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Improving urban metabolism through agriculture : an approach to ecosystem services qualitative assessment in Rome

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Urbanization processes and development of new forms of agriculture

1 The intense urbanization process that has involved, at different levels of intensity, many countries worldwide, is responsible for the extension of unbalanced and undefined city's borders, as well as, for the expansion of discontinued and often fragmented areas - sometimes designated as peri-urban - towards the countryside. Different agents are accountable for this tendency to move away from the city, such as : population growth, increased living standards, cheap agricultural land availability, citizens' preference for larger spaces, cities' environmental and noise pollution, lack of green spaces, social security problems, etc. This process has generated considerable environmental impacts as soil consumption and degradation, that are some of the most important contemporary issues, insofar as it concerned fertile soils and natural areas that lose their functionality (Salvati et Tombolini, 2013 ; Zasadaj, 2011) causing the loss of associated ecosystem services (ISPRA, 2017). In several Mediterranean cities economic growth, urban development, and massive population increased during the 1960s and 1970s, while a lack of demographic concentration was observed since the early 1980s (Salvati et Tombolini, 2013).

2 In Mediterranean Europe, from the early twentieth century, urban growth focused on large and medium-sized cities in compact forms, following a dynamic process that initially saw population growth and consequent overcrowding in the central areas,

colonization for purposes residential areas of the former suburbs later, and finally the densification processes of the second peripheral areas located at a short distance from the center, in a typically additive process (Salvati et al., 2012). These dynamics have determined, in terms of spatial configuration, processes that can be considered within the *urban sprawl* phenomenon, characterized by the development of settlement models towards adjacent agricultural areas of cities, along the main axes of rubber transport or along the coast, discontinuous, irregular and low-density residential (Marino, 2016/a).

3 In this context, Rome can be considered as the paradigm of the urban Mediterranean city ; characterized by the intense relationships between the city and the countryside, in which the understanding of metropolitan processes must necessarily go through a reading of urban/rural relations. In fact, along with the development of a particular urban expansion model recognized as peri-urbanization (Adell, 1999), peri-urban agriculture begins to have recognizable and identifiable features as a specific agricultural activity developed in the areas of transition between the areas traditionally urban and rural areas. In these areas, despite the pressure due to the advancement of the artificial areas, agricultural activity has maintained its presence in mutually different and sometimes interstitial forms. These forms of interstitial agriculture, developed in the urban and peri-urban areas, are resistant to settlement pressures, produce innovative forms and functions and respond, through the diversification of the agricultural economy, to an urban demand for social and environmental needs, with relevant results in terms of education, culture, employment and value added (Marino et Cavallo, 2014). In a constantly changing context, where the countryside enters rural space (and vice versa), where housing settlements and agricultural production areas intersect in a continuum in which it is difficult to identify the boundaries of the city, there is the possibility of redefining roles and configurations taken from the primary sector (Cavallo et al., 2015).

Socioeconomic values of roman agriculture

4 The municipality of Rome is an extraordinarily rich metropolis from both an historical and environmental point of view with a long history of biodiversity conservation and sustainable development (Capotorti et al., 2015). Nevertheless, a considerable amount of pressure is exerted on its urban and suburban ecosystems, which is also threatening the health and well-being of city dwellers. Main pressures and threats include soil consumption (Frondoni et al., 2011), air pollution (Manes et al., 2012), heat island effect (Bonacquisti et al., 2006) biological invasions (Celesti-Grapow et al., 2001), biodiversity loss, and landscape degradation (Capotorti et al., 2013).

5 Urbanisation has been by far the most important change process in terms of extent and impact on landscape composition and pattern included in a model of development that is largely shared by other Italian and European cities. First, it took place mainly at the expense of agricultural land, which generally represents the most available class for the majority of European cities and the most suitable cover type for building, considering topographical and economic reasons. Besides the important reduction in extent, results confirm that urbanization increased fragmentation of agricultural land through the sprawl of artificial surfaces.

6 Roman urban agriculture has always been characterized by a close correlation between the urban population and local agriculture, therefore, it becomes necessary to analyze the phenomenon of urban agriculture by observing the relations between the city and the

surrounding countryside both in quantitative and socioeconomic terms. This approach takes into consideration a peculiar trait of the Roman landscape which is the deep intersection between the agricultural dimension and the urban dimension, resulted from a very complex set of historical and socioeconomic dynamics that radically transformed, during the 1950s, land ownership and settlement structures through a a strongly fragmented urban fabric in which agricultural and semi-urban areas coexist with the city in the spaces left free from urbanization (Marino, 2016/a). The reasons behind this significant urban landscape fragmentation, that is subject to soil consumption (Blasi, 2008), are in fact to be identified with an overall misconduct and abuse at the level of expecting plans strategies and policies that allowed building on agricultural land. This peculiar spatial configuration is characterized by large areas of agricultural production that enter into the city in a wedge-shaped way (Cavallo et al., 2015). Other scholars (Frondoni, et al., 2011) recognize a horizontal growth irradiated from the highly compact core area along the main transport routes and created a star-shaped urbanization pattern. Both other definitions acknowledge the strong integration between city and countryside, with the flow of socioeconomic relations and ecosystem services that this configuration entails. These particular agricultural shapes are confirmed by the fact that 28 % of the cultivated area falls within the Grande Raccordo Anulare (GRA, Great Ring Junction) (Blasi et al., 2008), that is close to high density housing areas. The Agro Romano, the broad rural area - partly flat and partly hilly - that extends around the city of Rome has progressively reduced its economic and social weight. According to the latest agriculture census (Istat, 2011), the area cultivated within the city of Rome has increased from 2000 to 2010, recording a growth of 6,236 hectares (17 % of UAA) (Used Agricultural Area). The same trend is measurable for the TAA (Total Agricultural Area) : +6,289 hectares (+12 % compared to the 2000 census). This is even more interesting if compared with similar data relating to other Italian and Mediterranean contexts, where, over the last ten years, the cultivated areas within the urban and metropolitan area have decreased significantly (Cavallo et al., 2015) ; also the comparison with the national data shows how dynamic the roman peri-urban agriculture is, to the extent that in Italy wooded areas have increased by the 14 % from 1960 to 2012, mainly due to the effects of the phenomena of abandonment of the inner areas, especially the Apennines.

7 In the decade 2000-2010, farms in the municipality of Rome increased by 40 %, bringing the total number to 2,656, of which 744 direct sale (Marino, 2016/a), while those in protected areas represent 39 % of the total. However, the business structure appears fragmented, revealing a certain fragility in terms of land ownership : in fact, 30 % of businesses have less than one hectare, while those between one and five hectares are 34 % of the total. From the surface point of view, it is interesting to note that only 2 % of farms, the ones over 100 hectares, occupy 40 % of UAA, while those with a surface area of up to five hectares cover 11 % of it. The companies that adopt the biological method have passed from 44 to 100 units from 2000 to 2010. Tree cultivations are practiced on 3,209 hectares in Rome, and account for about 10 % of the woody cultivated areas of the province. Among these, in absolute terms, there is the olive tree, with 1,726 hectares, follows the vine with 911 hectares. Regarding livestock farming, despite a difficult economic phase affecting the entire region, in the municipality of Rome is still a priority sector : 20 % of dairy farms are located at the provincial level and the same percentage is recorded for herd-breeding farms, which are historically part of the rural culture of the Agro Romano. Urban gardens, in their specificity linked to services that go beyond the production of agri-food products, are one of the categories that make up the varied

mosaic of urban and peri-urban agriculture in Rome. Compared to the 2000 census, the number of urban gardens and their extension has increased, but quantification is particularly difficult as it is usually spontaneous phenomena based on informal dynamics, both by individual families and small groups, or in small plots of land (Cavallo et al., 2015). The lack of reliable data on the number and extension of urban gardens in Rome reflects the insufficient political willingness to build a framework for the management, the regulation and the recognition of the benefits of such important component of city's urban agriculture. Nevertheless, a wide and even more participated network (Orti in Comune – Shared Gardens), together with some representatives from Rome Municipality, are making valuable efforts to effectively apply a municipal law for the regulation of urban gardens : their activities entail meeting among actors of civil society, community events, legal and lobbying activities for speeding up and improving the application of the law.

8 The data presented here show that even in a heavily urbanized area such as Rome, agricultural activity does not cease to be flourishing thanks to its ability to interact with the city, thus giving life to different forms of urban agriculture, belonging both to the category of urban horticulture and that of urban professional farming.

Urban agriculture as a producer of benefits and values for dwellers

9 In this brief analysis, we chose to present the system of economic and social relations that are emerging in a spontaneous way throughout Roman urban agriculture - "not only among agro-food products producers and consumers but rather within a much more complex social, economic and institutional network" (Marino, 2016/a) - by considering the effects of these new configurations in terms of farms' spatial distribution, entrepreneurs' strategies, land use and, consequently, ecosystem services. We refer, in particular, to the "patterns of production and consumption based on the relationship between territoriality, products' proximity and consumption, socialization practices, trust dynamics between producer and consumer, work's safeguard and fair remuneration" (Sismondi Rural Laboratory, 2012), often identified with short chains or, more generally, with Alternative Food Networks (AFN). The role of these networks in the Roman area is not questionable, especially in the case of farmers' markets (33 cases in the municipality of Rome), Solidarity Purchased Groups' (SPG, 55 cases) and box schemes experiences. It is important to note that all these innovative processes, carried out primarily by those agricultural enterprises that have been gradually conforming to the new conformations of the urban and rural landscape, activate a peri-urban territorial coverage process that improves city-countryside relations through, for example, the use of food short chains, one of the most frequent and successful tools. Additionally, since these innovative processes also involve consumers by establishing, within an AFN context, a relation of co-production, they favor relational values and goods. Within the Roman context, the role played by social agriculture, recently recognized by the Province of Rome through Law 112/2005 and the establishment of the Social Agriculture Forum, is considerable, as well as the role played by agricultural cooperatives. These latter are not only significant operative within the processes of abandoned public land's reorganization carried out by young farmers, but also represent a valuable alternative food production system of cultural and relational services, a reference point for the activities offered by

civil society, the world of association, volunteers and the experiences of Community Supported Agriculture (CSA).

10 In 2013 the City Council launched the program “Rome Cultivating the City” (Roma Città da Coltivare) that provides farming lands and rural properties, owned by the Municipality, to young farmers (under 40) as established in 2012 by the Art. 66 of the National Decree-Law. The program’s main goal is the heritage regeneration and environmental protection of the Ager Romanus, for a total of about 100 hectares entrusted, through the employment of multifunctional farms that are required to use short food chain aiming at developing innovative management tools for the peri-urban areas as well as establishing closer relations between entrepreneurs and roman consumers. This program has allowed young farmers, aged on average 26, not only to undertake biological agriculture activities but also multi-functional services and other activities of social relevance while improving greening and biodiversity. A similar venture named “Terre ai giovani” (Lands for youth) was carried out by the Lazio Region together with Arsial (Agency for the Development and Innovation of Agriculture - Agenzia Regionale per lo Sviluppo e l'Innovazione dell'Agricoltura del Lazio) for the purpose of creating jobs, giving opportunities to young people who have demonstrated self-initiative in terms of innovative sustainable agriculture plans.

11 Despite several difficulties and after only a few years of existence each of these farms have proven to be particularly relevant considering their aim. It is therefore important to note the action of the cooperative Coraggio (Cooperativa romana agricoltura giovani), in the farm of the Borghetto San Carlo, which has been particularly active in the promotion of agricultural production, responsible consumption, as well as biodiversity, landscape and ecology’s enhancement and protection. The analysis of ecosystem services was centered on the creation and the provision of a wide range of agricultural goods as well as becoming through their social activities a reference point in term of educative and leisure benefits for the surrounding communities (Cartiaux, 2017). Their strategic location within the green grid of Rome plays both the role of productive connector between the different parks in the border of Rome and a solution of to the urban sprawl problem.

Urban agriculture ecosystem services

12 We have mentioned the multiple roles of urban agriculture in the metropolitan contexts, and we have seen in particular how in the case of Rome the production of agro-food goods is often accompanied by a series of services - voluntarily pursued or intrinsic to the activity - that involve benefits for urban population. In the last decades, following the growing environmental pressures and the exploitation of natural resources at unsustainable pace for the resilience of the planet, many studies have begun to recognize, classify and assign biophysical and economic values to services "delivered" by ecosystems and, that are indispensable for man's life (TEEB, 2010 ; MEA, 2005 ; De Groot et al., 2002 ; Constance, 1997). These services are almost unanimously transposed into four categories : supply services, regulation, cultural and support services. Without specifically examining the various classifications and methodologies, that are not among the specific goals of this paper, we can recognize a number of functions that urban agriculture in Rome, as well as in other large urban contexts, can play. Given the social and economic characteristics of urban and peri-urban agriculture above, we can primarily recognize the value in terms of ecosystem cultural services, insofar as innovative forms of distribution

and co-production play an important role in social cohesion, involvement and transparency of the chains. At the same time, urban gardens, which represent a widespread phenomenon in Rome, bring people closer to agriculture, also representing a great opportunity of education and training for young people and for the integration of marginalized groups of society.

13 The benefits of urban and peri-urban farming extend to environmental regulation services since agricultural areas play a role as a green corridor, a connection and continuity between the city's core - where it lives the most part of the population - and the surrounding areas. In this context, planning green infrastructure - defined by the European Commission (2013) as "natural and semi-natural areas networks planned at strategic level with other environmental elements, designed and managed to provide a broad spectrum of ecosystem services" - can contribute to the maintenance of a range of environmental services : pollination, biological control, carbon storage and seizure, conservation of freshwater reserves, temperature control, reduction of the risk of forest fires, reduction of flood risks, reduction of consumption soil, soil fragmentation and soil non-permeability, water flow regulation, water purification and many others (MATTM, 2014).

14 It is important to keep in mind that this study has been realized during the early stage of these farms existence with the specific goal of shedding a light on the importance these projects can have in terms of benefits for environment and society. Although we have just mentioned different ecosystem services we recognize the partialness of their quantification as well as the difficulty of properly identifying their impact especially for those services related to environmental regulation (see table 1). The improvements of the ecosystem services' knowledge base together with its valuation has already proven to be effective in terms of better decision making. Better comprehension of such services could therefore help projects of this kind to be further developed and funded.

Table 1. Ecosystem categories and corresponding related services synthesis of the farm projects.

Provisioning services	Habitat or supporting services
Multifunctional, resilient agriculture and forestry	Conservation benefits
Investment and employment	Low carbon transport and benefits
Regulating services	Societal services
Enhance efficiency of natural resources	Tourism and recreation
Climate change mitigation and adaptation	Education
Water management	Health and wellbeing
Land and soil management	
Disaster prevention	

Conclusions

15 Relations between the city and the countryside are today in an intense debate involving different disciplines and fields, from land planning to urban planning, from agro-forest management to the governance of peri-urban areas, from the sustainability of agri-food production to the new strategies of farms. Despite the growing awareness of their environmental and socio-economic relevance, peri-urban agricultural spaces, peripheral territories rendered such by that process that Bauer and Roux (1976) define as *rurbanisation*, are not, however, the object of a project nor by of the city nor by the rural space management policies, because, as Donadieu (2006) argues, they are not sufficiently educated to recognize it or equipped to interpret it. These deficiencies undermine the roles that Bernardo Secchi identified in the agricultural landscape when he states that "most of the open space is an agricultural landscape : [...] landscape in which the deposit of the complex system of values, knowledge and social relations that has characterized the agrarian world and its history can be recognized "(Secchi, 1989). Consistently with the arguments of Secchi, we can mention the research on traditional agricultural landscapes (Paesaggi Agricoli Tradizionali - PAT), defined as those "landscapes, present in a territory for a long time, which are stabilized or evolve slowly over time" (Barbera et al., 2014). A traditionality that finds, therefore, expression in the forms, in the structures, in the conservation of the functions enclosed in the concept of landscape. It is therefore to be noticed that, in parallel with the risks associated with the simplification and fragmentation of landscapes, the new relations between the places of production and the trade in food products identify new landscapes, both innovative and traditional : (1) innovative, because human action on these landscapes consists of actions aimed at identifying new commercial channels and new forms of sales based on proximity relations ; because they reinforce the sense of community by making the citizenship informed and involved in the farm's activities, within a broader operation of transparency ; (2) traditional, because they meet the three criteria for the classification of Traditional Agricultural Landscapes (Barbera et al., 2014) - complexity, resilience and connection - in a new sense, based not only on ecological indicators but also on elements of type socio-economic.

16 It is important to conclude by highlighting these initiatives' growth potential as a determinant step towards a more sustainable food system able to provide a wide range of benefits in terms of economic profit and citizens' life quality. As Donadieu (2006) states, « the best way to preserve a living and dynamic agricultural campaign is to make landscapes for the citizens ». In a context in which there is a deep integration between the urban and rural areas, the city becomes a strategic area to orient the political agenda towards resilient urban models (Marino, 2016/a). In fact, urban areas are the largest and most advanced agri-food markets and represent the main commercial outlet for agricultural producers, especially those located near large cities. The urban level - intended in the consolidated meaning of *city-region* - is the one that holds the widest room for maneuver in terms of governance. It is now widely shared that without a systemic thinking, capable of making dialogue between sectors, institutions and sectoral policies, the sustainable city project is unworkable. With its innate complexity, food system, understood as an urban system composed of numerous territorial subsets (agriculture, transport, logistics, distribution, consumption, waste management), offers

unique opportunities to overcome the current divisions between disciplines and professions that deal with the city and territory (Ilieva, 2016). Despite the recent mentioned initiatives for the allocation of public lands in Lazio region and the regional law for the promotion of short food chains and farmers' markets, we can state that Rome misses a systemic approach capable to integrate all food aspects. An Urban Food Policy supported by a municipality Food Council (as demonstrated by many experiences mainly in the Global North), could be able to strengthen urban and peri-urban agriculture, providing governance tool to preserve and possibly enhance ecosystem services supplied by these areas. Imagining food as an urban system can not only allow us to discover possible synergies between cities and countryside that have been neglected until now, but also to understand and manage environmental problems and urban metabolism. The city of Rome has the means to bring together these bottom-up initiatives into a participative and profitable planning tool that also includes more efficient and suitable regulatory frameworks and policies, particularly advisable for the success and development of these new forms of agriculture.

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ABSTRACTS

This paper presents the case of peri- and urban agriculture in the context of Rome municipality by highlighting, in particular, its contribution to ecosystem services provided to urban population. These different agriculture cases are participating to the city's resilience by marking and influencing the functioning of the urban agricultural landscape of the city. Among the different tools that the municipality has set up, we have taken into consideration the loans to young farmers of public lands launched in 2013 in order to participate to the development of multifunctional farms aiming at both the protection and restoration of the agricultural system. Despite the demand for the access to public lands are growing, further landscape policies or planning frameworks have not been developed yet, with the risk of leaving these initiatives as sporadic. Results have shown that those multifunctional farms provide a large panel of essential benefits influencing and regenerating the neighbourhood and that agricultural activities maintain soil function and provides important societal ecosystem services.

Cet article présente le cas de l'agriculture péri-et urbaine dans le contexte de la municipalité de Rome soulignant, en particulier, sa contribution aux services écosystémiques fournis à la

population urbaine. Ces différents cas d'agriculture participent à la résilience de la ville marquant et influençant le fonctionnement du paysage agricole de la ville. Parmi les différents outils mis en place par la municipalité, nous avons pris en considération les prêts accordés aux jeunes agriculteurs du projet « terre publiques » lancé en 2013 afin de participer au développement de fermes multifonctionnelles visant à la fois à la protection et à la restauration du système agricole. Malgré la demande et volonté d'accès aux terres publiques, aucun réelle politique paysagère ou cadre de planification ont été développées faisant courir le risque de voir ces différentes initiatives sporadiques. Les résultats ont montré que ces fermes multifonctionnelles fournissent un large panel de bénéfices influençant et régénérant le voisinage et que les activités agricoles maintiennent la fonction de sol et fournissent des services écosystémiques essentiels pour la société.

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Mots-clés: agriculture urbaine, paysage productif, planning urbain, planning environnemental, rurbanisation, services écosystémiques
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