Evaluation of sustainability of the farms in the Agricultural Park of South Milan and their production chain

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Abstract

To assess the sustainability of the agricultural sectors of three farming systems of the Agricultural Park of South Milan (horticultural, rice and livestock) the analysis was performed on agro-environmental and socio-economic aspects of 9 farms with different management systems: conventional, integrated and organic. The agro-environmental sustainability was measured through indicators of the soil, water, air and landscape-biodiversity. Socio-economic indicators was carried out by detecting economic indicators. The result shows that the analyzed farms are managed in a barely sustainable with regard to economic aspects, but have quite a negative impact on the environment. Only organic farms received positive values of environmental sustainability but reach the worst economic performance. The conventional and integrated farms have very negative values of environmental sustainability and better economic results of organic farms.

Keywords*: Sustainability evaluation; agro-environmental and socio-economic indicators; organic vs conventional agriculture; Agricultural Park of South Milan.*

Introduction

The Agricultural Park of South Milan (PASM) system includes 61 municipalities of the Province of Milan, an area of 47,000 hectares where there are 1,400 farms with a total of 39,900 hectares of utilized agricultural area (UAA) (Province of Milan, 2007). By comparison with others Italian Regional Parks, the PASM is a special case. Agriculture characterizes almost all of the landscape and the natural components are less important than in other parks (Migliorini, 2010). The agricultural setting is immersed in an strong man-made environment where the farm fields bordering the industrial buildings. From one side the agricultural land of PASM has been an obstacle on urban and industrial development in recent years. On the other hand, there has been a progressive impoverishment of the biodiversity of agricultural ecosystems, due to the decrease of wooded areas, tree plantations and hedges on fields margin, the dismantling of permanent pasture and water meadow, river courses and permanent wet areas. The main crops for area are maize (17,337 ha) and rice (10,699 ha) that dominate by far over other crops such as permanent grassland and permanent pasture (4034 ha), autumn-winter cereal crops (2,018 ha), soybean (1,830 ha), tree crops (465 ha), horticultural and floricultural crops (117 ha). The main crop rotation in the park is a two-year rice-maize (one third of the whole UAA), followed by a rotation of winter cereals. Another specific aspect of this area is the water availability that has determined high production levels. The most common method of irrigation is the surface one (border strip irrigation), a classic in the Po valley, but it requires accurate agrarian work and considerable volumes of water. Evaluate the quantity and quality of water is therefore a very important aspect. If it is true that the resulted values are not the responsibility of individual farms but of the context in which it is inserted, it is also true that the sustainable management of water resources should be made especially at farm level. Among the farmers of the PASM, the majority (46%) have an area between 10 and 50 hectares, followed (25%) by those with a surface area between 50 and 100 hectares. Farms are well above the Italian average (7,9 ha) and are typical of these contexts. The farming systems more present is the livestock production, cereals and forage (47%) followed by cereals (39%).

From a socioeconomic point of view, the farms located in the PASM are characterised by three main issues: the closeness with the town of Milan, the new role of the farmers or the new farmers and finally the relationships along the supply chain. The farms in the PASM are affected by the closeness of the town in many ways. On one side, on the "supply side", the food farms are threatened by the alternative uses of land, like no-food (energy crops for instance) or no-agriculture: there are very profitable land uses in respect of holding a farm, especially the possibility of building new residential compounds at a reasonable distance from the centre of Milan or infrastructures like motorways or ring roads. All those elements contribute to create the phenomenon that we can define as "fragilization", because the farmers haven't the necessary confidence in the term of the land use. Otherwise on the "demand side" the proximity to Milan stimulates the demand of local farms agrofood products and consequently the activity of marketing of the farmers. First of all there are the visitors of the area for recreational reasons: bikers and day trip tourists that directly sell at the farm gate or using the vending machine just outside the

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farms, providing products, e.g. milk, cheese, yogurt, ice-cream. Then there are the customers of the various Farmers Markets of Milan and surroundings promoted by Coldiretti and Slow Food for instance. And finally the net of common customers of the farms, e.g. common supportive agriculture, group of consumers, private consumers. The second socio-economic issue is the role of the farmer. Farming is more and more an economic activity, which is not self sufficient, meaning that it doesn't guarantee an adequate source of income for all the farmer's family, sometimes neither for the farmer him/her-self. There are few young farmers and without an high level of proactivity agriculture will decline. In some cases new farming activities are able to create new farm job opportunities for young and women: dairy processing of the farm milk, marketing in short supply chain modalities, making of Christmas gift baskets. To guarantee a future for farming in the PASM more and more new initiatives to promote a new agriculture must be supported to appeal young farmers. The last issue we would like to present are the relationships of farming along the supply chain, especially ex post. The main possibilities in the area of PASM are three: to sell the produce to big processors (the case of rise for instance) or to big retailers (horticulture), to sell the produce directly to consumers in the farmers markets, direct sales on farms, or a mixture of the previous ones. The first case is obviously the more convenient solution. Convenient means a reduction in the transactional costs (managing one contract, easier plan of the production and deliveries) and lower economic risks (and we are talking about very perishable goods); but there are also cons: the price is very low and the power market is all in the hands of the buyers. Alternative channels of distribution guarantee a premium price, it's an opportunity to advertise the farm, to communicate directly to the consumers and, as we said before, to create farm job opportunities for young and women, but for the moment is only an income support and not the main source of the farmer's income.

Methodologies for assessing agricultural sustainability are many and use different matrices of indicators (Belle and Morse, 1999; OECD, 1999). Agricultural sustainability is a very complex issues as agriculture is multifunctional, multi scale and multi-issues terms and it need a multi-dimension and multi-criteria assessment and set of indicators. This research combine the agro-environmental with the socio-economic assessment on 9 farms with three different farming systems and managements. The results can be used by the policy makers (i.e. at Regional and Park level) in order to better plan the agricultural development of this area.

Material and Methods

In order to assess agricultural sustainability, 9 farms have been identified (Tab.1) among those participating in the Slow Food "Earth Market" (farmers market in the centre of Milan) representative of the area from three production sectors (rice, dairy and horticultural) potentially more interesting for the PASM. In order to ascertain what their contribution in achieving improvement goals three case studies have been chosen for the evaluation of the environmental and socio-economic sustainability from each production sector with three different management: organic (Reg EC 834/07), integrated (formerly Reg EC 2078/92, today Agroenvironmental Scheme - Measure 214) and conventional.

Table 1 - *Structural feature of case study farms divided for production sector and management method (C: conventional; I: integrated; O: organic).*

Production sector	Management methods	N of farms	UAA ha	N of crops	LU	N of animal spices	Sales channels
Rice	C	1	140	1	0	0	W
	I	1	60	3	0	0	W, FM, OF
	O	1	44	5	40	1	OF
Dairy	C	1	70	6	200	1	CO, FM, OF
	I	1	80	4	130	1	W, FM, OF
	O	1	40	9	100	1	CO, FM
Horticulture	C	1	100	7		1	LOD
	I	1	100	14	0	6	OF, FM, LOD
	O	1	28	30	15	6	SPG, OF

UAA: Utilized Agricultural Area; LU: Livestock Unit; W: wholesales; FM: farmers markets; OF: on farm; CO: cooperative; LOD: large organized distribution; SPG: Solidarity Purchasing Groups.

Agro-environmental evaluation

To assess the sustainability of organic farming systems with regard to agro-environmental aspect is adopted a methodology based on indicators of sustainability (Pacini et al., 2008). The collection of farm information are captured through interviews with farmers, business documents and maps, estimates data during farm visits.

To assess agricultural sustainability at farm level the following environmental subsystems have been identified: the soil system, the water system, the air system, the biodiversity and landscape system. For each subsystems different agro-ecological indicators are processed, aimed at evaluating a specific attribute of the system and its critical points. Each indicator is associated with a low (negative), medium or high (positive) score which is derived from literature and adapted to the territorial context of reference (Table 2).

Socio-economic evaluation

The survey was conducted by visiting the farms and interviewing the farmers, of selected case studies (tab.1). The parameters we analysed were: variable costs, gross income and gross margin. We started from the application of this methodology in other study in same area (Bechini and Castoldi, 2009). The parameter "variable costs" concerns the costs of some farm inputs that are common to all the supply chains: pesticides, fertilizers, seeds, water and fuel; in the case of breeding we added costs for feed and pharmaceuticals products. The gross income is calculated by the simple multiplication of the amount of product for the market price. Finally the gross margin is the difference between the gross revenue and the variable costs. The unit of measure of each parameter is € ha-1. The second category of data is the impact of CAP (Common Agricultural Policy) subsides on gross revenue, measured as percent ratio between gross revenue per hectare and subsides per hectare.

Table 2 - *List of sustainability indicators identified for the various environmental systems, indicator description, unit measure (u.m.), low, medium and high levels and relative weight (r.w.) in %*

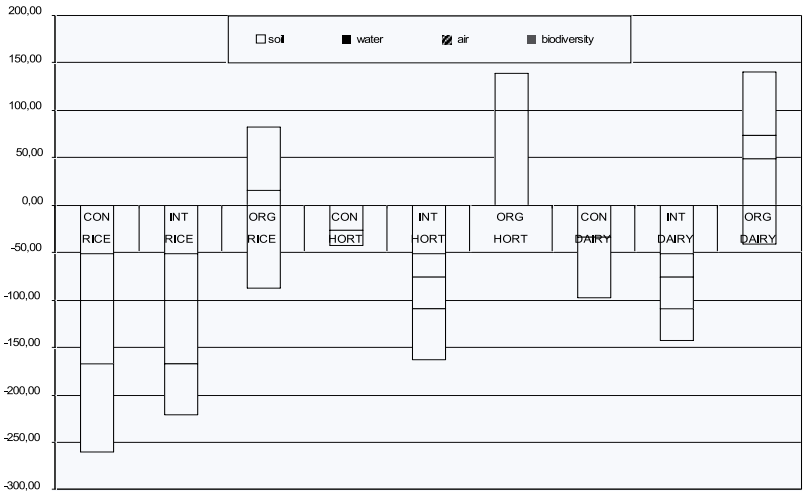
System	Aspect	indicator	u.m.	low	medium	high	%
Soil	Physical, chemical, biological fertility	Soil cover	%	<50	50-80	>80	16.67
		Crop rotation	year	<3	3-6	>6	16.67
		Presence of meadows	% SAU	<20	20-50	>50%	16.67
		Input of organic fertilizers	q ha^{-1}	<100	100-300	>300	16.67
		Green manure	N year of rotation^{-1}	<0,3	0,3-0,5	>0,5	16.67
		Organic matter	%	<2	2-2,5	>2,5	16.67
Water	Pollution	Pesticide	kg a.i ha^{-1}	30	5 - 30	5	33.00
	Alternative source	Recycling, rainwater utilisation	%	<30	30-50	>50	33.00
	Quality	Nitrates in water	mg l^{-1}	>50	25-50	<25	33.00
Air	Nitrous oxide (N_2O)	Chemical nitrogen input	kg N ha^{-1}	>250	250-100	<100	33.33
	Methane (Ch_4)	Cattle	LU UAA^{-1}	<1	1 - 2	>2	33.33
		Rice cultivation	ha	>50	50 - 10	<10	33.33
Biodiversity and landscape	Genetic diversity	Local livestock breed	n	0	1	>1	16.67
		Local landrace of crop	n	0	1	>1	16.67
	Specific diversity	Species	n	<6	6-20	>20	16.67
		Species	n	2	2-3	>3	16.67
	Habitat diversity and landscape	Wetlands	mq	<500	500-1000	>1000	6.67
		Hedges and rows	meter	<300	300-1000	>1000	6.67
		Forest	% of UAA	<4	4-10	>10	6.67
		Water meadows	ha	<3	3-5	>5	6.67
		Recovery springs	n	0	1	>2	6.67

Results

Figure 1 shows the overall result as the sum of agro-environmental sustainability indicators in the three agricultural sectors (rice, horticultural and dairy) and the three management methods (conventional, integrated and organic) converted to values -1 (bottom), 0 (medium) and +1 (high) multiplied by the weight percentage corresponding to the indicator. Please note that the potential extremes are -400 and + 400. The analysis shows that environmental sustainability by adding the values of the three farms is positive for the organic management (+238), is negative in the integrated one (-523) while the conventional result in between (-398). Among the three productive sectors the rice is very impactful (-483) while the horticultural is the best (-63) and the dairy is intermediate (-136). In fact these results are highly influenced by the values of organic horticulture farm that has a very positive result in the biodiversity system that makes this sector better than the dairy one. Among the environmental systems the biodiversity one is the most critical (-399) followed by soil and water (-133 and -150, respectively) and air (0).

The data collected in the socioeconomic analysis shows, as we could expected, a generalized situation of economic difficulty (tab. 3). As a general tendency we could note that the conventional farms have higher gross revenue and consequently higher gross margin, while the organic farms have lower costs of production, but also lower revenues and margins. Lower costs mean lower costs of farm inputs and this aspect is quite important when access to credit is hard and money does not circulate a lot in the economy. The integrated farms are in the middle. The percentage ratio between CAP subsides and gross revenue is quite similar, showing a general dependence of the agriculture in respect of public intervention. There are not big difference between different type of agriculture, but there are if we consider the supply chains.

Figure 1 - *Sum of agro-environmental sustainability indicators in the three agricultural sectors (rice, horticultural and dairy) and the three management methods. Con: conventional; Int: integrated; Org: organic.*



Discussion and Conclusion

The analysis of the environmental sustainability of agricultural farms of PASM showed very different levels of sustainability depending on the system measured and on the production system. The rice sector has a very negative impact on the environmental system and obtained positive results in the economic system but incurred 27% of CAP subsidies. The horticultural sector has an overall negative environmental impact although relatively is the best and get economically successful only if supported by the market (for conventional farms) or by the Agro-environmental scheme (for integrated and organic farms). The livestock sector is perhaps the most fragile in terms of economic performance and at the same time get intermediate results for environmental sustainability. The assessment of sustainability, however, leads to very different results when comparing the methods of management (conventional, integrated and organic). From the environmental point of view organic

Table 3 - *Economic parameters of the farms (€ ha^{-1}).*

Economic parameters	*Farming system*	*Conventional*	*Integrated*	*Organic*
Gross Income	Horticulture	3000	2067	1864
	Dairy	6194	2755	4699
	Rice	2048	2355	1581
Variable Costs	Horticulture	1386	907	1160
	Dairy	2317	2755	2669
	Rice	981	885	835
Gross Margin	Horticulture	1614	1159	704
	Dairy	3878	2498	2029
	Rice	1067	1470	746
Cap/Gross Income[1]	Horticulture	15.00	30.24	14.22
	Dairy	10.38	14.91	19.88
	Rice	32.21	21.24	27.31

[1] Data expressed as percentage.

farms are those that least impact the non-renewable resources, organise optimally crop rotation with very positive effects in the landscape and biodiversity. Also from the commercial point of view they are focused more on short chain and commercial innovation but this is not sufficient to achieve a positive margin as to lower variable costs do not correspond more margin (3 out of 3 farming systems have the lowest gross margin). The integrated farms are getting worse values of environmental sustainability and from economic point of view in two chains of three gets second place. The conventional farms are the best ones from an economic point of view (2 out of 3 farming systems have the highest gross margin) but they get negative values for environmental sustainability.

Conventional farms (C) have a higher gross income, due to the higher yields that compensate lower prices (Delmotte et al., 2011; de Ponti et al., 2011). The higher gross income cover the higher variable costs for C. The "covering effect" arises less for integrated farms (I) and for organic farms (O), due to lower crop yield and animal rearing performance. Finally the O and C systems had good rank but for different reasons. The O system had greater environmental performance, and the C system had higher economic and animal rearing performance, confirming other studies (Castellini et al., 2012).

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