 128	100	100

* Definitions of land area categories are drawn from FAO (1999). Source of data, I.S.T.A.T. (1970, 1975, 1980, 1985, 1990, 1997. ** Uncompleted data. (1) Percent on total agricultural land area. (2) Percent on total national land area. (3) Includes: abandoned fields, temporary uncultivated fields, building areas, parks and gardens, non-cultivated farm areas. (4) Includes: buildings, roads, unproductive areas, water body areas and wetlands, etc. n.a.: not available.

2.2 Differences within intensively farmed agricultural habitats

Some parameters may afford the basis for differentiating agricultural territory in order to understand which situation or crops may be the cause of major impact and/or which cultivations are particularly favourable to some species or group of species. The most common parameters are: type of crops cultivated, production methods, spatial composition of the cultivated areas, proximity to other categories of habitats, etc. (OECD, 2001).

Crops may be distinguished on the basis of the following: number of chemical treatments, kilograms per hectare of chemical products applied, total number of farm operations, number of farm operations with high impact, etc., or with more detailed measures. On this basis an impact matrix for crops and group of wildlife species can be formulated to define different level of impact by crops or group of crops. Field studies involving different species or groups of species may test and verify this impact matrix as time goes on.

A complementary approach consists of a matrix on habitat use by single or group of species in line with a recent Canadian work based on an habitat matrix (Neave and Neave, 1998). However, the problem of this approach is the high level of informations needed for each single crop or group of agricultural crops.

On the basis of main crop impacts on wildlife and the principal characteristics of Italian cultivations we divided intensive agricultural crops into various groups and sub-groups (Table 2). Arable crops have been subdivided into winter cereals, improved forage crops, row crops, flower crops and fallow or set-aside fields³. Fruit crops have been subdivided into apples/pears, peaches/apricots/plums/cherries/etc. (stone fruits), vineyards/kiwi, olives, citrus, nuts and others.

³ Row crops include: others cereals (maize and sorghum), proteoleaginous crops (sunflower, soybean, rape-seed, peanut, charlok, sesame, bird rape), other industrial crops (sugar beet, tobacco, common flax, cotton, oil meal) and vegetable crops (root crops, vegetables open field, vegetables tunnel, grain leguminous).

Table 2 - Intensive agricultural land area*

Intensive agricultural crops, areas (000 hectares), percentage of intensive agricultural land area and of the total agricultural land area (Italy, 1970-1997).

	1970			1975			1980			1985			1990			1997**		
	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾
A INTENSIVE AGRICULTURAL LAND AREA (3)	12 544	100	70.7	11 959	100	68.3	12 109	100	69.0	11 860	100	69.4	11 705	100	69.5	10 965	100	73.9
A.1 (Most intensive crop area) (4)	5 204	41.5	29.3	4 860	40.6	27.7	4 993	41.2	28.4	5 383	45.4	31.5	5 565	47.5	33.0	5 503	49.1	37.1
1 Arable crop area	9 311	74.2	52.5	9 274	77.5	52.9	9 400	77.6	53.5	8 949	75.5	52.4	8 899	76.0	52.8	8 252	73.6	55.6
1.1 Improved Forage Crops (5)	2 774	22.1	15.6	2 752	23.0	15.7	2 859	23.6	16.3	2 644	22.3	15.5	2 397	20.5	14.2	2 333	20.8	15.7
1.2 Winter cereals (6)	4 249	33.9	24.0	4 039	33.8	23.1	3 955	32.7	22.5	3 874	32.7	22.7	3 612	30.9	21.5	2 884	25.7	19.4
1.3 Row crops:	2 276	18.1	12.8	1 884	15.8	10.8	2 032	16.8	11.6	2 310	19.5	13.5	2 597	22.2	15.4	2 543	22.7	17.1
1.3.1 Others Cereals (7)	973	7.8	5.5	769	6.4	4.4	887	7.3	5.1	926	7.8	5.4	792	6.8	4.7	1 069	9.5	7.2
1.3.2 Proteolegineous Crops (8)	10	0.1	0.1	26	0.2	0.1	32	0.3	0.2	195	1.6	1.1	643	5.5	3.8	600	5.4	4.0
1.3.3 Others Industrial Crops (9)	370	2.9	2.1	333	2.8	1.9	357	2.9	2.0	313	2.6	1.8	363	3.1	2.2	296	2.6	2.0
1.3.4 Vegetable Crops	923	7.4	5.2	756	6.3	4.3	756	6.2	4.3	876	7.4	5.1	876	6.8	4.7	578	5.2	3.9
1.3.4.1 Grain leguminous	416	3.3	2.3	232	1.9	1.3	192	1.6	1.1	193	1.6	1.1	152	1.3	0.9	65	0.6	0.4
1.3.4.2 Root crops	168	1.3	0.9	138	1.2	0.8	137	1.1	0.8	139	1.2	0.8	121	1.0	0.7	91	0.8	0.6
1.3.4.3 Vegetables	339	2.7	1.9	386	3.2	2.2	427	3.5	2.4	544	4.6	3.2	526	4.5	3.1	422	3.8	2.8
1.4 Flower Crops	12	0.1	0.1	8	0.1	0.0	8	0.1	0.0	9	0.1	0.1	8	0.1	0.0	n.a.	0.0	0.0
1.5 Fallows or Set-aside	396	3.2	2.2	591	4.9	3.4	543	4.5	3.1	422	3.6	2.5	416	3.6	2.5	247	2.3	1.7
2 Irrigated perm. meadows (10)	317	2.5	1.8	308	2.6	1.8	299	2.5	1.7	269	2.3	1.6	262	2.2	1.6	n.a.	0.0	0.0
3 Permanent crop area (11)	2 916	23.2	16.4	2 968	24.8	16.9	2 953	24.4	16.8	3 064	25.8	17.9	2 960	25.3	17.6	2 960	26.4	20.0
3.1 Apples/Pears	551	4.4	3.1	341	2.9	1.9	266	2.2	1.5	121	1.0	0.7	72	0.6	0.4	121	1.1	0.8
3.1.1 Intensives	137	1.1	0.8	126	1.1	0.7	119	1.0	0.7	121	1.0	0.7	72	0.6	0.4	121	1.1	0.8
3.1.2 Mixed with arable crops	414	3.3	2.3	215	1.8	1.2	147	1.2	0.8	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
3.2 Peaches/Cherries/etc.	432	3.4	2.4	366	3.1	2.1	308	2.5	1.8	137	1.2	0.8	169	1.4	1.0	161	1.4	1.1
3.2.1 Intensives	101	0.8	0.6	109	0.9	0.6	114	0.9	0.6	137	1.2	0.8	169	1.4	1.0	161	1.4	1.1
3.2.2 Mixed with arable crops	331	2.6	1.9	257	2.1	1.5	194	1.6	1.1	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
3.3 Vineyards/kiwi	1 917	15.3	10.8	1 908	16.0	10.9	1 756	14.5	10.0	1 109	9.4	6.5	1 072	9.2	6.4	928	8.3	6.3
3.3.1 Intensives	1 212	9.7	6.8	1 309	10.9	7.5	1 308	10.8	7.4	1 109	9.4	6.5	1 072	9.2	6.4	928	8.3	6.3
3.3.2 Mixed with arable crops	705	5.6	4.0	599	5.0	3.4	448	3.7	2.6	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
3.4 Citrus	206	1.6	1.2	205	1.7	1.2	209	1.7	1.2	184	1.6	1.1	184	1.6	1.1	179	1.6	1.2
3.4.1 Intensives	156	1.2	0.9	161	1.3	0.9	167	1.4	1.0	184	1.6	1.1	184	1.6	1.1	179	1.6	1.2
3.4.2 Mixed with arable crops	50	0.4	0.3	44	0.4	0.3	42	0.3	0.2	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
3.5 Olives	2 253	18.0	12.7	1 057	8.8	6.0	2 138	17.7	12.2	1 207	10.2	7.1	1 149	9.8	6.8	1 131	10.1	7.6
3.5.1 Intensives	973	7.8	5.5	1 057	8.8	6.0	1 050	8.7	6.0	1 207	10.2	7.1	1 149	9.8	6.8	1 131	10.1	7.6
3.5.2 Mixed with arable crops	1 280	10.2	7.2	1 115	9.3	6.4	1 088	9.0	6.2	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
3.6 Nuts (12)	741	5.9	4.2	646	5.4	3.7	505	4.2	2.9	209	1.8	1.2	199	1.7	1.2	162	1.4	1.1
3.6.1 Intensives	212	1.7	1.2	245	2.0	1.4	170	1.4	1.0	209	1.8	1.2	199	1.7	1.2	162	1.4	1.1
3.6.2 Mixed with arable crops	529	4.2	3.0	401	3.4	2.3	335	2.8	1.9	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
3.7 Others (13)	225	1.8	1.3	191	1.6	1.1	154	1.3	0.9	40	0.3	0.2	49	0.4	0.3	49	0.4	0.3
3.7.1 Intensives	13	0.1	0.1	24	0.2	0.1	17	0.1	0.1	40	0.3	0.2	49	0.4	0.3	49	0.4	0.3
3.7.2 Mixed with arable crops	212	1.7	1.2	167	1.4	1.0	137	1.1	0.8	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

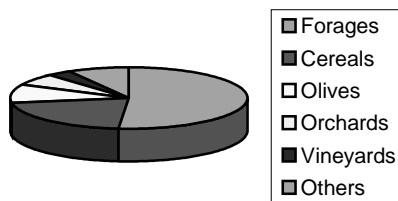
* Source of data, I.S.T.A.T. (1970, 1975, 1980, 1985, 1990, 1997. ** Uncompleted data. (1) Percent on total intensive agricultural land area. (2) Percent on total agricultural land area. (3) Includes categories: 1, 2 and 3. (4) Includes categories: 1.3, 1.4 and 3. (5) Monospecific and polyspecific temporary forage crops, monospecific and polyspecific temporary meadows. (6) Wheat, barley, oat, rice, rye and secondary cereals. (7) Maize and sorghum. (8) Sunflower, soybean, rape-seed, peanut, charlok, sesame, bird rape. (9) Sugar beet, tobacco, common flax, cotton, oil meal. (10) See note 3 in table 5. (11) Include only intensive permanent crop area (fruit crops). (12) Walnut, almond and hazel. (13) Quince, common pomegranate, common persimmon, common fig, carob, white mulberry, etc.

Row crops and flower crops belong to the main impacted group of crops because of the number of chemicals treatments and number of farm operations. We have distinguished winter cereals (wheat, barley, oats, rye, etc.) from others cereals because of the reduced amount of chemical treatment and farm operations (from 1 to a maximum of 4 or 5) performed in a less dangerous period for wildlife (fall and winter). Improved forage crops are considered as a group apart, because of their general importance to biodiversity and environment. Fallow and/or set-aside land are kept separate because of their extensiveness and importance for several species of wildlife. Because of that, they should instead be included in the group of semi-natural habitats. In different ways, therefore, these last three groups have different reasons prompting separation. Several studies have shown the importance of these areas for wildlife species (Southerton *et al.*, 1994; Wilson *et al.*, 1996; Evans, 1997).

Method of production is another important factor of differentiation. Within intensive agricultural habitats we may find very different production systems: organic/biological agriculture, integrated agriculture, integrated pest management, conservation tillage operation, crop rotation, etc. The problem here is about definition and comparison of alternative production systems or farm operations involving different countries, but also involving different regions of the same country. Distinct legislation, traditions, evolution in the farm sector, etc. are present, whereas detailed information on the production system are often not available. The only alternative production method allowing consistent comparison between different countries at present is organic/biological agriculture; this is due to its long tradition, common EU legislation (EEC Reg. 2091/91 and 2200/96) and contacts through international organizations (IFOAM, OILB/SROP, etc.). An overview of its evolution and development in Italy is presented in Table and Figure 3.

Table and figure 3 - Evolution of organic farms in Italy and type of crops involved*.

Years	n° of farms	Areas (he)	% t.a.l.a.
1985	600	5 000	0.03
1986	700	5 500	0.03
1987	800	6 000	0.04
1988	900	7 500	0.04
1989	1 100	9 000	0.05
1990	1 300	11 000	0.07
1991	1 500	13 218	0.08
1992	1 830	16 850	0.10
1993	4 189	70 674	0.42
1994	9 042	154 028	0.93
1995	10 851	202 208	1.22
1996	17 393	305 641	1.85
1997	31 118	564 913	3.43
1998	43 698	788 070	4.79
1999	49 188	953 057	5.67



* Data includes established and conversion farms.

Sources: N. Lampkin Welsh Institute of Rural Studies.
Centro studi AMAB (1985-92); Bio Bank (1992-99).

Spatial composition of the cultivated areas or crop pattern are another important factor in differentiation between different areas of intensive agricultural habitat. This involves cultivated habitat fragmentation, heterogeneity, vertical vegetation structure, etc. (OECD, 2001), which may be evaluated using such parameters as: average field size, number and type of crop rotations, growth stages of different crops in different seasons, etc. Average field size appears to be an interesting indicator because it is an indirect measure of ecotones, crops heterogeneity and development of field margins from different cultivation areas. Moreover, it is an indicator that could be quantified and compared homogeneously over time and within different countries. Presently in Italy data are neither available from the agricultural census nor from aerial photos and satellite images. However, the rapid development of these instruments will help to better quantify such information for different agricultural areas or bioregions.

2.3. Transition between intensive and semi-natural agricultural habitats

How is it possible to distinguish within agricultural habitats between intensive and extensive cultivation? Definitions reported in each paragraph ought to help to identify and separate different habitats, but some degree of “undefined areas” is always present especially when different habitats have to be quantified using whatever information and tools available.

Within intensive agricultural habitats the slight information currently available in agricultural census data are of no help in distinguishing the intensity of the production level for forage crops (improved and permanent), winter cereals and fruit crops. Improved forage crops or improved meadows mostly fall under intensive agricultural crops because of intensive cutting (three or five cuts per year). However, some of such cultivations, in southern regions or upland areas, have seen a reduced level of production with only one or two cutting periods. Also, among the category of permanent forage crops, that are generally extensive meadows or pastures, the sub-category of irrigated permanent meadows should be considered more as improved meadows and therefore be included in the category of intensive agricultural habitats. Agricultural census data define and quantify this sub-category; therefore, these hectares are added and subtracted in tables 2 and 5. Winter cereals belong to the category of intensive crops; however, in some Mediterranean regions such as Puglia, Sicilia, Basilicata, etc., the particularly low intensive production, without use of pesticides and with a very reduced use of fertilizers, warrents including these cultivations in the extensive group.

Also included in the category of fruits crops are some cultivations that are particularly extensive. For example, olives and nuts in certain regions (mostly Southern regions or upland marginal territories) are characteristic of reduced intensity in cultivation. These areas should be included in the category of extensive or semi-natural habitats. However, present agricultural census data do not distinguish between intensity of production methods; therefore only future improvement in census methodology will allow such territories to be evaluated and included in the group of semi-natural habitats⁴. In the category of fruit crops, we should mention that in the recent past in Italy, as in many other European countries, mixed cultivation of fruit crops and arable crops were also present in the agricultural system. This type of cultivation was particularly interesting in light of the heterogeneity of agri-ecosystems and should be included in the category of semi-natural habitats. However it almost disappeared in the last three decades (Table 2). Currently it is present only as a residue of old agricultural production systems and therefore insignificant in areas.

Another point of uncertainty concerning the classification as intensive or extensive cultivation relates to the presence of alternative methods of production, such as the following: organic/biological agriculture, integrated agriculture, integrated pest management, conservation tillage operation, etc. There is a degree of uncertainty to be defined as to whether these cultivations ought to fall under intensive or extensive

⁴ In a recent work Petretti (1995) mentions 1.033.590 hectares of extensive olive cultivation in Mediterranean Italian regions, but the criterion employed is not clear.

agricultural habitats. The subject will receive fuller treatment in the next paragraph on semi-natural agricultural habitats.

2.4. Indicators

Recently OECD (2001) has defined two main indicators for intensive agricultural habitats: 1) the share of each crop in the total agricultural area; 2) the share of organic agriculture in the total agricultural area. These indicators seem the most adequate for application at the international level due to ease of quantification and comparison between different countries. However, some further refinements and discussion about their improvement and evaluation would be in order. For example, is “total agricultural land area” the best dividend to be considered? Or dealing about intensive crops, would it not be better to compare crops areas to “total intensive agricultural land area? Comparing the two parameters found in Table 2, the second appears to better underline changes over time and is less likely to be influenced by other changes in the area of non-intensive cultivation (semi-natural agricultural habitats). However, we should point out that all changes for the two types of percentage over time take the same direction (increase or decrease), although with different intensity. In addition, “total agricultural land areas” is a more well-established and generally accepted parameter than “total intensive agricultural land areas”, which has not yet been defined and accepted at the international level.

Another point about the first indicator is that reporting the share of each crop would result in a long list of percentages difficult to summarize. For this reason it appears important to define criteria on how to group different crops. The most appropriate criterion would be based on different impacts on environment or on the different role of wildlife species relative to each crop. The approach based on the crops impact matrix and habitat use matrix mentioned in paragraph 2.2 may be applied to define a set of crops. A simple grouping based on the main impact differences between crops is defined in Table 2, while a description of the criterion used to group different crops is reported in the same paragraph.

Concerning the second indicators, organic agriculture is actually the most well-defined sustainable production method quantified and compared between different countries. However, in past decades there has been considerable development of different sustainable production methods, so that we should take them into account as potential indicators of different agricultural systems or crop cultivation within intensive agricultural areas. Some examples of these cultivation methods have already been mentioned. The share of the area involved in a specific sustainable method of production (internationally recognized and comparable) or all other sustainable methods of production (except organic agriculture) in the total intensive agricultural area may represent an additional indicator to the organic agriculture ones.

Another important indicator for intensive agricultural areas is the average field size, or average field size of main crop categories. This represent an index of agricultural heterogeneity and ecotones within cultivated areas. Such indicators may be differentiated by crop, group of crops or eco-regions (plain, hill, mountain, etc.). This data in some countries may be available from the agricultural census or, in the next future, from the elaboration of aerial photos or satellite images.

2.5 The situation and evolution

Total agricultural land area (t.a.l.a.) currently (1997) represents around 50% of Italian total national land area (t.n.l.a.). The trend of this territory to decrease, common to most of the “developed” countries, has been particularly intense in the last 40 years, down from 60% of t.n.l.a. in 1970 to perhaps less than 50% of t.n.l.a. in 2000 (Table 1). More than 2,900,000 hectares of agricultural areas were lost in 30 years. The rate of reduction is one of the highest within European and OECD countries (OECD, 2001). Total intensive agricultural land area (i.a.l.a.) represents a major part of the t.a.l.a. (70%), revealing a particularly intensive use of this territory compared to other countries. The decrease in this area after 1960 was surprisingly low from 1970 to 1980 in terms of expectations, with an increase of the share of intensive territory as compared

to a.l.a. (Tab 2). The reasons are probably attributable to the contemporary marked reduction in permanent pastures and meadows and the increase involving a part of intensive crops (mostly vegetable oil crops and fruit crops) in this decade.

Within the intensive agricultural land area, intensive fruit crops represent some 22-25% of the t.a.l.a., showing that a significant part of the agricultural territory is used for this type of intensive and permanent crops. Excluding from the analysis the no longer extant extensive fruit cultivation mixed with arable crops, the specialised and intensive fruit cultivations constantly increased after the World War II, in both absolute (he) and relative (%) terms. The increase was mostly due to the stone fruits categories (peaches, apricots, plums, cherries, etc.), while citrus and olives steadily increased compared to apples and pears, which steadily decreased. Vineyards and kiwi instead increased until 1980 then decreased until 1990.

Arable crops comprise the major portion of intensive agricultural crops, representing 76-78% of the t.a.l.a. The trend of arable crops was quite similar to agricultural land area; mostly decreasing over time; however, in terms of share of t.a.l.a., it increased from 1970 to 1980. Within this category winter cereals, which represent the most important group of crops ranging from 20 to 24% of the t.a.l.a., steadily decreased, although with a reduced rate in the last twenty years. Improved forage crops increased slightly until 1980, but markedly decreased in the last fifteen years. Irrigated permanent meadows likewise steadily decreased. The category of row crops evidenced a different trend compared to other crops, decreasing until 1980 because of the influence of leguminous grain that almost disappeared from 1960 to 1980, and greatly increased from 1980 to 1990 because of the positive influences of proteoleagineous crops (mostly soy beans and sunflowers). Fallow or set-aside land has increased recently because of set-aside programs instituted by EC and EU regulations, but which previously were always present in significant areas due to the importance of fallow lands in crop rotation systems.

If we look separately at a sub-category of the “most intensive crop area”, represented by intensive fruit crops, row crops and flower crops, we observe a clear upward trend for this group as a share of t.a.l.a. This trend was particularly pronounced in the last 20 years, as a consequence of the incentives provided by European agricultural policies to proteoleaginuous crops.

3. Semi-natural agricultural habitats

3.1 Definitions and quantifications

The first problem we face regarding semi-natural or extensive agricultural habitats concerns the definition of the same. Many definitions and studies have been elaborated in the past as well as in recent times, concerning this type of habitats or agricultural production systems. The most common concepts and terms used are: extensive agriculture/crops, low intensity farming systems, low impact agriculture, sustainable agricultural systems, high-nature-value farming systems/habitats and semi-natural agricultural habitats. In addition to the matter relative to terminologies employed, the real problem is how to define exactly this part of the total agricultural habitat. Which parameters should we use? According to previous works (Beaufoy et al., 1994; Baldock, 1999; OCDE, 1997, 1999 and 2001; Genghini and Busatta, 2001), the leading concept is about the way agricultural systems are realised in a certain territory or area. This way, of course, refers not to the conventional or intensive way, but to ways pertaining to the extensive, the reduced intensity, the low impact, the relevance to biodiversity or single wildlife species, etc. The following points may help to define and identify this type of habitat. The first assumption is that these semi-natural habitats are part of agricultural territory, where some kind of agricultural activities are, or were recently present. The following describe the potential categories of habitats to be considered:

- 1) Where traditional agricultural systems with a reduced environmental impact or with a certain importance to wildlife species are present (i.e., alpine cattle breeding, called *alpeggio* in Italy; livestock raising on dry grasslands, stubble fields or wooded and shrubby pasture land; pasture areas where transhumance is practised; traditionally-cultivated olives and nuts, etc.).

- 2) Where recent agro-naturalistic or eco-touristic activities without significant environmental impact are present.
- 3) Extensive or low intensive agricultural cultivations with low input (particularly chemicals products) and a low level of other human intervention (i.e., farm operations)⁵.
- 4) Heterogeneous agricultural areas where small patches of agricultural fields are alternate to small patches of woodlands, shrubs, wetlands or natural areas⁶.
- 5) Fallow land or long term set-aside (more than 5 years).

Table 4 – Extensive or low intensive agricultural cultivations*

HABITATS	MANAGEMENT	PRODUCTION PRACTICES
Extensive permanent grassland	No fertilisers treatments (mineral or manure) and no pesticides treatments	Fodder production (maximum two cuts per year) and limited grazing. Grazing limited to short periods (1-2 weeks), maximum twice a year.
Low intensity permanent grassland	Low fertilisers use (only manure) and no pesticides treatments	Fodder production (maximum two cuts per year) and limited grazing. Grazing limited to short periods (1-2 weeks), maximum twice a year.
Meadows used for litter	No fertilisers and no pesticides	Primarily cut for litter, hence not used for fodder. Meadows maybe on marsh land.
Extensive pastureland	No fertilisers treatments (apart from manure from livestock grazing) and no pesticides treatments	Grazing with low animal density or limited to short periods.
Wooded pastureland	No fertilisers treatments (apart from manure from livestock grazing) and no pesticides treatments	Wood cover on 5-50 % of pasture area.
Extensive cultivation of winter cereals	Low fertilisers use (only manure), no pesticides treatments and no irrigation	Stubbles maintained for long period.

*(OECD, 1998 mod.; Genghini and Busatta, 2001)

Consistent with the OECD approach (2001), we exclude, in the category of semi-natural agricultural habitat, uncultivated (natural or man-made) habitats present and scattered over the agricultural territory. Quantification of semi-natural agricultural habitats is particularly complex and difficult in a large-scale territories. At the opposite extreme, data for small areas and/or limited territories can be evaluated and refined on the basis of work in the field or by interviews of farmers. In large territories (provinces, regions,

⁵ For a detailed definition of extensive or low intensive agricultural production, see Table 4 (OECD, 1998).

⁶ The reduced intensity of cultivation in these areas occurs because it is evaluated in a comprehensive territory of both, small patches of intensive cultivations and small patches of uncultivated or forested areas.

states), we should supplement information with the aid of agricultural census reports, official statistics, aerial photos and satellite images. In Italy the agricultural census and official statistics only approximately estimates these areas (Table 5).

In Table 5 semi-natural agricultural habitats exclude relevant areas that are surveyed in the census in intensive agricultural habitats (see paragraph 2.3)⁷ and include some cultivations that cannot be considered truly extensive or semi-natural⁸. Probably there are also some others areas not surveyed as agricultural territory, and therefore are to be found listed under the categories of “forests”, “others areas” and “unproductive areas” (Table 1), and are not taken into account in Table 5.

Official statistics on hectares involved in agri-environmental programs may help to quantify areas of extensive or semi-natural agricultural habitats, but these areas may overlap data contained in the agricultural census. Therefore, care should be taken in the selection of cultivated areas to be included in the category of semi-natural agricultural habitats. The improvement of semi-natural agricultural habitats classification and its application in agricultural census methodology would help in the future to ameliorate the quantification of such habitats.

The use of aerial photos and satellite images interpretation currently available do not help to quantify these types of habitats mostly because the intensity of production methods cannot be derived from images or photos. In general, digitalised maps based on Corine Land Cover and Regional Soil Use classifications are not designed for the purpose of evaluating agricultural territory and cultivation. In fact, the minimum survey unit⁹ is too large to quantify agricultural fields in detail. Nevertheless, the rapid evolution in these types of tools would help in the near future to ameliorate such evaluations.

3.2. Indicators

OECD (2001) defined a unique general indicator for this habitat: “the share of the agricultural area covered by semi-natural agricultural habitats”. Future development of this indicator may be in the direction of a more strict definition of different categories of semi-natural agricultural habitats and, consequently, the selection of different indicators. The criterion, however, remains the same: the share of agricultural area for each sub-category of different semi-natural agricultural habitats.

⁷ Only areas of fallow land or set-aside (temporary or permanent) are surveyed by the agricultural census and therefore they can be quantified in the category of semi-natural agricultural areas (see Table 2 to Table 5).

⁸Because of that, irrigated permanent meadowland is excluded from the category of semi-natural agricultural habitat and instead included in the intensive agricultural habitat category, even though some of such meadows maintain the characteristics of extensive cultivation.

⁹ 25 hectares for Corine and 2.25 hectares for the most detailed Regional Soil Use map currently available.

Table 5 - Semi-natural agricultural areas*

Semi-natural agricultural habitats, areas (000 hectares), percentage of the semi-natural agricultural area and of the total agricultural area (Italy, 1970-1997).

	1970			1975			1980			1985			1990			1997**		
	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾	he	% ⁽¹⁾	% ⁽²⁾
B SEMI-NATURAL AGRICULTURAL AREA	5 392	100	30.4	5 487	100	31.3	5 370	100	30.6	5 133	100	30.0	5 043	100	29.9	4 632	100	31.2
1 Permanent forage crops	5 313	98.5	29.9	5 204	94.8	29.7	5 126	95.5	29.2	4 980	97.0	29.1	4 868	96.5	28.9	4 371	94.4	29.5
<i>1.1 Meadows</i>	<i>1 135</i>	<i>21.0</i>	<i>6.4</i>	<i>1 151</i>	<i>21.0</i>	<i>6.6</i>	<i>1 128</i>	<i>21.0</i>	<i>6.4</i>	<i>1 085</i>	<i>21.1</i>	<i>6.3</i>	<i>1 104</i>	<i>21.9</i>	<i>6.6</i>	<i>971</i>	<i>21.0</i>	<i>6.5</i>
1.1.1 Irrigated meadows (3)	317	5.9	1.8	308	5.6	1.8	299	5.6	1.7	269	5.2	1.6	262	5.2	1.6		0.0	0.0
1.1.2 Dry meadows (4)	818	15.2	4.6	843	15.4	4.8	829	15.4	4.7	818	15.9	4.8	842	16.7	5.0		0.0	0.0
<i>1.2 Pastures</i>	<i>4 178</i>	<i>77.5</i>	<i>23.6</i>	<i>4 054</i>	<i>73.9</i>	<i>23.1</i>	<i>3 998</i>	<i>74.5</i>	<i>22.8</i>	<i>3 894</i>	<i>75.9</i>	<i>22.8</i>	<i>3 764</i>	<i>74.6</i>	<i>22.4</i>	<i>3 400</i>	<i>73.4</i>	<i>22.9</i>
1.2.1 Alpine pastures										957	18.6	5.6	927	18.4	5.5	1 245	26.9	8.4
1.2.2 Other pastures										2 937	57.2	17.2	2 837	56.3	16.8	2 155	46.5	14.5
2 Fallow or set-aside land	396	7.3	2.2	591	10.8	3.4	543	10.1	3.1	422	8.2	2.5	437	8.7	2.6	261	5.6	1.8
2.1 Short term set-aside (5)							543	10.1	3.1		0.0	0.0	416	8.2	2.5	247	5.3	1.7
2.2 Long term set-aside (6)													21	0.4	0.1	14	0.3	0.1

* Source of data, I.S.T.A.T. (1970, 1975, 1980, 1985, 1990, 1997. INEA (1997, 1999). ** Uncompleted data. (1) Percent on semi-natural agricultural land area. (2) Percent on total agricultural land area. (3) Improved meadows with two or more cut. (4) Extensive meadows. (5) from 1988 to 1992 facultative 5 years set-aside, after the CAP reform of 1992, obligatory 1 or 5 years set-aside. (6) After the CAP reform of 1992, facultative 20 years set-aside within the 2078/92 EC regulation.

3.3 The situation and evolution

Semi-natural agricultural habitats amount to approximately 30% of the t.a.l.a., an average situation within European and OECD countries. This type of habitat has diminished in size over time, particularly in the last 20 years. However, the percentage of this area in t.a.l.a. remained almost constant at around 30% during that period. Beginning in 1970, major reductions were caused by the decrease in pastureland, with meadowland instead remaining almost constant, and an increase in dry meadowland. This evolution however, does not take into account the increase in uncultivated land which occurred in the last 30 years. In fact, part of the general reduction of agricultural land areas was due to the abandonment of farm and cultivated areas in upland territories. Most of this territory is not evaluated in agricultural censuses and in official statistics; it constitutes part of the increase which occurred in “other areas” and “unproductive areas” over the last 30 years (Table 1). Such abandoned cultivated areas switched to other categories of land use, becoming rough pastures, natural land for pasture, uncultivated areas where weeds and wild plants grow freely, wooded pastures, scrub and forest land. These different categories, which escape official evaluation, belong partly to semi-natural agricultural areas and partly to the uncultivated areas adjacent to agricultural territories.

4. Uncultivated (natural or man-made) agricultural habitats

4.1 Definitions

There is a third type of habitat that may be identified within agricultural territory: the uncultivated areas. In other words, the areas not directly affected by crop cultivation or animal husbandry. These habitats may be natural, semi-natural or man-made more or less recently. Normally, the uses of these areas do not include agricultural production, although the relative management and conditions are influenced by the proximity of agricultural activities. Although a definition is called for here, there is no general agreement on such definition and identification of the habitat. Should we consider only small patches of uncultivated habitats present in the agricultural territory, or should we also consider borders along agricultural areas and adjacent ecosystems? And, if so, to what extent should we measure these borders? Again, how big must these areas be to be considered part of the agricultural ecosystem and not a distinct ecosystem? Should we recognise only natural and semi-natural areas or also recognise man-made habitats? These are some of the unresolved questions concerning the definition of the subject.

A solution may be found in light of the fact that there are two sub-groups in this habitat: a) the uncultivated (natural or man-made) habitats located both within and at the border of agricultural habitats; b) the uncultivated natural habitats adjacent to agricultural habitats. The former is a part of the agricultural ecosystem and represents small patches or linear features. The latter represents different ecosystems which, because of the proximity of agricultural areas, are influenced by agricultural activities, their side effects and their evolution.

The distinction between sub-group a) and the complex of uncultivated areas, as well as semi-natural agricultural habitats¹⁰ is important because these micro-habitats represent important ecological features to

¹⁰ Some authors, in fact, prefer to consider this sub-group of habitat as a part of the semi-natural agricultural habitat, which appears justified because the influence and the density of these features (hedges, ponds, woodplots, etc.) may change the characteristics of some intensive agricultural habitats, modifying their role or importance vis-à-vis the environment. However, this was mostly true in traditional agricultural habitats (before 1975-80 in Italy), where hedges, trees, etc. were part of each cultivated field. With the disappearance of that type of agriculture, such features are more scattered over agricultural territory and only in some cases they do create situations similar to the past. Because of that, they should be included in the agricultural habitat, but as a separate habitat or micro-habitat.

be conserved or improved by environmental and agri-environmental policies. Because of that, these habitats should not be excluded or downplayed in studies about environmental indicators for agriculture.

There are several list or classifications of features included in this type of habitat; below we mention two. Zuercher (1998), in discussing semi-natural agricultural habitats, defined five different boundaries arising from the interaction between agriculture and other ecosystems: aquatic (wetlands exploited for agricultural use, such as grazing in marshland or watery meadows), forest (agri-forestry and pastoral woodlands), mountain (alpine pastures and grass patches) and steppe (from semi-arid to desert steppe, including dry meadowlands and dry pasturelands).

Another classification is based on prevalent eco-components of features (Genghini and Busatta, 2001). We distinguish features or habitats where the prevailing components are: A1) trees and shrubs (hedges, windbreaks, shelterbelts, woodlots, trees, rows of plants, etc.); A2) erbaceous vegetation (headlands, road bank, river banks, beettle banks, tramlines, filter strips, set-aside strips or set-aside fields, etc.); A3) wetland areas (ditches, waterways, drains, ponds, bogs, retting-pit, etc.); A4) rural or anthropic elements (dry stonewalls, stone piles, old or new rural buildings, ruins, etc.).

The second sub-group of habitats is not part of agricultural ecosystems, but instead part of other ecosystems: natural or semi-natural (forestland, scrub, wetland, etc.). Its relation to agricultural habitat is based on the effects or impact that agricultural activities may have on these adjacent habitats due, for example, to the run-off of chemicals used in farming which may damage such ecosystems (wetlands in particular), or because of the conversion over time of these ecosystems into farmland or viceversa.

4.2. Indicators

Indicators of the first sub-group may be represented by the total area or linear development of all uncultivated (natural or man-made) ecological features present within an agricultural territory¹¹. These features may also be distinguished in terms of the four components previously defined (A1, A2, A3 and A4). The quantification of these indicators is difficult to obtain in Italy and other countries because of the lack of such information to be found in official statistics and agricultural census reports. However, in the future agricultural censuses may develop a specific chapter dedicated to the evaluation and quantification of these ecological features. Also, the use of aerial photos and satellite images, although they currently do not allow detailed quantification, in the near future would permit easy quantification of these important areas.

For the second sub-group, the OECD (2001) defined two main indicators: “net area of aquatic ecosystems converted to agricultural use” and “area of ‘natural’ forest converted to agricultural use”.

The quantification of these areas is mainly possible with the use of official statistics, agricultural census reports and specific studies conducted in the past. As for Italy, this kind of evolution was in fact particularly pronounced from the end of the 1800s until 1960-70. Subsequently, agricultural evolution has evolved in an opposite direction, namely the conversion of agricultural areas into scrub, forestland and wetland. Because of that, it seems important that these indicators should take into account that evolution as well¹².

Moreover, they should be distinguished inasmuch as they are an uncultivated habitat and because they are specific targets of agri-environmental policies.

¹¹ Alternatively we may use the share of total area of all uncultivated (natural or man-made) ecological features within total agricultural area.

¹² The evolution of forestland and wetland in Italy open another big chapter about land use changes on the Italian territory. Because of our focus on agricultural habitats and the limit of time and space we do not intend to develop here this subject. Therefore we postpone these part to future development and we refer to other recent studies (Colpi et al., 1999; IRSA-CNR, 1999, Merlo, 1999, Pettenella and Piuissi, 2000; Cesaro and Povellato, 2001).

5. Conclusion

A lot of work has been done recently on the subject of agri-environmental indicators for agriculture; we have to thank in particular the OECD for its efforts to group different experiences, to try to elaborate a common language for parameters, indices and indicators; and to provide us with timely reports, results and tools that help improve our research. We are not far from a general agreement on a first basic set of indicators based on recent OECD works (2001). However, it will probably take more time, depending on each country, to modify or integrate the information system (agricultural census and official statistics) in order to apply the common methodology.

Up until now, basically the criterion adopted to find indicators involved the identification, the definition and the subdivision of the agricultural territory into different sub-categories of habitats. This differentiation was intuitive on the basis of visual perception of the agricultural landscape and on general information about the main differences present in agricultural systems or about the varying impact of agricultural activities. We identified a first level of different habitats: intensive, semi-natural and uncultivated. However, we understand that even within these categories there is a high degree of differentiation, mostly for intensive crops, but also for semi-natural and uncultivated agricultural habitats.

Because of that, we are now looking for a "second level" of more detailed indicators. In this area, the Canadian work on habitat matrix (Neave and Neave, 1998) probably offers the most interesting approach. Here the criterion utilised to differentiate habitats is based on how species use or prefer different habitats, with a detailed list of potential use (breeding, nesting and reproduction, foraging, cover, resting, roosting, basking, loafing, wintering and staging). In that way we should be able to understand, with reference to the intensive agricultural habitat, the role of different crops or group of crops and the most important times during the course of the crop seasons, as well as the importance of different semi-natural and uncultivated habitats. To obtain all such information probably will require a considerable time, while the level of knowledge will differ from country to country. However, this approach will help us to differentiate habitats in greater detail and consequently help us to define more sophisticated indicators that will permit policy-makers to introduce more precise policy measures to protect, manage and improve wildlife habitats and biodiversity.

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ACKNOWLEDGEMENTS

We would like to thank the Italian National Institute of Agricultural Economics (INEA) and in particular Drs. Antonella Trisorio to facilitate our contacts with the OECD and to provide us of updated documentations and statistics.