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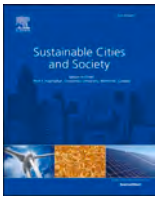

Multiple evaluation of urban and peri-urban agriculture and its relation to spatial planning: The case of Prato territory (Italy)

David Fanfani [a,*], Barbora Duží [b], Marco Mancino [a], Massimo Rovai [c]

[a] Architecture Department, University of Florence, P. A. Micheli 2, Florence, 50121, Italy
[b] Institute of Geonics of the Czech Academy of Sciences, Department of Environmental Geography; Drobného 28, 602 00 Brno, Czech Republic
[c] Department of Civil and Industrial Engineering, University of Pisa, Largo L. Lazzarino, 56122, Pisa, Italy

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ABSTRACT

Urban and peri-urban agriculture (UPUA) can play a fundamental role in producing Ecosystem Services (ES) ES at the local level improving sustainability of urban / rural relations. Referring to the peri-urban areas surrounding Municipality of Prato (Tuscany - Italy), we assessed the potential of urban and peri-urban agricultural areas in providing some key ES: food supply, CO_2 storage and biodiversity / connectivity. We also analysed the planning tools operating in the area to foster the enhancement of the UPUA area within the planning processes.

The study was conducted using the scenario method by comparing the current situation with an agroecological scenario and verifying the change in the delivery of these three ES. The results show an increase of CO_2 storage capacity and ecological connectivity with tolerable repercussions on food provision. Indeed, results highlights the potential of the UPUA in satisfying the food needs of almost 87.9% of the inhabitants of Prato for cereals and 27.9% for legumes whereas, in the agroecological scenario, these produce decrease by about 23% and 11%. Finally, the study suggests the need to integrate governance and territorial planning tools to promote and enhance the role of ES provided by UPUAs on an urban and peri-urban scale.

1. Introduction

Agricultural areas within the boundaries of urban areas or in close proximity to cities, in addition to food and / or no-food crops, produce usually other important ES for the urban resilience drawing on the presence of "hybrid" agricultural activities that in literature are usually classified as Urban and Peri-urban Agriculture (UPUA).

For these reasons, UPUA enables the integration of manifold ecological discourses in the urban environment based on the ecosystem services (ES) approach (Douglas, 2006; Swinton et al 2007; Power, 2010; Aerts, Dewaelheyens and Achten, 2016; Wilhelm, Richard & Smith, 2017; Gren & Andersson, 2018) and to their relation to the spatial planning system (Simon Rojo & Duží, 2014; Ronchi, Arcidiacono, & Pogliani, 2020). According to Piorr et al., (2018), food issues that are mainly related to the disposal of UPUA areas, represent a pivotal entrance point for newly integrated policies to enhance the urban ecosystem, provides sources to foster urban regeneration (Tapia et al., 2021) as well as urban/rural re-embedding for sustainable cities and a healthier urban environment (Foster & Escudero 2014; Filippini, Mazzocchi & Corsi, 2019). Otherwise, all that calls for application of enhanced assessment and planning tools in order to better support awareness of UPUA multifunctional role in the policy-making process and in the spatial planning field (Simon Rojo et al., 2017; Sanyé-Mengual et al., 2020). Related to these issues an improved spatial coordination of policies at landscape scale is claimed to better tap into provision of agricultural ES originated in peri-urban areas. Moreover, even if UPUA is credited as entailing a sustainable local food provision model (Aerts, Dewaelheyens & Achten 2016; Wilhelm & Smith 2018) and providing other sustainability-oriented activities Brinkley (2017), there is a need for a deeper understanding of its real role in providing ES for urban environment improvement and enhancing ecological sustainability performances either on a global or local scale. This also considering the trade-off between the various ecosystem services that can be supplied by farmland (Swinton et al., 2007; Power, 2010).

For these reasons, UPUA functions related to ES need to be better appraised adopting more refined analysis approaches according to the contexts. That especially focuses on the adopted and possible farming methods, related land use patterns as well as to spatial settlement features on which UPUA itself unfolds (Sanz Sanz, Napoleóne and Hubert 2016).

* Corresponding author.
E-mail address: david.fanfani@unifi.it (D. Fanfani).

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Drawing on the previous considerations we can finally contour the main inquiry field relating to deepening the co-evolutionary relationship between ES provision potentialities of the urban and peri urban farmland (UPUA) and spatial planning strategies to better integrate in operational terms these two fields.

Particularly, referring to the case study of Prato municipality peri-urban areas, the first aim of the paper is to assess potentialities of UPUA in selected ES (CO_2 storage, biodiversity/connectivity and food provision as the key ES). Accordingly, we also focus on the analysis of the main spatial planning tools on this area evaluating their current role as well as potentialities to enhance UPUA as multifunctional landscapes in terms of ES.

Based on this two key aims, we set up related research questions:

- What is the potential of UPUA ecosystem services under the agro-ecological regime, compared with the current one?
- How can spatial planning be improved to better grasp the hybrid character of urban and peri-urban areas and to appraise the multi-functional role of UPUA?

Exploring these kinds of questions will allow us to gain some insights and propose some criteria about criticalities/potentialities referring to the integration of spatial planning practices with rural development policies along with the needed requirements of innovative methods and tools to better address this matter. This, in the prospect to enhance the role of the UPUA in promoting urban/rural re-embedding and sustainability, either in socio-economic and ecosystem terms.

Drawing on the issues and research demands shortly presented, the paper is structured as follows:

After this first section of introductory nature, a brief theoretical framework is reconstructed to better contour:

- the enhanced nature of UPUA in providing, in addition to the primary food service, also other fundamental ESs to foster settlement sustainability (Artmann & Sartison, 2018);
- the rising demand for tools that integrate/coordinate territorial planning and rural policies aimed at strengthening the role of UPUA to bring together local production and consumption of food and in producing other ESs useful for the overall sustainability of the city.

The next section introduces the methodology steps adopted to assess in the study area context:

- the provision of three ES (CO_2 capture, agroecology patterns for biodiversity, food production) under the current "productivist" farming model and in a planned scenario with a greater presence of green infrastructure (e.g. hedgerows and riparian vegetation) according to an agroecological production model to evaluate changes in ES provision;
- criticalities and potentialities of the adopted spatial planning tools and local governance systems relating to the possibility to enhance integrated urban/rural policies, especially to support ES provision.

Subsequently, results and discussion sections highlight, show and evaluate the obtained evidence.

Finally in the conclusive section we address some further research demands stemming from the study, especially concerning a deepening of UPUA possible models, trade-off between delivered ES and settlement patterns. That also with the aim to further refine and foster an innovative planning method to enhance integration between spatial planning and rural development policies affecting UPUA practices.

2. UPUA and urban/rural re-embedding

2.1. Definitions and approaches to urban and peri-urban agriculture

Key definitions of urban agriculture mainly refer to its cross-cutting nature in terms of spatiality and scale (Nasr, Ratta & Smit, 1996; Mougeot, 2000) as activity carrying on, either food and no-food productions within the boundaries of urban areas in close proximity of urban dwellers (Mougeot, 2005; Opitz et al., 2016; Piorr et al., 2018) and mainly referring to the local market or to Short Food Supply Chain (SFSC) (Kneafsey et al., 2013). Depending on whether this agricultural production is closer to the inner parts of the urban fabric or to the surrounding rural/peri-urban region, urban agriculture (UA) can also be classified as urban (or intra-urban) or as peri-urban (PUA) agriculture Mougeot (2000). These categories are complementary and UA is also referred to in a wider concept as UPUA (Opitz et al., 2016) and jointly encompasses local and global market oriented farming activities,

For the purpose of our study, according to Mougeot (2000), we assume the very complex nature of UPUA as an underpinning part of the urban ecosystem and conceived as an integrated whole of ecological, economic and social factors (Opitz et al., 2016). A whole where UA and PUA borders are fluent whereas PUA turns out as being mainly alike to Rural Agriculture (RA) except for the urban pressure and food market influence that entice new commercial and exploitation models (Piorr et al., 2018).

Drawing on this definition, spatial issues turn out to be pivotal, from the point of view of our research, in deepening mutual relation between urban and rural domains. Particularly two main aspects concerning the spatial issues should be emphasized:

- the importance to adopt a cross–scale approach and categories expressing the "rapprochement" of cities with surrounding territories and asking for new planning and design tools also at urban scale;
- the growing fragmented nature of urban development patterns, where urban and rural intertwined, that calls for multipurpose and more complex classification categories (Moustier & Danso, 2006; FAO, 2007; Sanz Sanz, Napoleóne & Hubert, 2016) and new heuristic concept in the field of spatial planning and design (Viljoen, 2005; Parham, 2015; Viljioen et al., 2015; Opitz et al., 2016) .

The previous considerations reveal that the complex nature of UPUA calls for a twofold deepening of it, either in terms of a better description of its role in delivering ES - considering also local food provision - and of its spatial features relating to regulating land use planning. The next two paragraphs are aimed to better refine these two points.

2.2. UPUA and ES provision

Recognizing the actual or potential role of the UPUA in providing essential ES for the well-being of citizens is a key point for the urban-rural re-embedding strategy. According to key literature references (Costanza et al., 1997; MEA, 2005), ES are the services provided by natural, agricultural, urban, etc. ecosystems which have a strong relationship with human well-being. When we apply this approach to human managed activity as UPUA, the most important provisioning service can be considered food and non foodstuff. Besides this, UPUA provides and also influences many other (dis)services, depending on the level of less or more (un)sustainable management (Foley et al., 2005, 2011; Aerts, Dewaelheyns & Achten, 2016). Based on agroecosystems and as a result of well managed practices Power (2010), UPUA also influences supporting services (like biodiversity, connectivity), regulating services (climate, water and carbon cycle etc.) (Simon Rojo et al., 2014) and cultural opportunities, especially multifunctional agriculture (Zasada, 2011; Brinkley, 2012) via agrotourism and education. Except the last one, these will be the subject of further analysis in this study. Despite that, not many studies have delved into the complex relationship

between UPUA and ES provided. Among these, some point out the key role of PUA in landscape management (Gullino, Battisti & Larcher, 2018) and land sparing (Wilhelm & Smith, 2017) and consequently the role played for the sustainability of the peri-urban ecosystem and, therefore, to prevent a negative trade-off between UPUA and human well-being. That, whereas other studies highlight the role of UPUA in securing jointly ES with food supply in order to increase food security on a local scale (Aerts, Dewaelheyns and Achten 2016; Filippini et al., 2018). Relating to that, a further research demand is outlined to ensure adequate levels of biodiversity and ES in UPUA across urban expanding areas (Lin, Philpott & Jha, 2015) also adopting nature based solutions (NBS) (Artmann & Sartison,2018) to pursue environmental resilience, inclusive society, food security and sustainable urban design (Tapia et al., 2021). Eventually, Simon Rojo et al., (2014) evaluated the ES potential of UPUA by distinguishing between the current state and of a future policy designed scenario. Authors pointed out the need to better envision and represent the connection between UPUA and ES to enhance public awareness about that in order to involve local actors and mitigate prevailing reluctant attitude and inactivity of the decision makers.

2.3. Geographical/territorial understanding of re-embedding UPUA: new challenges for spatial planning system

The mentioned multidimensional and place-specific nature of UPUA open to the need to review current methods of urban and territorial planning and their tools and practices, especially with reference to rules on the use of urban and peri-urban farmland areas (De Wrachien, 2003; Tassinari, Torreggiani & Benni, 2013; Bousbaine, Akkary & Bryant, 2017). Moreover, official documents (EESC, 2004), focus on UPUA's key multifunctional role in pursuing sustainability goals and calling for innovative urban policies and planning practices and tools. A key issue in this context is the enhancement of UPUA's multifunctional role in restoring and re-embedding Polanyi (2001)[1] the ecological and socio-economic proximity relationship between the urban domain and the surrounding rural one Zasada (2011). In this prospect urban-rural interface becomes critical to meet multiple goals such as the quality of the landscape, the coexistence of diverse ecosystems, conservation of different resources, economic development and social tensions (López-Goyburua & García-Montero, 2018). That also calls for a new "agroecological urbanism" (Deh-Tor, 2017; Tornaghi & Dehaene, 2020) to be considered as a plausible model to better respond to the challenges of resilience and sustainability. A challenge that has, among its key points, the strengthening / creation of local food systems and, therefore, it is essential for the planning and design of the territory, to preserve / enhance the productive role of UPUA (Viljoen et al., 2015; Parham, 2015; Bousbaine, Akkary & Bryant, 2017) and its "place making" function (Sonnino, Tegoni & De Cunto, 2019). That also recovering according to Feagan (2007) a critical cross-scale approach to the "local" category in term of sectors and institution collaboration (Franklin & Marsden, 2015) to develop a strategic approach for proactive integrated policies and an UPUA programme (EESC, 2004; Piorr et al., 2018). Whereas at a wide scale that lately enticed the recovery of some holistic and cross-scale geographical categories for integrated spatial planning such as: foodshed (kloppenburg, Hendrickson & Stevenson, 1996), city-region food system (CRFS) (Foster & Escudero, 2014; Blay-Palmer et al., 2018) urban bioregion (Fanfani & Duží, 2019), at the local/urban scale design issues turned out to be of remarkable relevance. Particularly many studies addressed the issue of peri-urban agro-ecosystem enhancement by establishing new criteria and rules for spatial planning (Nasr, Atta and Smit, 1996; Viljoen, 2005; Lee, Ahern & Yeh 2015; Doherty, 2015; Opitz, et al., 2016; Tornaghi & Dehaene, 2021). Indeed the prospective assessment of ecosystem services in urban environments can foster the introduction of nature-based solutions (Artmann & Sartison 2018) and green infrastructures in urban ecosystems. Nevertheless it calls for an innovative planning approach integrating Performance Based Planning (PBP) and participative methods (Ronchi, Arcidiacono & Pogliani, 2020). That in order to make decisions transparent and methods transferable to others (Gomez-Villarino & Ruiz-Garcia, 2021) as also underpinned by the adoption of multidimensional and cross scale scenarios (Scorsa et al., 2020).

3. Study area and methodology

This study was conducted in the context of Prato peri-urban area where Prato Municipality represents the main urban core. The study area is placed in one of the smallest and recent Italian provinces, located in the central-eastern part of Tuscany (Fig. 1). Province territory covers a surface area of 356,72 Kmq and its population reaches 257,075 inhabitants (ISTAT 2019). It encompasses seven Municipalities whereas the biggest of them is Prato with a surface area of 97.35 Kmq and a population of 192,469 inhabitants that represents about 75% of the inhabitants of Prato Province (ISTAT 2019).

Relating to our aims it is worth noting how croplands are mostly located close to Prato in peri-urban floodplain areas and a substantial amount of non-urbanised land (some 60%) is constituted by woodlands located in valleys and hilly areas of the Province (Fig. 2a). For this reason, and fitting with the study goals, we assessed the ESs related to UPUA focusing on the peri-urban farmland area surrounding the main urban center of Prato, mainly constituted by croplands (Fig. 2b).

Referring to this territory, to answer the research questions raised in the previous chapter we deepened two main matters:

- Mapping of current land use patterns and evaluation of the supply of three key ES: biodiversity / connectivity (support services), CO_2 capture, (regulation services) and food production (supply services) of UPUA areas according to high resolution analysis of urban/rural patterns. To do that we compared current land use with a designed agroecological scenario (Nelson et al., 2009) according to a proxy method (Martínez-Harms & Balvanera, 2012; Martinez-Harms et al., 2015; Maes, Crossman & Burchardt, 2016) ;
- the current level of integration between spatial planning tools and the rural development policies in order to suggest possible actions to effectively foster UPUA delivered ES and, particularly, local food provision to enhance the sustainability of the Local Food System.

We did that according to four steps as explained as follows.

3.1. Analyzing current farmland land use patterns and scenario setting

As a first step, with the support of a GIS software, the use of spatial models, spatial data on land use (Tuscany Region Land Cover Opendata) we analyze current land use and, drawing on the OpenData ARTEA[2] cultivation data source we related those to four main types of crops. Considering the land use distribution (Figs. 2 a,b; 3), we particularly focused on evaluation of the three ESs (CO_2 capture, biodiversity / connectivity and on food provision) at the peri-urban area of Prato level. To define the scenario of land use patterns we related to a model of more ecological farming practices (e.g.organic) consistent with a more

[1] To frame this matter we refer here to Polanyi's insights about the dis-embedding concept (Polanyi, 2001), that meant to describe process entailing commodification and mobilization of labour (humans), land (nature) and capital (money) and jeopardizing, among others societal endowments, inherited food supply "safe" patterns and land(scape) degradation prevention (Polanyi 2001: 75-76, 190-193). Drawing on Polanyi's criticisms we introduce here also the reverse "re-embedding" (or embeddedness) concept in order to address the recovery of urban/rural balanced relationships and of "re-localized" agri-food self-relied proximity farming schemes.

[2] A.R.T.E.A: Regional Tuscany Agency for payment of CAP funding

Fig. 1. The location of Prato Province in Tuscany (Italy).
Source: Authors' own elaboration on Data provided by Stamen Terrain Background, Bing Satellite and ISTAT.

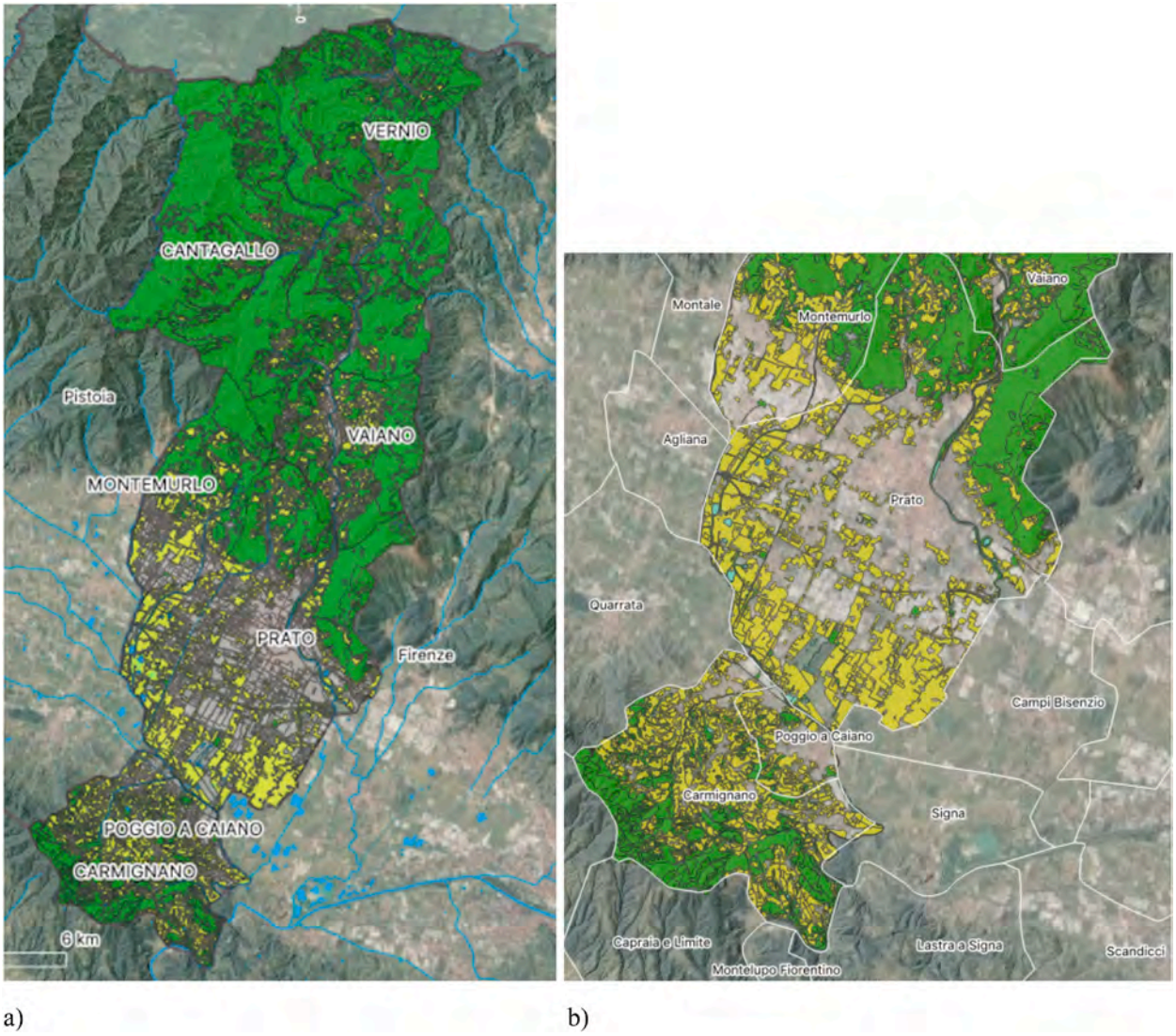

Fig. 2. a) Prato Province and b) study area where the ES provision of peri urban farmland was assessed
Source: Authors' own elaboration on Data provided by Tuscany Region Opendata.

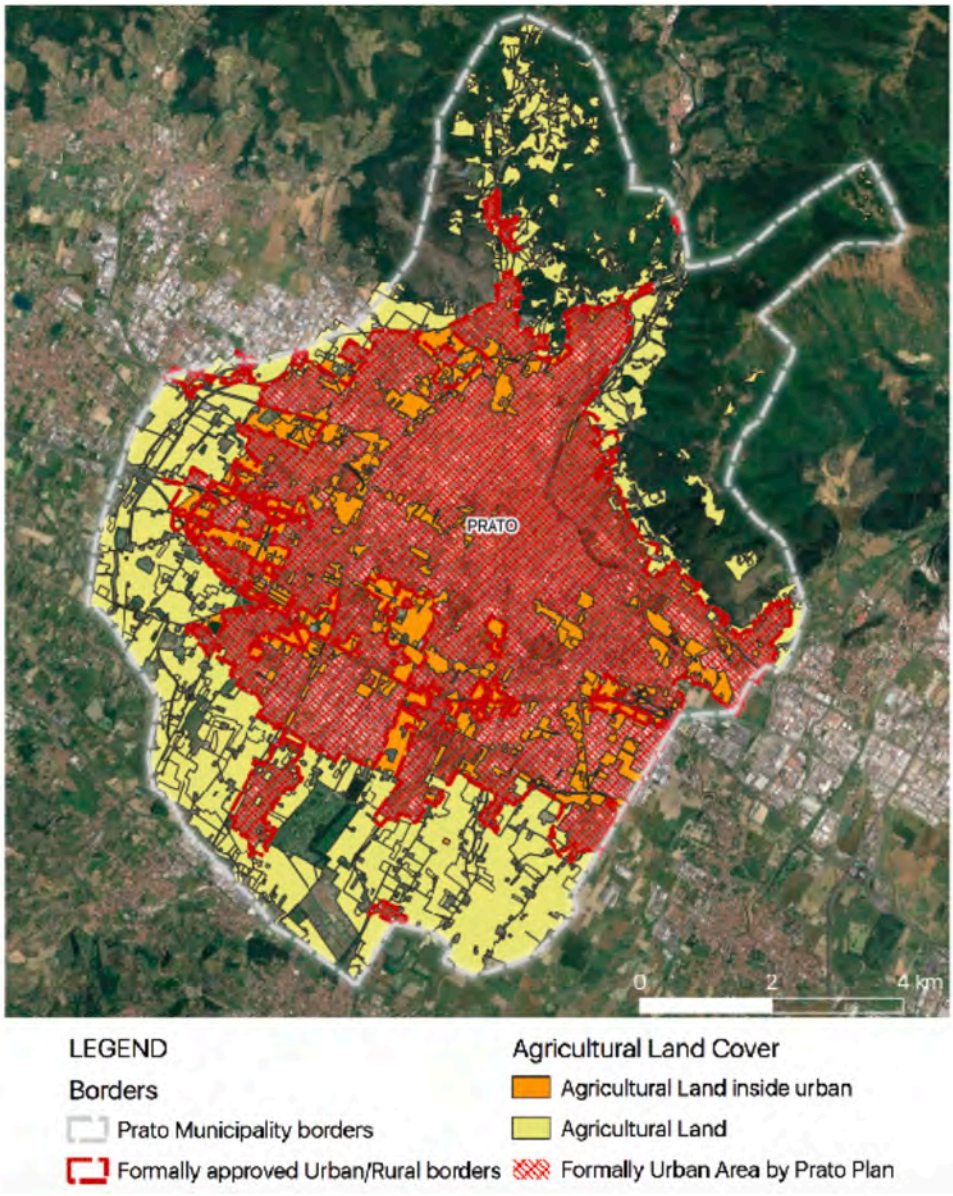

Fig. 3. Patterns of interwoven Urban/farmland areas: sample referred to Prato Municipality. In orange the still present and managed farmland inside the "urban area" (red line) defined by the municipal land use plan and farmland-belt land cover around the urban area in yellow.
Source: authors own processing, data based on Region Tuscany Land Cover Opendata and Prato Municipality spatial plan.

complex agro-ecosystem matrix (Power, 2010; Wilhelm & Smith 2018) and urban/rural gradient (Kroll, 2012). With this aim we added and enhanced the current land use patterns with polygons representing retrieved and enlarged hedgerows mainly placed on farmland existing plots and minor hydrological networks, and retrieved riverine areas.

3.2. Evaluation of connectivity/biodiversity and CO_2 capture

As second step, to analyze and evaluate biodiversity support and connectivity service, in terms of complexity of ecological network patterns, has been calculated a length/surface ratio, related to the number of linear elements (green and blue bodies as lines) contained in each unit resulting by the superimposition of a regular grid of 30x30 mt on land cover features assumed as surfaces. To calculate this ratio we used an algorithm that takes a polygon layer and a line layer and measures the total length of lines and the total number of them that cross each polygon. In this case we used, to compare resulting maps, actual and scenario land cover as a polygon input layer of green and blue bodies as lines to evaluate. In addition, node density index has been obtained from the analysis of the hedgerows network by calculation of point interpolation.

To evaluate actual vs scenario's CO_2 storage capacity, we used CO_2 storage index (T/ha) calculating land use surface (ha) defining the variation (Delta) in percentage. Surfaces data related to Urban-industrial, Water, Irrigated Land, Dryland farming, Dense Shrubs, Vineyard/olive, Pastures, Riparian vegetation are based on Region Tuscany Land Cover Open Data and we applied index and parameters drawing on Simon Rojo et al., (2014).

3.3. Evaluation of the food production capacity and demand within the study area

As a third step, we assessed the potential contribution of the land currently under crops within Prato Province towards the food requirements of the inhabitants of Prato Municipality: the larger urban center of the area. As for the previous services we also evaluated the

current and agroecological scenario state. To this end, considering our level of analysis, different from other studies based on average annual consumption/production referring especially to UA (Aerts, Dewaelheyns and Achten, 2016), we widened the scope of study to PUA production (Filippini et al., 2014, 2018; Tedesco et al. 2017) according to the meaning we previously assumed for such a socio-spatial category. Then, we carried on, in analogies with one of the key analysis models in this field, a fine-tuned "capacity study" (Schreiber et al., 2021) as quantitative methodology which estimates the potential of locally UPUA yielded crops to meet - for some key produce - the local mediterranean diet per inhabitant demand. That allowed us, also referring to other studies (Simon Rojo et al., 2014), to obtain more specific and updated data compared to those usually earned from the national Census (ISTAT, 2011). Moreover, this approach also permitted us to better point out the different levels of food provision specifically referring to each one of the categories of produce considered in the study and, accordingly, to best appraise how such productions currently fit with dietary requirements according to the same categories. That is also beyond the evaluation of a generic food energy ratio production / demand for inhabitants (Kroll et. al., 2012). To do this we calculated:

- the theoretical mean *per capita* requirements of some of the principle food categories of the Mediterranean diet using a model based on a study carried out by researchers from the University of Modena and Reggio Emilia (Sassi et al., 2016) and referring to the food consumption categories provided by the European Food Safety Authority (Cereals[3], Market Garden vegetables, Legumes, Fruits) (EFSA, 2010). Drawing on this framework our original calculation quantified weekly and annual requirements for each of the food categories analysed.
- the potential food production in Prato Province drawing on farmland type of cultivation plans data acquired from the ARTEA geodatabase (ARTEA 2018)[4]. We considered it a sound proxy sample of the entire study areas farmland land cover as particularly including about 51% of the total cropland in the study area (then woodland excluded) and more updated, detailed and direct compared to the one provided by ISTAT 2011 Agriculture Census (Fig. 4).

Then we reclassified ARTEA types of cultivation according to the previously mentioned food categories and, to obtain the total amount of farmland in the study for each cultivation category, we extended the quantities partition of each category contained in the ARTEA sample to the remaining farmland of the study area.

Finally, we attributed an average yield per hectare for each category (Province of Alessandria, Confagricoltura Alessandria, 2008) and to obtain the total production *per* year in the study area, we multiplied mean yields per hectare by the total amount of surface area dedicated for each corresponding type of cultivation as obtained by the extended proxy values of ARTEA sample.

Then, to assess current food self-sufficiency level, we compared production to the demand according to the classified demand categories. Finally, to calculate potential food provision under an agroecology cultivation regime we adopted the same procedure with some corrections. We calculated the yields according to a reduced farmland surface because of the increased land cover occupied by green infrastructures. Moreover, we adopted a mean reduction value of yield for each category, referring to some yield reduction parameter by category according to what emerges from scientific literature on this topic and (de Ponti, Rijk & van Ittersum, 2012).

[3] For the evaluation purpose as cereals we considered wheat (soft and durum) that are the main cultivated categories in the area.

[4] Cultivation Plans Geodata from ARTEA (2018).

3.4. Evaluation of spatial planning issues and local governance for urban rural re-embedding

With reference to the last research question, territorial planning documents that operate at different territorial scales (region, metropolitan city, municipality, etc.) were evaluated. The objective of the analysis, approached with a qualitative method, was to verify how much the issue of the enhancement of the rural territory and of the UPUA was considered in this field and the possible integrations with the regional agri-food policies. The main consulted documents were the Tuscany Region Planning Act (L.R. 65/2014), the Territorial and Landscape Plan (PIT/PPTR), the Florence Metropolitan City Strategic Plan, the Prato Municipal Structure and the Land Use Plans (Piano Strutturale and Piano Operativo).

We evaluated to what extent spatial planning policies and tools and other agri-food system governance initiatives, enact, set the conditions, or meet meaningful limits in integrating UPUA issues, ES discourse to promote urban/rural collaboration and re-embedding at landscape and municipal scale. Our evaluation criteria were as follow:

- *Urban-rural integration*: the relevance of the joint and integrated treatment of territorial planning and rural development (Morgan & Sonnino 2010; Tegoni & De Cunto, 2019);
- *Farmland protection:* what measures have been taken to effectively protect agricultural land against urban land taking process (Tassinari, Torreggiani & Benni, 2013; Caselli, Ventura & Zazzi, 2020);
- *Adoption of strategic planning and innovative design tools* (EESC, 2004; Bousbane, Akkary and Bryant, 2017) to implement agricultural activity management in UPUA areas to support local food systems;
- *Governance tools based on cross-scale innovative socio-institutional policies*: multi-level governance to strengthen the local food system through Public Private Partnerships (PPP) to foster joint top-down and bottom-up processes of change (Pothukuchi & Kauffman, 1999; Parham, 2020; Galli et al., 2020).

4. Results

4.1. Agro-environment spatial patterns of the study area

Even though the evaluation of ESs delivered by UPUA areas was carried on at the Prato Province level but, considering the scope of our study, and the province distribution of land uses (Fig. 2 a), to appraise results we focused on the intermunicipal area surrounding the main urban core of Prato where the most part of UPUA areas is concentrated. (Fig. 2b). Before presenting ESs study results, thanks to the fine-grained structure of the urban / rural interface, we highlight the wide diffusion of peri-urban agriculture (PUA) and open spaces within the urban fabric (UA) (Fig. 3). Moreover, focusing the attention on the "urban area" - formally defined by the rules of the Municipal Operational Plan-POC - we observe a considerable diffusion of agricultural areas (22% of the total at the municipal scale), still cultivated and managed by agricultural professional entrepreneurs often also under land tenure formal contracts (Fanfani et al., 2020) (Fig. 4).

These spatial features, typical of the development of many urban areas in Italy, find here a "model situation". These spatial patterns of agro-environment areas shaped like green wedges or enclosed patches, strongly intertwined with the urban fabric (see Fig. 5) are unintended by-product of planning activity combined with the historical polycentric settlement pattern that underwent, after the 60th, a weakly controlled urban/industrial encroachment.

4.2. Evaluation of the biodiversity / connectivity and of the CO_2 storage

As described in par. 3.2, the biodiversity / connectivity service was assessed both spatially and in qualitative terms by comparing the current ecological infrastructures of the UPUA areas of the municipality of

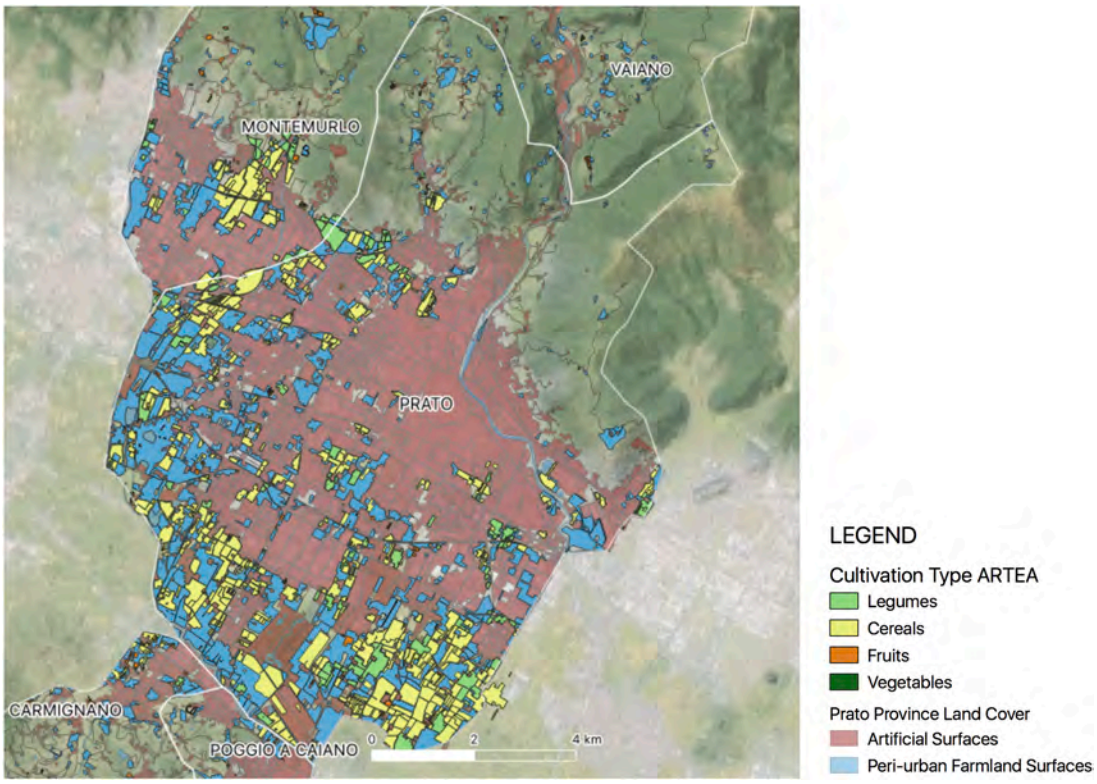

Fig. 4. Detail of Prato farmaland study area: cultivation type of the areas of ARTEA database sample and other cropland peri-urban areas (light blue). Source: data based on Tuscany Region GEOscopio OpenData and ARTEA Open Data and processed by the authors.

Prato (Fig. 5) with the hypothesis of a scenario aimed at strengthening these infrastructures.

In particular, the agroecological scenario is characterized by a more dense pattern of hedgerows, trees rows and green corridors and wedges accompanying the grid of the fields (Fig. 6). The length and number of linear green bodies (hedges) goes from 98.00 km and 507 linear elements in the current situation to 355.75 km and 1,847 linear elements, respectively, in the hypothesis of the agroecological scenario. Moreover the density of nodes (obtained from the analysis of the hedge network) by calculation of point interpolation indicates a marked increase in value in the scenario, compared to the present situation. That, above all, also enhances and fosters the connectivity function of the existing and residual open wedges connecting peri-urban farmland areas with the enclosed ones (see Fig. 7).

As regards the ES CO_2 storage capacity (see Table 1) there is an increase of nearly 12% passing from the current situation to the agroecological scenario, making an important contribution to GhGs equivalent emissions absorption.

4.3. *Evaluation of the potential of food provision in Prato territory*

According to the methodology explained in paragraph 3.2, we evaluated the average annual *per capita* consumption of some of the main food categories of the Mediterranean diet as previously established. We referred the evaluation to Prato Municipality population as being by far the larger urban core of the study area (see Table 2).

Results about food production / consumption ratio, *inter alia*, considering the plain cropland main land use and related food cultivation features (Fig. 4), allowed us to shed light on the relevance of the potential contribution of farmland peri-urban areas towards meeting the food demand of the 192,469 inhabitants of Prato Municipality (Table 2).

Table 3 shows the situation of the variation of cropland in the study area, considered as "edible land" for UPUA, in the current scenario and in the agro ecological scenario. We can observe a reduction in the area of almost 8% due to the increase in the area occupied by green infrastructures. The table also shows how the per capita availability of "edible" land dedicated to the production of food reduces from approximately 178 square meters/inhab. to approximately 164 square meters/inhab. in the agroecological scenario.

Particularly, with reference to the main products of the Mediterranean diet evaluated (cereals, legumes, vegetables and fruit), Table 4 shows the level of self-supply both in the current scenario and in the agroecological one. Indeed, in the current scenario, if for fruits the contribution to meet the demand of Prato Municipality is not significant we found that concerning cereals (mainly sweet and durum wheat and other minor cereals), legumes and market garden vegetables, these can reach a good level of production in the study area. showing a good level of self-supply with respectively 88%, 29% and about 21%.

In the agroecological scenario, we have a reduction of the cultivated areas, owed to the insertion of green infrastructures to enhance the agroecological structure, and of the average yields due to the transition to organic farming. Despite that, the reduction of production doesn't jeopardize the possibility to reach, anyway, a good rate of self-sufficiency. In this case the most significant reduction concerns cereals with a -23%, passing from a rate of almost 88% to 64.8%, while the reduction of other crops is decidedly more limited.

4.4. *Evaluating spatial planning issues and local policies in order to foster UPUA and local food production*

Documents studied showed how under the point of view of urban/rural integration, Tuscany Spatial Planning Act (L.R. 65/2014), drawing on the competence devolved to Regions since 1975, widely overcome the outdated National Urbanism Act (L.1150/1942) mainly focused on urban areas and, therefore, rural and agricultural area are hardly considered. Tuscany Spatial Planning Act mainly draws on an inspiration that sets the long-lasting territorial heritage (patrimonio territoriale) as guiding principle for an integrated vision of territory with a

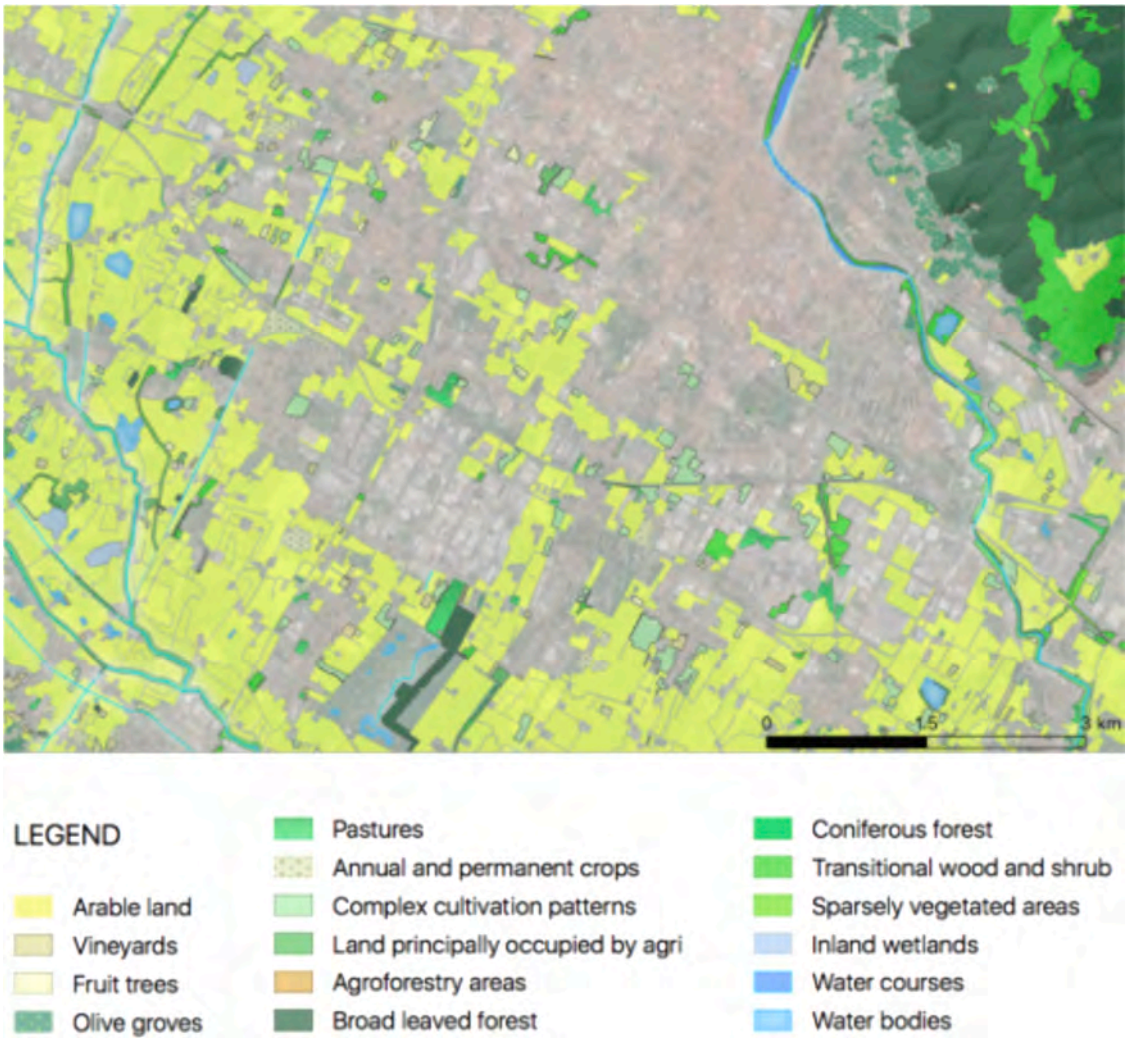

Fig. 5. Prato current agricultural land cover and structure. Source: authors own processing, data based on Region Tuscany Land Cover Opendata. Source: authors own processing, data based on Region Tuscany Land Cover Opendata, AGEA aerial image.

closer relationship between urban and rural domains. In this logic framework the Landscape Plan integrated with the Regional Territorial Spatial Plan (PIT) (approved in 2015) allows a better coordination between the "landscape quality targets" established by the Landscape Plan and spatial goals defined by the Regional Territorial Spatial Plan. In this context it is important to recall how the latter plan established the possibility to implement the plan by setting up some "Landscape or Territory Projects" at intermunicipal scale with an integrative and cross-sector nature in order to connect rural and peri-urban areas.

Furthermore, relating to "farmland protection" goals, the Spatial Planning Regional Law also obliges the Municipal Structural Plans and the Land Use Plans to define and enforce the Urban Growth Boundary (UGB) to distinguish between rural and urban areas with the goal to of avoiding / limiting further land consumption and unwanted urban development. That alongs with the individuation of the specific category of "peri-urban rural areas" (art.67) where implement specific strategies for their enhancement, among which the UPUA is seen as pivotal. Unfortunately that without making it mandatory to connect this measure to more propositive and operational design tools for peri urban rural areas enhancement.

Moreover, referring to the "Adoption of Integrated and Innovative Strategic Planning Tools", in the context of the Regional Planning Act, we can also recall art. 67 that, at least as a declaration of principle, calls for the protection of UPUA areas, local food production and multifunctionality of farms as appointed to the level of municipal planning tools. But also in this case is missing the integration with other instruments of territorial governance (eg Local Food Policies) and related funding resources to be diverted to UPUA valorisation

At the metropolitan level, concerning our case study, the main instrument for carrying out the potential of the UPUA areas in providing ESs and to enhance the local food system is the integration of Prato Municipality peri-urban areas into the Agricultural Park of the Metropolitan Area of Florence approved in the year 2014. This project was introduced by the Regional Territorial Spatial Plan as one of the mentioned Territory Projects. It encompasses 7 municipalities and 4,000 hectares of peri-urban farmland of a great quality located on the floodplain, thereby enforcing the preservation of the farmland as well as surrounding natural areas. Despite its declared agricultural nature, the policies lately implemented for the Agricultural Park weakly refer, despite they draw on some reserved funds of the Rural Regional Development Plan defined in the framework of Common Agricultural Policy (CAP), to enhance farming by integrating its food and ESs provision potentialities with some supported actions to counter the effects of climate change. This "sectoral" approach is also the inspiration followed for the Operational Plan (Piano Operativo) of the Prato Municipality (2019) that pursuing a strategy for urban (agro)forestry pays a limited reference to fostering sustainable local agri-food systems.

Moreover, drawing on the framework of Regional Territorial and Landscape Plan of Tuscany and referring to the "Structural Invariant" IV of the plan, it is important to recall the possibility, on behalf of

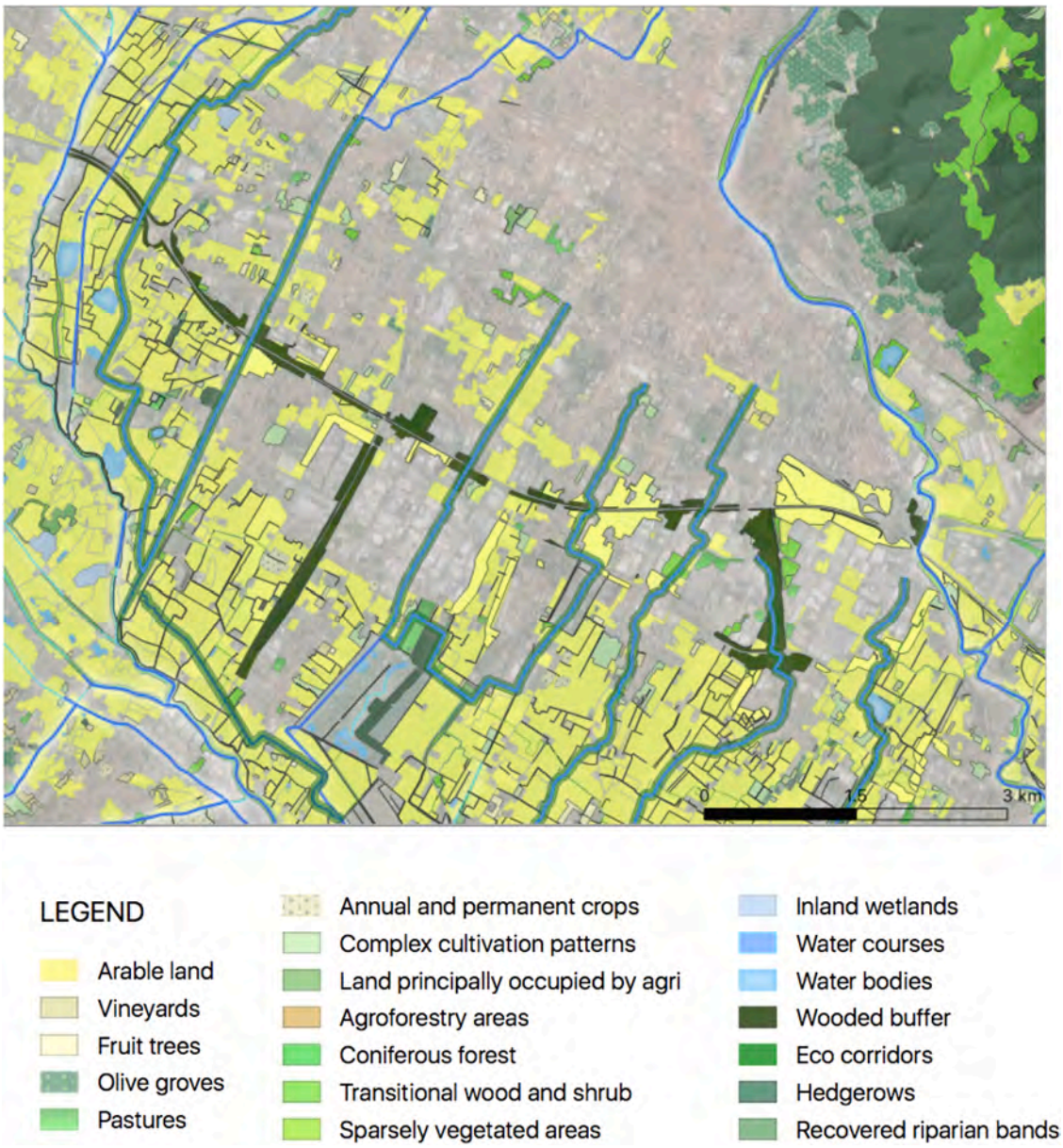

Fig. 6. UPUA areas and scenario enhanced agroecological structure: detail at the Prato municipality urban/rural interface. Source: authors own processing, data based on Region Tuscany Land Cover Opendata.

municipal plans, to identify and contour rural and peri-urban/rural morphotypes. Those are conceived as specific spatial patterns, integrative of agroecological and cultural aspects as guiding principles for innovative design and/or innovative policies regarding UPUA areas. Despite that in the Regional Landscape Plan ecological issues and farmland landscape characteristics, are assumed mainly in interpretive terms (Structural Invariants II and IV) and remain weakly integrated in propositive terms.

Finally, beyond spatial planning tools, measures adopting a cross-scale and Public/Private Partnership (PPP) model for the governance of UPUA areas and food issues are currently being successfully developed according to a Community Led Local development (CLLD). In this set of actions we can indeed mention the ongoing experience of the Organic or Bio-Districts (Distretti Biologici) mainly aimed to promote an integrative development model for rural areas, strongly based on the promotion of local food production as inductive of fair and sustainable local development, jointly with other sectors (food transformation, tourism, typical foods and crafts).

Concerning food issues measures, even if not directly spatially featured, it is worth to note that, among many directives for promoting Short Food Supply Chains (SFSCs), organic agriculture, and other agro-alimentation projects the Tuscany Region has been emanating since the year 2007, there is a recent one which states that at least 50% of the food purchased for school canteens in years 2019/2020 has to be local and organic. Directives that also triggered and fostered some public/private initiatives to feed school canteens of some municipalities of the study area according to a "food-shed" approach principle. (Comprehensive table summarizing all aspects and analysing the strengths and criticalities of the planning and governance tools in the Prato area is available at the end of the paper as Appendix A).

5. Discussion

With reference to the ES offer of UPUA areas, the comparison between the current scenario and the agroecological scenario highlights an overall not negligible increase (Table 5): if on the one hand, in terms of

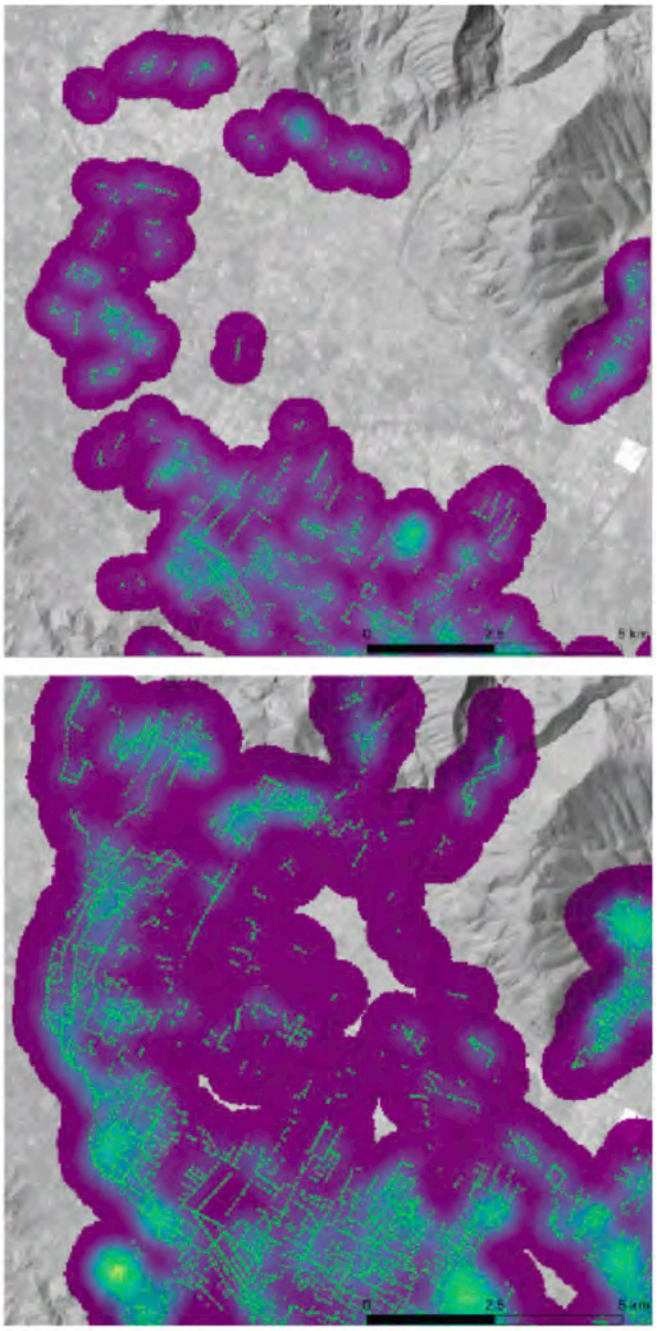

Fig. 7. Network/node density analysis in actual situation (top) and scenario (bottom).
Note: yellow-green indicates high density, violet low density.
Source: authors own processing, data based on Region Tuscany Opendata.

biodiversity, this is quite obvious having increased the ecological infrastructures, on the other hand, it is very interesting to highlight the significant increase in CO_2 storage capacity (+12%) corresponding, in absolute value, to an increase of approximately 5,000 ton.

The agroecological conversion scenario, in addition to recovering ecological connectivity and improving biodiversity, also showed the potential of the UPUA area for reconnection between the various isolated green spaces and, in particular, at the urban-rural interface (Fig. 6). Particularly, as stated by Goldman *et al.,* (Goldman, Gretchen & Daily, 2007), the joint importance of spatial composition and configuration of agroecosystem elements in order to effectively deliver some ES is also highlighted (Turner et al., 2001).

Furthermore, the evaluation of the potential food supply allowed us to obtain more suitable results on the UPUA scale compared to the use of aggregated regional data or potential data - eg. expansion of agriculture on uncultivated areas as in Simon Rojo et al., (2014) - or to the assessment of the UA's food potential with standard models referring to contexts of northern European cities (Aerts, Dewalhheyns & Achten 2018; Zasada et al., 2019) or referring to methods applied at the neighborhood scale (Hume, Summers & Cavagnaro, 2021)

The potential food supply in Prato Province only partially meets the overall food requirements of the inhabitants of the city of Prato and only for some key food categories of the Mediterranean diet due to the territorial characteristics. The main reason is that the local cropland is mostly located in the floodplain which occupies quite a small area of the province. The remarkably steep hilly areas are mostly wooded with some olive trees and vineyards on the lower slopes (see Fig. 2a). Even though the "food equation" (Morgan & Sonnino, 2010) requirements of the city of Prato can only be solved on a wider metropolitan and regional scale, the contribution of the Prato UPUA areas to the food supply is, however, important and certainly not significantly reduced in the hypothesis of a wider urban-rural re-embedding strategy. based on an agroecological land use scenario. The food production potential of the territory has been partially assessed because we didn't take in account livestock for meat and milk / cheese production, but we focused on the main productions of the mediterranean diet. Results underline, anyway, how, also in agroecological scenario, cereals production is potentially sufficient to meet the needs of nearly 64.8% of Prato's urban inhabitants, while legumes meet the needs of about 20.4% and market garden vegetables about 16.0%. On the other hand, only negligible quantities of fruit are produced.

Eventually, results about food production under agro-ecological scenario regimes showed a moderate negative trade-off with the two other evaluated ES. That is particularly valuable considering also that:

- we have considered the less favourable hypothesis in yields reduction rate when other sound studies show less significant reductions, no reduction or even surplus rate in case of organic production (Badgley et al., 2007);
- land cover studied sample didn't encompass parcels for crop categories related to livestock feeding (e.g. fodder). That means that our model can also include a reserve for local market meat production (Filippini et al., 2014) well integrated with organic farming method (e.g. manure provision) still present in mediterranean/european diet (Joseph, Peters & Friedrich, 2019);
- transition to local food system schemes enables UPUA profitability, that is, positive multiplier effects in socio-economic terms (Markuszewska et.al., 2012; Kneafsey et al., 2013; Stein & Santini, 2021) adding a further goal to resilience targets set.

Finally, has to be taken into account as in the mid/long terms the farmland management models based on agroecology allow the improvement of other key ES: e.g. soil fertility, nutrient cycle, capacity of water recycling, improvement of the storage / CO_2 emissions ratio owed to the reduction of energy/chemical exogenous supports (Power, 2010; Wilhelm & Smith,2018).

That adds further insights about the valuable role of Local Food Systems, integrated with other ES and encouraged to integrate, although with a critical assessment (Stein & Santini, 2021) UPUA ES provision in spatial planning and policy domain.

Therefore, to strengthen the role of the UPUA in the context under examination, the need for integrated and cross-cutting urban planning and urban/rural planning policies emerges.

In fact, in a perspective of "urban/rural integration", the examined current planning tools at various scales (see also Appendix A), revealed weakly address the problem. At best, rural areas are regulated in a passive protection / safeguarding logic. The logic of "active protection of agricultural land" does not emerge and there is no proactive and

Table 1
CO_2 storage capacity related to actual and scenario agricultural land cover.

Land use	CO_2 storage index (ton/ha)	Actual surface (Ha)	Actual storage (ton)	Scenario surface (Ha)	Scenario storage (ton)	Delta CO_2 storage
Urban-industrial	0	5,821.82	0.00	5,821,82	0.00	0%
Water	0	129.82	0.00	129.82	0.00	0%
Irrigated Land	3.2	6.30	20.16	6.30	20.16	0%
Dryland farming	2.2	3,418.00	7,519.60	3,148.35	6,926.37	-8%
Dense Shrubs	14.5	333.26	4,832.27	530.26	7,688.77	+59%
Vineyard/olive	6.1	2,422.56	14,777.62	2,422.56	14,777.62	0%
Pastures	1.5	12.06	18.09	12.06	18.09	0%
Riparian veg.	38	371.29	14,109.02	443.94	16,869.72	+20%
Totals	12,515.11	41,276.76	12,515.11	46,300.73	+12%	

Source: authors own processing, data based on Region Tuscany Land Cover Opendata, index and parameters on Simon Rojo et al., 2014.

Table 2
Average food category consumption per inhabitant (weekly and annually).

Foodstuff type	Weekly consumption	Annual consumption	Annual Demand Prato Municipality per year
	(g/inhab)	(kg/inhab)	(ton)
Cereal (wheat)	1,675	87.10	16,764.05
Market garden vegetables	2,450	127.4	24,520.55
Legumes	460	23.92	4,603.86
Fruits	2,100	109.20	21,017.61
Inhabitants Prato ISTAT 2019 192,469			

Source: Data elaborated by the authors on ISTAT (2018) and ARTEA (2018) data.

Table 3
Edible land per inhabitants related to UPUA areas in the study area

	Actual	*AgroecologicalScenario*	Var%
Cropland UPUA areas (ha)	3,418.00	3,148.35	-7.9%
Cropland / inhabitants (mq/ inhab.)	177.59	163.58	-7.9%

Source: Data elaborated by the authors on ARTEA Open Data (http://dati.toscana.it/organization/artea).

planning vision that brings out their multifunctional role in terms of ES supply and, above all, innovative governance tools aimed at involving farmers, citizens and NGOs to promote collective planning.

These findings are similar to Simon Rojo et al., (2014) who pointed out that spatial planning has traditionally disregarded many functions of the territory, including UPUA, as verified via research of local perception in Spain (Simon Rojo et al., 2014). Within this framework, land-use policies, applied at the municipal level, do not adequately address changes in land use and spatial patterns in agricultural areas, changes which are mainly sector-driven by rural development tools aimed at promoting the efficiency of farms according to the "hidden design" of European Union Agriculture Policy (CAP) or aimed to prevent from the effects of climate change addressing only peculiar functions or areas (e.g. protected natural areas, urban forestry). Otherwise, speaking about the "Adoption of Strategic Planning and Innovative Design Tools" some recent instrument proposals sound promising. Indeed the agricultural park tool Fanfani (2019) defined as "Territory Project" and the category of the "rural morphotype" -introduced by the Regional Landscape and Territorial Plan- as interpretive/integrative tool - seems suitable to support positive trade-off between different ES provision Power (2010), agri-environmental schemes at the landscape and farm scale (Swift, Izac & van Noordwijk, 2004; Batáry, et al., 2020) and then the coordination of socio-economic, rural and planning issues to foster local food system.

Particularly these last innovative instruments seems potentially suitable to fruitfully interact, as in the case of Agricultural Park of the Florence Metropolitan Area Project, with "Governance tools based on cross-scale innovative socio-institutional policies" or with PPP-bottom up based model like the case of the Organic District.

Finally, within the described territorial planning system, featured by a strong call for integration, the proposed scenario methodology, based on the introduction of agroecological spatial patterns to support viable

Table 5
Performance of the ESs for the two scenarios.

		Actual	*Agroecological Scenario*	*Var%*
Biodiversity / connectivity	linear green bodies (hedges) - length Km	98.00	355.75	*263.0%*
	linear green bodies (hedges) - number	507.00	1,847,00	*264.3%*
CO_2 storage	amount of carbon dioxide absorbed - ton	41,276.76	46,300.73	*12.00%*
Potential self-sufficiency	Crops land within UPUA areas (ha)	3,418,00	3,148,35	*-7.9%*
	Cropland / inhabitants (mq)	177.59	163.58	*-7.9%*
Foodstuff type - P/C Ratio	Cereal	87.9%	64.8%	*-23.1%*
	Market garden vegetables	21.5%	16.0%	*-5.5%*
	Legumes	27.9%	20.4%	*-7.6%*
	Fruits	0.3%	0.3%	*-0.1%*

Table 4
UPUA Surfaces and potential food production in the study area under current farming regime and agroecological scenario: quantities and P/C rate reduction for food categories.

Foodstuff type	Consumption (ton)	Actual				Agroecological Scenario				*Var-PC ration*
		Cropland surface (ha)	yield (ton/ha)	Production (ton)	P/C Ratio	Cropland surface (ha)	yield (ton/ha)	Production (ton)	P/C Ratio	
Cereals*	16,764	2,456.55	6.00	14,739	87.9%	2,262.28	4.80	10,859	64.8%	-23.1%
Market garden vegetables	24,521	528.04	10.00	5,280	21.5%	490.59	8.00	3,925	16.0%	-5.5%
Legumes	4,604	428.59	3.00	1,286	27.9%	390.81	2.40	938	20.4%	-7.5%
Fruits	21,018	4.82	15.00	72	0.3%	4.67	12.00	56	0.3%	0.0%

*mainly wheat sweet, durum- and minor cereals
Source: Data elaborated by the authors on ARTEA Open Data (http://dati.toscana.it/organization/artea).

and sustainable forms of UPUA, reveals suitable and fruitful in enhancing the urban/ rural sustainable integration and in bridging the gap between spatial planning, rural development and sustainability targets. Thanks to the use of the scenario method is, indeed, possible to provide evidence and criteria to verify and to evaluate the UPUA areas multifunctional role either in spatial, ecologic and socio-economic terms.

6. Final remarks and perspectives

The present paper draws on the acknowledged role of UA (Kroll et al., 2012; Aerts, Dewaelheyens & Achten, 2016), and particularly PUA (Swinton et al., 2007; Kroll et al., 2012; Wilhelm et al., 2018) in enhancing sustainability and fairness of the built environment and in providing jointly food along with some other ES. The aim was to verify how this role can be performed and fostered in terms of agroecological transition of peri-urban areas referred to the case study of Prato municipality scale and related UPUA.

Specifically, three ESs of urban and peri-urban agricultural areas were jointly assessed both in the current scenario and in an improved agroecological scenario. It therefore emerges that in the latter scenario it is possible to maintain almost the same level of food supply for the local food system along with increased performances of ecological connectivity and CO_2 absorption. All that as a proxy of an overall possibility of urban/rural re-embedding at the local level improving the recovery of metabolic flows of matter and energy and settlement resilience (Foster, 1999, Dehaene et al. 2016, Tornaghi. & Sage, 2016). Subsequently, the current ordinary framework of spatial planning and design policies was examined in order to verify the possibility of suggesting urban / rural integration strategies related to the evaluation of the ES of UPUA areas within this framework (Rossi, Arcidiacono & Pogliani, 2020).

The obtained results allowed to point out mainly on:

- The key role that UPUA areas in close proximity and interwoven with urban fabric can still play in terms of ESs provisioning with particular reference to food supply. Role that can be improved once the agro-ecosystem matrix is made more complex in term of disposition and composition of natural and green elements as stated also in literature references (Power 2010; Kroll 2012; Lee, Ahern & Yeh, 2015);
- The potential meaningful role of UPUA areas to provide foodstuff for the local food system. That also in a framework of a sustainable UPUA scenario jointly considering not only the utilisation of many enclosed and semi enclosed farmland areas at the urban/rural interface, but agro-greenbelt areas as well;
- The still limited room, despite some innovative tools and practices, inside the spatial planning system, for ordinary integrative and co-ordinated policies and design tools to integrate agri-food issues. That calls for a further innovative endeavour in this field in terms of strategic planning, governance models (Franklin and Marsden, 2015) and cross-scale integrated design approaches including the assessment of potential trade-off between ESs considering various future territorial use scenarios (Scorza et al., 2020) integrated with rural development funding scheme;
- Indication of need to better communicate, explain and promote participative planning instruments, cooperation among experts, local actors, including decision-makers, spatial planners and citizens (Ronchi, Arcidiacono & Pogliani, 2020; Gomez-Villarino & Ruiz-Garcia, 2021).

Finally the scenario design method adopted, drawing on the previous evidences earned, provides an innovative contribution in the field of spatial and urban planning to insert - thank to a streamlined procedure based on open data sources at local regional/level (Martìnez-Harms & Balvanera, 2012) - the key role od ESs and food issues, in the ordinary tools of strategic assessment and development design. That, covering a meaningful void, either in the policy field (Martìnez-Harms et al., 2015) and especially in the planning domain either in the international (Gren & Andersson, 2018) and italian context (Ronchi, Arcidiacono & Pogliani, 2020).

Despite the fine-tuned analysis model adopted, the research, however, was limited to evaluating only three ESs in order to verify whether an ESs appraisal method could be helpfully introduced within the current regulatory framework of strategy planning and design. We verified some positive pre-condition in this sense, even if it turned out necessary to evaluate a wider set of ESs with reference to the current classifications (MEA 2005, CICES, IPBES)[5] in order to identify the best trade-off solutions between environmental, social and economic needs to be applied (Baulcombe, et al., 2009; Power, 2010).

Finally, a last point concerns the issues of innovation in integrative planning and design methods for UPUA areas.

About that, our study encourages to strive for further insights in the field of institutional tools to apply and test the scenario method to support and enable the setting of “positive inducements” Ostrom (1990) and incentives to promote cooperation and “agglomeration” between farmers (Parkhurst & Shogren, 2007) in order to realize effective ecological patterns as well as “ES districts” creation and management (Goldman, Thompson & Daily, 2007).

Indeed, if we consider the “public” or “commons” nature of goods and services provided by agriculture and UPUA (Vanni 2014), the claim to set up and apply innovative rural design tools seems to represent a further result and fruitful research direction stemming from the present study.

CRediT authorship contribution statement

David Fanfani: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **Barbora Duží:** Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **Marco Mancino:** Investigation, Data curation, Visualization. **Massimo Rovai:** Conceptualization, Methodology, Investigation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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[5] CICES (Common International Classification of Ecosystem Services).https://cices.eu/; IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services). https://ipbes.net/

Appendix A

Analysis of the strengths and criticalities of the planning and governance tools linked to the Prato area

Evaluation criteria	Tools/actions	Potentials/Limits
Urban/rural integration	- Regional Spatial Planning Law 65/2014: evaluates the territory as a whole integrated "patrimony" which also includes rules for rural and farmland values enhancement (artt. 4,;67,68) - Regional Spatial and Landscape Plan (PPTR, 2014) contains guidelines for enhancing the landscape and rural areas ; - I*ntegrated rural/territorial Project* (Progetto Integrato di Territorio - PIT) which receives CAP funding for specific place-tailored needs;	*Potentials* • Territorial values integrated with food policy; • Construction of rural landscape guidelines to be sustained by CAP-funded reward mechanisms • *Limits* • Public administration sectors and bodies find it hard to change their routined methods; • There is no governance level between the regional and municipal ones.
Farmland protection	- Tuscany Governance of Territory (Governo di Territorio Governo di Territorio (ex. art. 4 LR 65/2014, adjusted LR 43/2016). Requires municipal planning authorities to establish and enforce an Urban Growth Border (UGB) to limit future urbanisation to protect rural and peri-urban areas; - Urban forestry strategy of Prato municipality within the Land-use Plan which allows also for agroforestry projects and initiatives for mitigating the effects of climate change on the urban environment .	*Potentials* • Formal acknowledgment of UPUA areas as a land use category; • Reduced loss of farming land and less pressure from developers; • The agroecosystem and food driven issues taken into consideration • *Limits* • The ecosystem values and farmland areas continue to be seen as "passive" and unproductive; • Tittle farmer involvement in determining urban planning policies;
Strategic, integrated planning and innovative design tools	-Agricultural Park of the Metropolitan Area of Florence (in the framework of Regional Territorial and Landscape Plan of Tuscany (PIT/PPTR - DCR 37/2015)); -Landscape Projects proposed at local level according to the Regional Landscape Plan; Individuation of rural and peri-urban/rural morphotypes drawing on the framework of Regional Territorial and Landscape Plan of Tuscany (PIT/PPTR - DCR 37/2015));	*Potentials* • Agro-food Park as Active protection of UPUA and enhancement of Farmers' role; • Better integration between context and rural development measure that are available; • *Limits* • Missing Agricultural Park Management structure; • Landscape Projects mainly conceived as rural and environmental heritage recovery for tourism; • No reference to SFSC creation; • Weak relation between urban/spatial planning tools for rural areas and the rural Biodistrict entity; • Weak and sectoral governance of spatial transformations in rural or peri urban/rural areas.
***Governance tools based on cross-scale innovative socio-institutional policies*"**	- Rural organic districts (Distretti Biologici) (L.R. 51/2019); - Public Private Partnership Society "Qualità & Servizi" for school canteens provides services in some municipalities of the metro area (including Carmignano) by mainly purchasing from local farmers; - SFSC, organic agriculture, and other agro-alimentation projects promoted by Tuscany Region since 2007; - Tuscany Region Law establishing a minimum threshold of at least 50% of food purchased for school canteens to be local/organic (2019/2020)	*Potentials* • Presence and involvement of some innovative public actors and private parties, including farmers' associations; • Fostering of the qualitative orientation of much food produce in Tuscany; • *Limits* • Difficulties to establish innovative procedures for cross-level and inter-institutional collaboration; • Loss and lack of intermediate territorial reference level (province) for agricultural matters; • Weak interaction with locally featured UPUA conditions and local policy issues.

Source: Official web pages and documents of Tuscany Region; Municipality of Prato, Metropolitan Area of Florence; municipalities in Prato province; Fanfani, 2018; Fanfani, Duží and Mancino, 2019.

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