Sustainable development for a model of agriculture in the metropolitan systems

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Abstract: Constant innovation in the production techniques of the primary sector has contributed to the exploitation of natural and agricultural systems, particularly significant in highly populated areas. The work is based on the study of the interactions between the metropolitan area of Milan and the agricultural activities around it. Our project aims to develop a support for the Parco Agricolo Sud Milano (47,000 ha). We decided to assess the 3 scales of sustainability (environmental, social, economic) of farms. The idea was to create a means to guide farmers, institutions and researchers towards innovative and sustainable solutions: a seemingly difficult territory for agriculture, localized close to a large city, instead can be used positively. The survey was carried out through a tool that compares farms through indicators that characterize the 3 scales using calculations, measurements, evaluations. It assesses the strengths and weaknesses of the production system and the ways to improve the level of sustainability. We sampled 30 farms and collected their data (from database, interviews, estimates, observations, tabulated data). The approaches are many, thus we can focus our work on the indicators that affect the goals of the farms. We evaluated and edited the method by following what European policies have addressed, integrating agricultural production with environmental protection. The results highlight the need to link these assessments with the income prospects of the farms provided by the institutions: a high-quality production, the maintenance of biodiversity and rural traditions, promotion of the competitive farms. Farms will have a method to assess their performance and the cost of production of products, to compare them with other farms and obtain explanations of a higher or lower profitability. It will be evaluated the impact of the product differentiation, the use of different agricultural practices, the energy efficiency, the marketing decisions.

Keywords: Sustainability, Innovation, Peri-urban rural areas.

Introduction

Considering the concept of *sustainable agriculture*, definitions are extremely numerous and often contradictory (Binder et al., 2010). Accordingly it probably cannot be defined or better it can considered to be defined only if referred to a specific context since agriculture is multifunctional, multi-scale and multi-issues. For this reason, it is necessary to distinguish the different aspects of sustainability: environmental, social and economic. The scientific community is continuously spurred on finding new techniques that combine an adequate production with a more sustainable impact through openness to new concepts and reflections rather than at an attempt at an overall understanding (Thompson, 2007).

Most of the future development in Europe will occur in peri-urban areas along the biggest cities. Checking the growth of urbanization is the primary tool for balanced territorial development through a proper land management. Besides, the urban, rural and peri-urban areas should be considered as a system linked with the urban planning and rural development activities (Allen, 2003). High-urbanized agricultural areas are, however, subject to various criticism. Indeed, in the pro-

cess of urbanization, the fringe area falls under pressure of development and there arise the potentiality to abolish the identity of rural area (Uddin et al., 2012). This phenomenon is in relation to the population density and a relative measure of the influence that an urban area may have on free surrounding space is the distance of the agricultural land from an urban center: the smaller the distance is, the bigger is the urban pressure on the farm property (Huang et al., 2006).

From the agricultural point of view, the literature identifies 3 main critical points of these areas:

1. these areas are often more valuable for development, thus farmers earn more by selling the land to developers as agriculture is still a low-profitability sector (Mazzocchi et al., 2013). This means they cannot be considered economic determinants in land use because their added value has no influence on the increase in value of agricultural land and rent (Sali et al., 2009);
2. the fragmentation of farm area is inversely proportional to the distance from the city and directly proportional to the size of the developed area (Carrion-Flores and Irwin, 2004) which involves the splitting of farm property into smaller units, reducing the efficiency of the enterprise due to numerous management problems: greater distances to cover, loss of working hours and difficult transportation of agricultural products;
3. as a consequence of point 2, the reduction of the farm agricultural area also leads to a reduction of the economic size of farms. Farms with a sizable economic dimension are profitable enterprises with a high degree of professionalism, production and diversification and their interest in land use conversion is lower than other farms (Mazzocchi et al., 2013).

Nevertheless, the proximity to a big town also can be a positive externality for the agriculture:

1. the demand for local food products could be stimulated: farms have the opportunity to find new economic opportunities by the diversification of the profit through secondary activities;

2. here the agriculture is perceived by community as capable of assuming important functions in addition to the production, as high quality products, the preservation of the landscape, the cultural conservation and the protection of plant and animal biodiversity (Gaviglio et al., 2006);

3. farms are currently considered to be the only type of economic activity that controls the land management of an area acting as an obstacle, however weak, to the pressure of urbanization (Mazzocchi et al., 2013); for this reason they are often protected by local institutions.

With the reduction or even the annulment of the spatial distances between the towns and the peri-urban agricultural areas, we need to exploit this trend (however inevitable) through the economic development of local farms, able to provide environmental, social, cultural and food quality services to citizens. Among the mechanisms identified in the literature, we observed:

1. Short Supply Food Chains (SSFCs) (Aubry et al., 2013). (i) Indirect relations (a local supply yet with an intermediary that mediates the relationship between producers and consumers); (ii) distance relations (it implies the proximity in terms of confidence and shared values such as quality, modes of production, specificity of products, etc.); (iii) direct relations (with geographical and organizational proximity, traditional forms of direct selling);

2. Higher value agricultural products (HVAPs). Products whose net benefits of selling directly are high, especially when quality and personal relations are appreciated by the customers (Govindasamy and Nayga, 1997);

3. Marketing. Capability to organize agro-business using a mix of traditional and new facilities, to attract the urban consumers in search of new shopping experiences, to adapt the selling strategies to cut costs and improve the quality of products (Reardon and Farina, 2002);

4. Cooperation. Association of small-scale producers, able to interact and coordinate their strategies to achieve economies of scale in logistic operations, transactions with input suppliers and buyers and marketing strategies (Rosa and Nassivera, 2007).

However farms are also “guardians” of other goods, non-monetized or hardly exploitable from the economic point of view. Over the years, part of the Common Agricultural Policy (CAP), like agri-environmental schemes, has used this concept as a means of justification for the subsidy policies for the agricultural sector. We feel in any case the need to deal with these goods, defined as "environmental goods" (Pfeifer et al., 2012) with a new approach, easily economically convertible to farmers especially in peri-urban areas, where the perception of citizens is greater.

The application of indicators, defined as "synthetic variables of substitution of other variables that are otherwise difficult to determine" (Bockstaller et al., 1997), plays a prominent role in the evaluation of sustainability standards both at decision-making and educational levels.

The methodologies are thus numerous. We can distinguish 3 main categories of approaches:

1. several indicators selected to highlight different aspects can be extremely focused on research aspects but, on the other hand, they lead to significant difficulties in finding the right combination to achieve highly consistent final results (Gómez-Limón and Sanchez-Fernandez, 2010), they require long time for the choice and for the collection of the data;

2. the use of a single model (simulation) ensures a high accuracy of results but it is often complex, expensive and time consuming (Castoldi et al., 2009), requires direct measurements and the success of the work greatly depends on the availability and quality of the data;

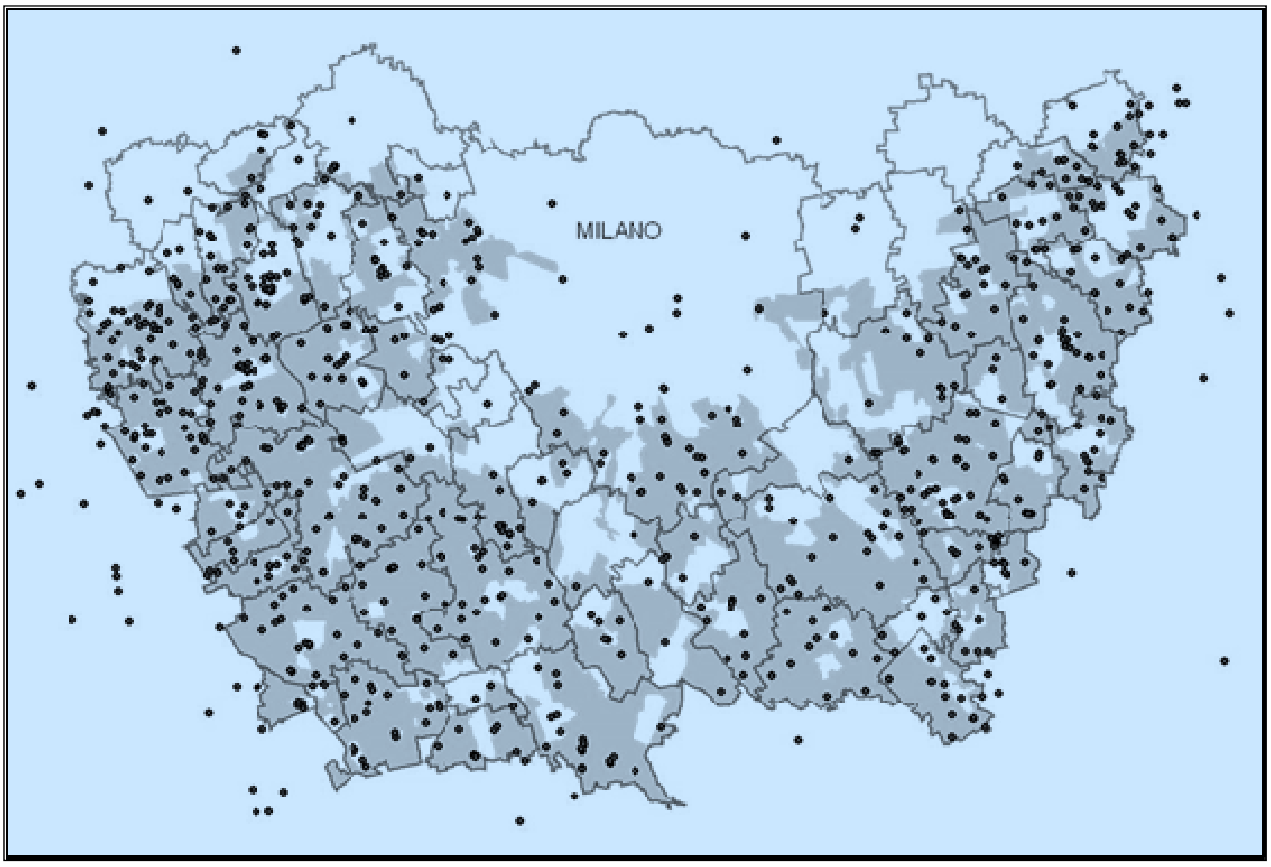
3. indicators included in synthetic applications, useful for fast studies that are applicable to different and unrelated situations, based on data already available or easy to collect (Bechini et al., 2009). The validity of these methods depends on the accuracy of the data and their specificity, especially regarding complex aspects of environmental and economic sustainability.

Materials and methods

In the Po Valley (Italy), agriculture is flanked by other productive sectors and the increasing urbanization of the cities is high. The importance of these issues has contributed to establish a regional metropolitan agricultural park, named Parco Agricolo Sud Milano (PASM, South Milan Agricultural Park) (Fig. 1)[260], with the objectives of the preservation of the environment and supporting the economy of agricultural production (Parcosud, 2013).

[260] The PASM, with 61 municipalities, covers an area of about 47,000 hectares (approximately 37,000 hectares of agricultural surface and 19,000 hectares of urbanized territory) and involves approximately 1000 farms with very differing production and sizes, economic and environmental systems and the typical characteristics of the intensive agricultural activities (Pirani et al., 1992).

Figure 1: PASM: municipalities, agricultural areas and farms.



The area is completely flat, farming is extremely developed, the population density is high and land has the typical attributes of peri-urban areas (fragmentation, competition from industries, high value of the land).

Currently, the main economic possibilities of food farms in the area seems to be 3: (i) to sell the produce to big processors; (ii) to sell to big retailers; (iii) to sell through short chain tools. The first two cases have lower transactional costs and economic risks but the price is very low and the market power is all in buyer's hands. Short chains guarantee a premium price and job opportunities, but are for the time being only an income support (Migliorini and Scaltriti, 2012).

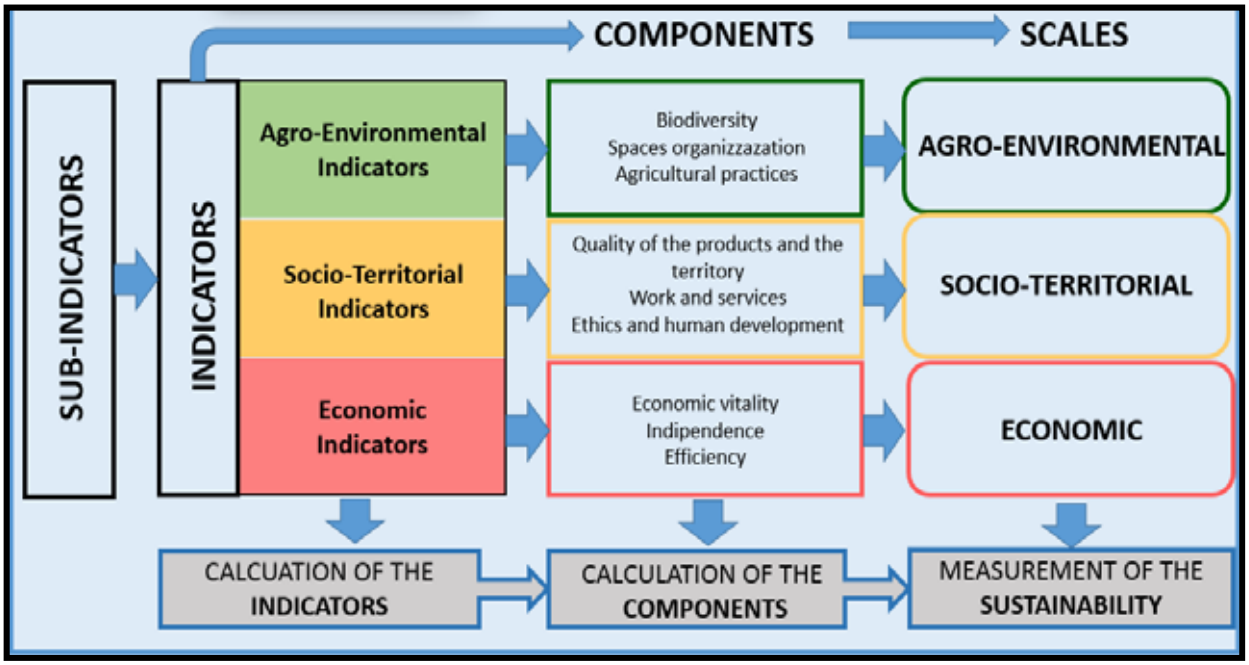
Our project, based on the study of the interactions between the metropolitan area of Milan and the agricultural activities around it, aims to develop a support for the PASM, useful for the evaluation of its programming policy for farmers, and the attestation of the positive externalities resulting from decisions undertaken in the interests of Park.

The Park has not yet issued a complete set of technical rules to drive agricultural practices (Bechini et al., 2009), marketing opportunities and innovative techniques to guide farmers, institutions and researchers in general towards environmental-friendly standards and more sustainable solutions, to assess the economic performance of farms and the cost of production of products, to evaluate the product differentiation, the energy efficiency, the marketing decisions.

Our approach is based on the idea that a seemingly difficult territory for agriculture, since strongly influenced by the presence of other productive activities and especially because localized close to a large city such as Milan can be used positively. Therefore, it is interesting to evaluate the role of the PASM as institution in the new scenarios of development of this area, and the effects of the decisions of the local policies, already taken or witch might be taken in future, aimed at the production of different environmental and commercial services.

Our work started with a literature review to select indicators that quantify the 3 scales of agriculture sustainability. We started with the concept that systems that require easily detectable data or simple and rapid evaluations minimize wasting time and resources and avoid methodological and practical problems (Bockstaller and Girardin, 2003). Thus, the criteria applied in the indicator selection were: (i) data availability (database, interviews); (ii) the spatial and time scale (PASM, crop year); (iii) the scale of detail (farm); (iv) the objective of the work (par. 1.4), (v) capability of synthesis; (vi) simplicity (indicators easily interpreted).

Figure 2: The structure of the IDEA method.



On the assumption that the use of a single method established through individual indicators already aggregated and balanced may be a viable solution to assess sustainability in its various aspects, our survey was carried out through the creation of a calculation tool, starting from what proposed by the method IDEA[261] (Vilain, 2008). The goals of the surveys performed using IDEA (Zahm et al., 2005, Cadilhon et al., 2006, Bockstaller et al., 2009) are: (i) (farm level) giving a support tool for entrepreneurial decisions assessing the strengths and weaknesses of the production system; (ii) (farm level) providing practical knowledge for funding opportunities of the agri-environmental Measures of the Rural Development Program (RDP) (Zahm et al., 2005); (iii) (institution level) providing information on the real potential of policies to achieve the goals set by policy makers (Vos et al., 2000); (iv) (research level) finding innovative and sustainable solutions.

Operationally, the method is based on calculations, measurements and evaluations which produce a result within a maximum (variable) and a minimum (0) of possible scores of 42 quantitative indicators (formed by sub-indicators) that characterize the components (9) of the 3 scales of sustainability (Fig. 2). These results can be easily assimilated into indexes, with more concise and representative values (Giupponi and Carpani, 2006) that aggregate more than one indicator that facilitates the use of complex information by non-experts (Castoldi et al., 2010). We have selected indicators, weighed the importance and calibrated components as a function of our area and goals.

The research involved: (i) the observation of the farms, by using of a database named SIARL[262] containing their quantitative characteristics (size, production, livestock, etc.); (ii) sampling of the detectable farms and selection of 30 farms by a stratification considering the type and the method of production[263], the economic dimension[264] and the geographical localization[265] (Table 1) and

[261] "*Indicateurs de Durabilité des Exploitation Agricoles*", or rather "Indicators of sustainable of the agricultural exploitation" is developed on the request of the General Directorate of teaching and research of the French Ministry of Agriculture and Fisheries.
[262] *"Sistema Informativo Agricoltura Regione Lombardia"*, from: www.siarl.regione.lombardia.it/index.htm
[263] We considered the main production,, the secondary activities and the production methods (organic and conventional).
[264] U.D.E., "Unità di Dimensione Economica" (U.E.S., "Unit of Economy Size"): high (>100), medium (from 50 to 100) and low (<50).
[265] We splitted the territory into 4 areas: Sector 1 (North-West), Sector 2 (South-West), Sector 3 (South-East), Sector 4 (North-East).

the activities[266]; (iii) creation of a database collecting the necessary data from SIARL, SITPAS[267], interviews (questionnaire) to farm personnel, observations and tabulated data (RICA[268]); (v) selection of the most appropriate indicators; (iv) calculation of the indicators.

Table 1: Classification of assessed farms by the method of production, UDE, geographical location and the main activity.

Production		**UDE**			**Sector**				**Main activity**		
Organic	Conventional	High	Medium	Low	1	2	3	4	Rice	Livestock	Horticulture
7	23	18	6	6	10	7	7	6	7	18	5

The environmental scale involves the biodiversity, the landscape management, the use of energy resources, pesticides, fertilizers. The social scale evaluates the quality marks, the mechanisms of short chain, the landscape features, the level of animal welfare and the quality of working conditions. The economic scale assesses the entrepreneurial capacity of farmers, the provision of quality products, the enhancement of the short chain and the management of related activities.

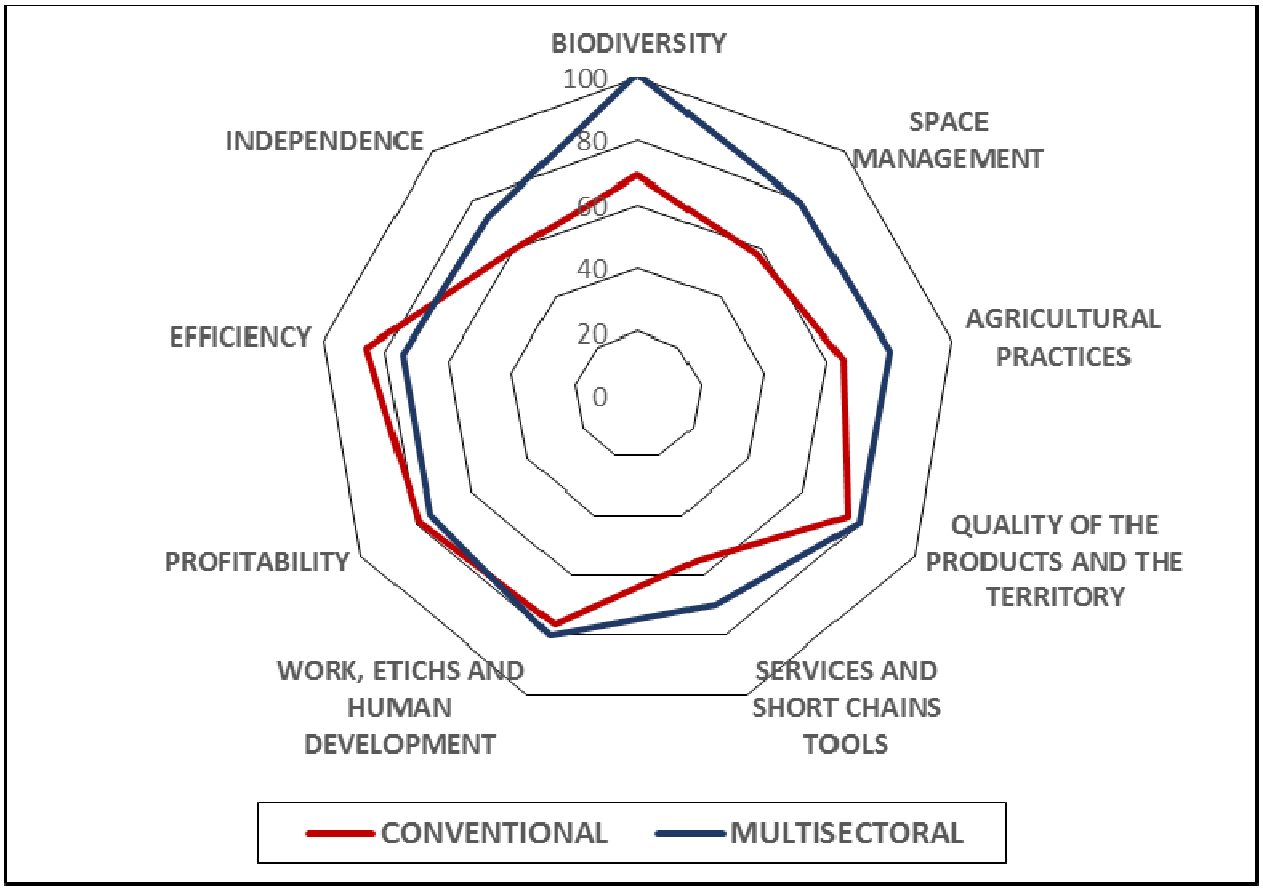
Results and discussion

Different ways of comparison of the results are possible that, standardized and represented with a spider graph, provides a preliminary integrated characterization of sustainability (Girardin et al., 2000): (i) between 2 or more farms; (ii) between the results of the same farm during 2 or more years (iii) between farms aggregated for similar economic characteristics.

Multisectoral and organic farms get a high score in the environmental components (highly linked to the type of production), due to a higher level of plant and animal biodiversity, a virtuous space management and the rational use of the resources. In the socio-territorial scale, multisectoral farms generally get a high score in terms of landscape quality and working conditions. The more specialized farms are penalized by individual indicators for the opposite reasons: in the economic scale, diversification and the large conventional systems (especially rice, milk and meat production) are positively valued (Graphic 1).

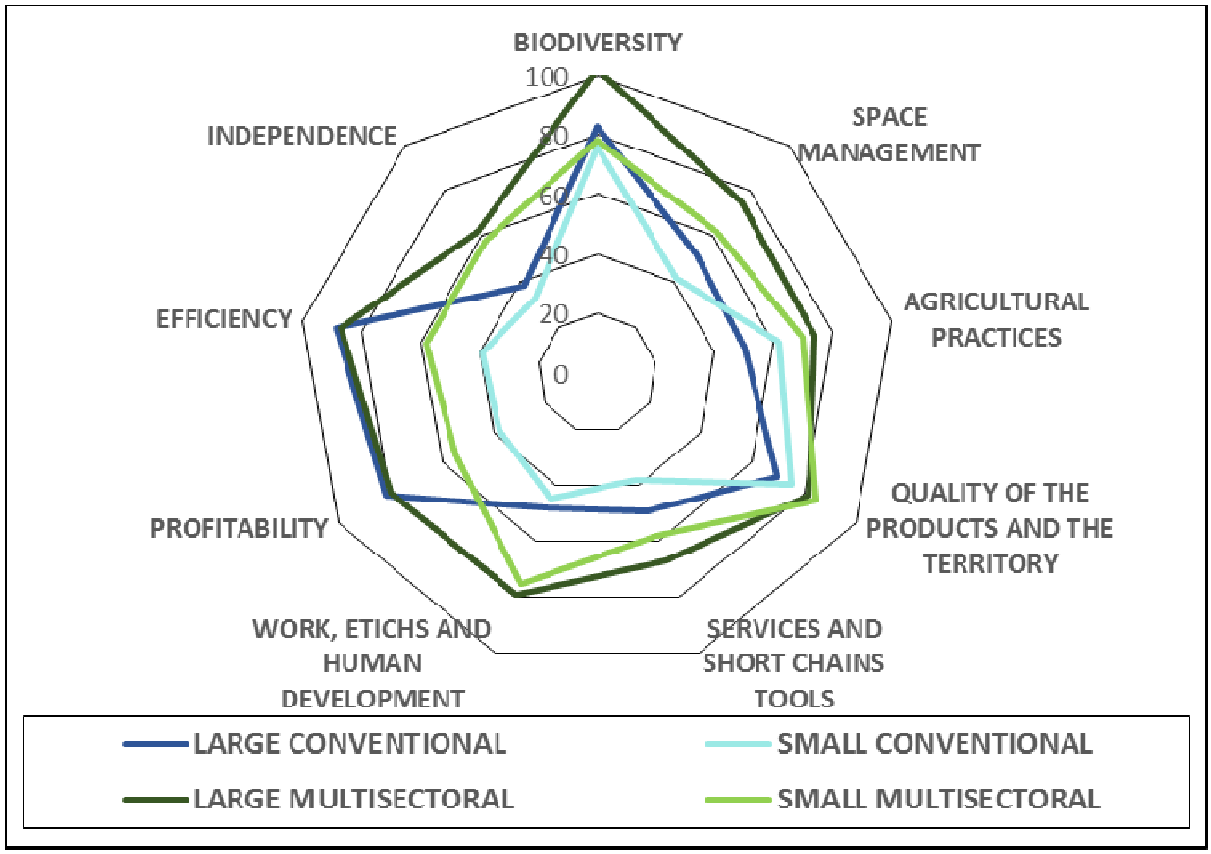
[266] Among the farms sampled: 14 farms have a multisectoral production (2 or more main products), 12 use short chains tools, 11 have agritourism activities and 8 have other secondary activities.
[267] "Sistema Informativo Territoriale per il Parco Agricolo Sud Milano", from: www.provincia.mi.it/parcosud/sitpas/index.html
[268] "Rete di Informazione Contabile Agricola", from: www.rica.inea.it/public/it/index.php

Graphic 1: aggregation of specialized farms (a major product) and multisectoral (more main products and/or secondary activities).

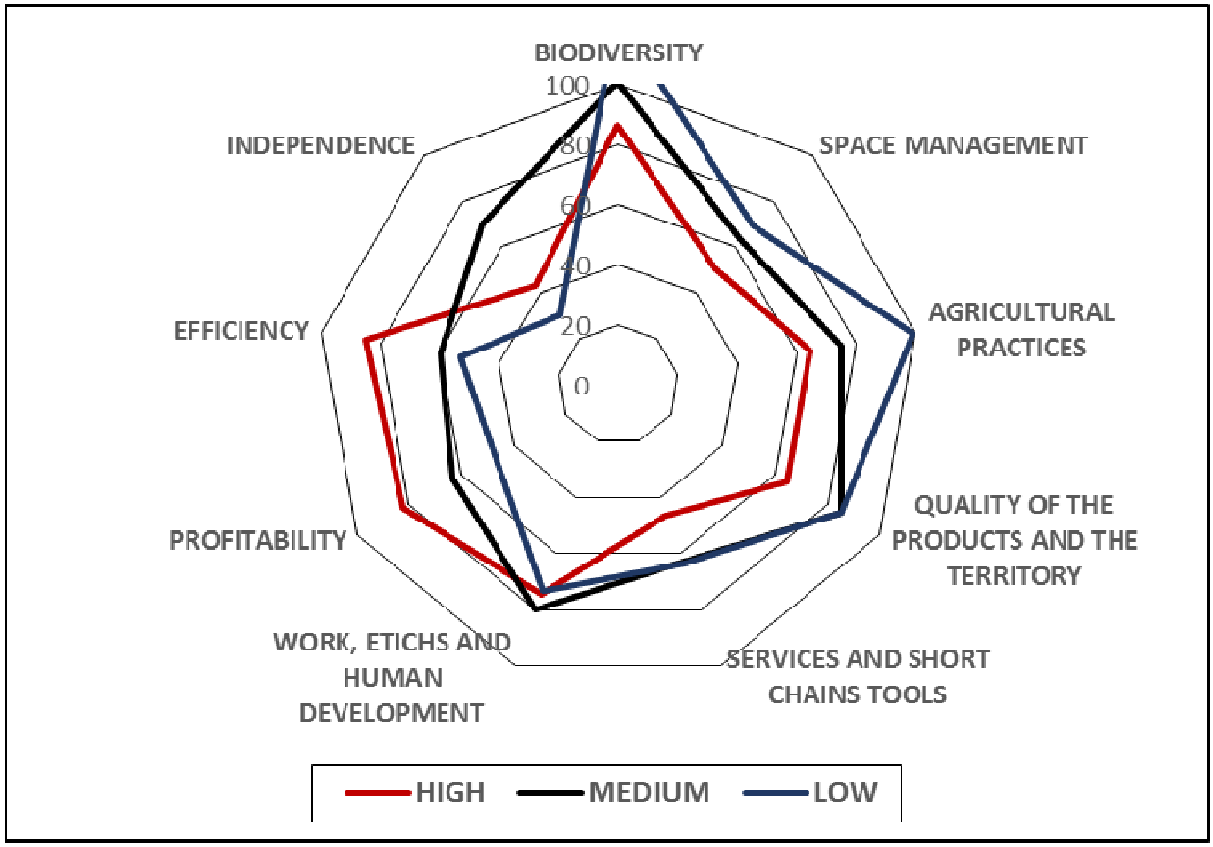


Graphics 2 and 3 highlight the difficulties of small farms with traditional production systems that do not operate any innovative multifunctional choices. Large farms, both multisectoral and conventional, represent the most virtuous activities (economically and socially, with well-established agritourism and direct sales activities and well-known by citizenship) and excellent elements of land protection, and on the other ensure environmental and social services to the citizens. On the contrary, small farms play a more important role in the areas in contact with the city, preserving the land derived from the progressive fragmentation.

Graphic 2: aggregation of large (UDE>100) and medium-small (UDE<100) specialized and multisectoral farms.

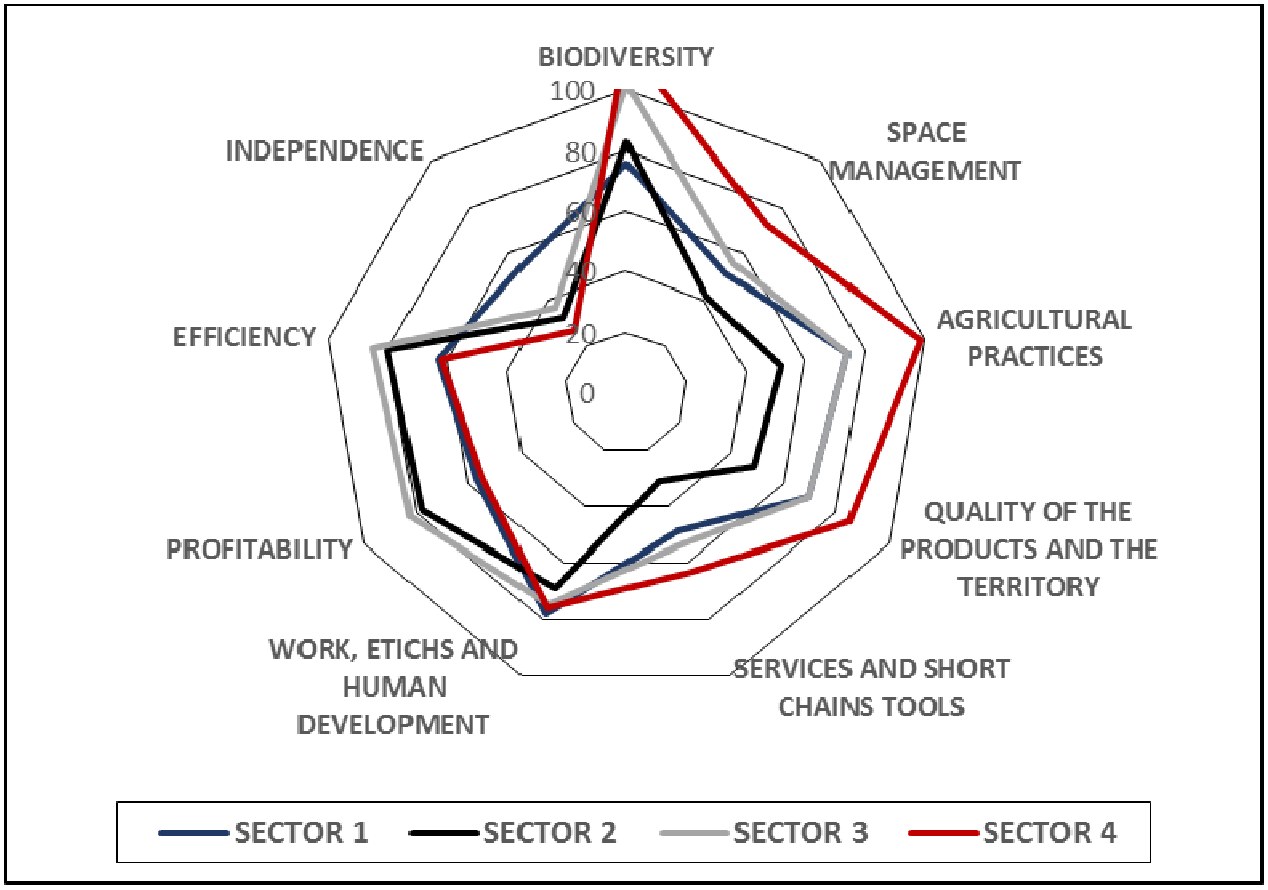


Graphic 3: aggregation of the farms with a high (>100), medium (50 to 100) and low (<50) value of UDE.



The “Independence” component, linked to the weight of the subsidies on farm income, is notoriously dependent on the type of production, here particularly referred to the weight of the aids in rice productions, main localized in the sector 2 (graphic 4).

Graphic 4: aggregation of the farms located in four different sectors of the Park.



Our method is particularly malleable and the characteristics of indicators and data needed for the calculations make it adaptable to other European peri-urban areas. We identified a number of criticism, however often noticed also in other works, principally due to: (i) a low significance of some indicators linked to complex aspects of the environment and economic sustainability; (ii) this type of method is able to assess the potential, but not the real, environmental impact of some agricultural techniques (Bechini et al., 2009) and however is based on an approach that forces to compromising, not considering the diversity of the role and the objectives of conventional and organic production systems (Rigby et al., 2001); (iii) as weights of the indicators are essentially value judgments, the method rewards (or punishes) indicators that are deemed more (or less) influential, depending on expert’s opinion, to better reflect policy priorities or theoretical factors: the balance of the weights is thus in some case questionable, requires rebalancing or compromised (especially in relation to our local context); (iv) in interviews to farm personnel the reliability of the responses is a limiting factor; (v) the additive aggregation of the sub-indicators and the indicators has often highlighted limitations in the results.

Conclusions

The PASM, founded more than 20 years ago, is one of the first cases of territorial institution for the protection of peri-urban agricultural areas. For this reason, initiatives aimed at the development of short chain, the protection of the territory and the promotion of local resources (Fondazione Cariplo, 2013) can be examples for other similar European urban areas. In these

years the territory and the economic situation have undergone changes and, in our opinion, the institution needs to move quickly. The results highlight now the need to be able to take advantage of the opportunity of the interest of the citizens of Milan for the nearby rural areas and the need to protect agricultural production of large and small farms, so that they can both enhance.

In particular, for small farms we refer to:

4. the need of leaving the old patterns of production to cope the competition of larger farms, economically and technologically competitive. The main goals could be expand the opportunities of profit diversifying the production, the marketing, the buyers and the secondary activities (agritourism, school farm, restaurant, etc.) that, in a peri-urban context contribute to create a network of consensus that function to preserve agriculture in the area;
5. promoting the creation of new mechanisms of short chains and civic food networks, improving marketing activities, long-term relationships with customers. These solutions seem to be very interesting considering the greater role that (i) the organic production (which is now only 2%); (ii) the HVAPs; (iii) the typical products may have in the area for farms that hover near the city;
6. on-line sales, which would be particularly favored by the high population density, by modern means of communication and high level of computer skills of consumers (Eltis, 2013);
7. mechanisms set out in par. 1, 2 and 3 could be not incisive if not supported by systems of cooperation among farms located in the same context, as in the case of the PASM.

About the large conventional farms:

1. protection of large competitive farms. Nevertheless, in most of the conventional farms of PASM, the economic venues mainly come from crop-livestock production, and in many farms no significant additional income is obtained. Therefore, crop and animal production are and will be the basis of the economic sustainability of these farmers. These farms need protection because they are elements of great economic importance in the local context and considering the increasing fragmentation and edification of the territory;

2. working with the LD on common promotional campaigns dedicated to food with PASM logos and creative expressions designed to capture the interest in regional and typical food products.

To reach these goals we consider of primary importance these opportunities:

1. seeking to grasp the aspects related to consumers, through marketing analysis in order to create a match with those obtained from the supply side;

2. creating tools of economic support, i.e. as already experienced by the *Ecopoints* (Mayrhofer, 2007), through the introduction of direct funding for activities related to sustainable production, mechanisms of commercialization, marketing and social activities for the Milan urban area;

3. Milan, hosting the world Expo-2015 with a global theme "Feeding the planet, energy for Life", will have a plus opportunity to reconnect the urban reality to its countryside (Dell'Agnese et al., 2011), to promote the existing farms creating a natural bridge between rural and urban areas;

4. although the concept of sustainability is often considered dispersive (Antrop, 2006), we believe that its many facets are instead an opportunity to improve the economic, social and environmental goals, in reference to the local context. Considering the on-going agricultural market liberalization and the uncertainty about European common agricultural policies, we perceive the lack of elements of improvement between the farms standing in the area and the in-

stitutions whose decisions affect, positively or negatively, their economic, social and environmental role. Nowadays, the consideration of a fourth scale sustainability, called "Governance" (FAO, 2013) is only a theatrical concept and, to our knowledge, in literature there are not evaluation methodologies. This institutional scale could aim at the evaluation of political, legal and bureaucratic choices and the degree of evolution of the relationship between farms and the decision-makers (i.e. information on technologies and regulations, streamlined bureaucracy) and to catalyzing new technological and management choices.

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