INTEGRATION OF LOCAL AGRI-FOOD SYSTEMS IN SPATIAL PLANNING: FOODSHED ASSESSMENT THROUGH ECOSYSTEM SERVICES (1131)

Serim Dinç[1*], Zeynep Türkay[1], Azime Tezer[1]

[1] Istanbul Technical University, Urban and Regional Planning, [*]srmdinc@gmail.com,

Abstract. Agri-food systems (AgrFS) has come to the agenda of spatial planning with the concerns of sustainability and resilience. One of the tools used to change cities/regions into self-sufficient settlements by developing local food systems is "The Foodshed Assessment (FsA)". However, based on the neglect of ecological values in determining the foodshed boundaries, the "Ecosystem Services" (ESs) approach is proposed to fill this gap. Accordingly, it's aimed to develop an assessment tool that will guide the handling of local AgrFS within spatial planning by integrating foodsheds with ESs approach. This study consists of four steps: (1)Conceptual approach based on secondary source literature research related to the "local AgrFS" and "foodshed". (2)Definition of the FsA based on predicted ESs indicators for decision-making on local AgrFS. (3)Evaluation of existing national/regional/local-scale spatial planning tools affecting Istanbul, with a focus on foodsheds and ESs. (4)Cross-scale discussion of the integration of the FsA into the Istanbul planning system. This research will contribute to local AgrFS as a priority area in spatial decision making. The opportunities include creating win-win relationships between ESs achieving food resilience, food security, and regional/social/environmental resilience at different scales.

Keyword: Agri-food system (AgrFS), Foodshed, Ecosystem services (ESs), Spatial planning tools, Istanbul.

1. Introduction

Considering the relationship of cities with agriculture and rural areas, food was understood as a non-urban, marginal issue and was not seen as an urban policy and research topic (Doernberg et al, 2019; Pothukuchi & Kaufman, 2000; Sonnino, 2009). Thus, the city food systems and their hinterland were increasingly connected over greater distances (Schreiber et al., 2021). However, today that is changing. As a result of removing food growing from an urban land use system, it has been understood that the vulnerability of agri-food systems (AgrFs) has increased, and sustainability efforts have weakened. The pressure of urbanization on natural and agricultural areas, the climate crisis that we unequivocally acknowledge, and the failure of the current food system, which the COVID-19 process has clearly shown, reduce the resilience of regions/cities/societies. Along with these concerns, the unrestrained growth of urban population puts spatial planning in a critical position before in the development of resilient and sustainable food systems more than ever (Cabannes & Cecilia, 2018).

While the Milan Urban Food Policy Pact, the UN New Urban Agenda, and the Sustainable Development Goals support inclusive, resilient, safe and sustainable food systems. They also explicitly demand that food systems to be a part of spatial planning (MUFPP, 2015; UN, 2015; UN Habitat, 2016). In response to these calls, national, regional, and local governments and academia are in search of new planning approaches and tools that cities/regions can develop local AgrFs and become selfsufficient settlements. “The Foodshed Assessment (FsA)” is also emerging as a planning policy tool that is increasingly used to discuss the geography of urban food supply and to describe the links between food growing-consuming regions at different scales (Brinkley, 2013; Zasada et al., 2019; Vicente-Vicente et al., 2021a; Peters et al., 2022).

A foodshed, with its most general definition, has been accepted in the literature as the agricultural area required to feed the population in a city/region (Brinkley, 2013; Peters et al., 2009). FsA is valuable as it provides input into spatial planning to increase the sustainability and resilience of food systems. However, foodshed boundaries are defined by political boundaries such as a region, metropolitan area, or municipality (Vicente-Vicente et al., 2021b; Wascher et al., 2015), or a radius around the place where the food is consumed (Kriewald et al., 2019; Schreiber et al., 2021; Zasada et al., 2019). The most important issue that is overlooked in determining these boundaries is the ecological character and connectivity. Even the studies (Sylla et al., 2022; Vicente-Vicente et al., 2021b) that point out this gap and emphasise the importance of considering the landscape character couldn’t go beyond drawing a circle based on distance. This research defends that it’s necessary to define the qualities that can reveal the ecological functionality of the specific city/region for an integrated spatial planning and policy. In this research, the applicability of “Ecosystem Services (ESs)” approach to fulfil this gap will be examined.

ESs are defined as all the direct or indirect benefits that humans derive from ecosystems (MEA, 2003). AgrFS have a multifaceted relationship with ESs because they are simultaneous providers and consumers of them (La Notte, 2022). For instance, ESs such as crops, water purification, carbon sequestration are provided by AgrFS too, where ESs such as pollination, nutrient regulation, pest/disease control underpin the productivity and ensure the sustainability of AgrFS (Power, 2010). The way of agri-food practices determines the lifetime and the quality of ESs. While the quantity of the use of chemical inputs can cause the destruction of ESs, while the existence of an agro-ecological system can provide a range of ESs too. Research on the use of ESs knowledge in spatial decision making has become a very popular topic (Gret-Regamey et al., 2017; Tezer et al., 2020; Goldstein et al., 2012; Menteşe et al., 2019). However, there is few research focusing on ESs and AgrFS (Rusinamhodzi,2019; Varyvoda and Taren, 2022). Since AgrFS cannot be considered independently from ESs, the proposed methodology has the potential to contribute to the existing literature.

Accordingly, it's aimed to reconsider the FsA that guides the development of local AgrFS with the approach of ecosystem services and to discuss its integration on spatial planning tools on different scales. The policy-level trials on which scale and with which spatial planning tools can be evaluated within the current planning system was made for the Istanbul Metropolitan Area. Considering that Istanbul's food system has a very fragile structure due to its dependence on the outside of the metropolitan area, and serious concerns are raised about the sustainability of resources despite the existence of unique ecosystem values, this study will be a guide for Istanbul's AgrFS.

This study consists of four steps:

(1) Conceptual approach based on secondary source literature research related to "local AgrFS" and "foodshed".

(2) Definition of the "FsA" based on predicted ESs indicators for spatial decision-making on local AgrFS.

(3) Evaluation of existing national/regional/local-scale planning tools affecting Istanbul, with a focus on AgrFS.

(4) Cross-scale discussion of the integration of the FsA into the spatial planning tools, focusing on Istanbul.

This research will contribute to local AgrFS as a priority area in spatial decision making with examining Istanbul Metropolitan Case. The opportunities include creating win-win relationships between ESs achieving food resilience, food security, and regional, social, and environmental resilience at different scales.

2. Background: Agri-food Systems and Foodsheds in Spatial Planning

The sprawl of cities has caused the loss of land that fed the urban population (Steel, 2008) and the urban-rural relationship to weaken or even disappear (Sonnino, 2009; Zazo-Moratalla et al., 2018). In addition, since the second half of the 20th century, repositioning food growing (Delgado, 2010), the global/industrial food system has separated production from consumption, both in time and space (Oosterveer et al., 2012). However, under the impacts of the crises such as COVID-19, climate change

(Béné, 2020; IPES-Food, 2020; Vittuari et al., 2021) and the growing socio-economic inequalities (Sonnino, 2016; Stierand, 2012) and the challenges of sustainable development and food security, the resilience of local AgrFS is gaining increasing attention (Sylla et al, 2022). Self-sufficient local or regional food systems based on food security and resilience are supported against the ecological and social disruption of the global food system.

When Pothukuchi and Kaufman (2000) placed local AgrFS on the agenda of spatial planning, they clearly stated that AgrFS has a spatial counterpart in the built environment (Cabannes & Cecilia, 2018; Raja et al., 2017) and the inseparable relationship between food and issues such as transportation, land use, environment, economy, health, energy, water which are the interests of planners. Therefore, it is inevitable that food should be integrated within the framework of the planning discipline that claims to create healthy communities and liveable environments. The "Policy Guide on Community and Regional Food Planning" prepared by the American Planning Association also urged planners to take an active role in establishing relation to the food system (Raja et al., 2008).

Although it has been accepted by academia and policymakers that food systems, by their very nature, interact with and shape places (Marsden and Sonnino, 2012; Sonnino et al., 2014), recent empirical studies (Doernberg et al. al., 2019; Van Haren et al., 2023) show that spatial planning has still little to do with food at the practical level. Similarly, Sonnino (2023) states that the idea of food systems is treated as a macro-level metaphor rather than a defined analytical concept of how to translate it into practice. This also explains the reason for the limited debate (Battersby, 2017; Buchan et al., 2015; Doernberg et al., 2019) on the relationship between spatial planning tools and food.

As a methodological tool, the FsA stands out among the few available tools for the spatiality of food. Assessing the self-sufficiency levels of cities/regions (Saavedra et al., 2017) is seen as an effective assessment tool (Peters et al., 2008; Zazo-Moratalla et al., 2018) to advance efforts to discuss the geography of AgrFS (Schreiber et al, 2021) and define the links between production and consumption at different scales (Sali et al., 2014).

The earliest definition of a foodshed was made by Hedden (1929) as the geographical region that represents the flow of food from the area where it is produced to the area where it is consumed. However, Getz (1991), introduced the concept to literature, advocating the protection of the food source, namely the agricultural area. According to Kloppenburg et al. (1996), the proximity of the consumer to the food source should define the foodshed, based on the coexistence of society (culturally food) and nature (-shed). This approach adds a new interpretation to Getz's definition, linking the concept of foodshed with the idea of a local and alternative food system. Since then, there has been a growing literature with empirical studies at different scales on FsA, in which the spatial context, capacity and functions of a AgrFS are assessed by spatial analysis, considering specific regional conditions (Zasada et al., 2019).

These studies highlight the benefits of FsA with the potential to reshape cities/regions by associating them with local AgrFS and carrying the subject beyond the romantic narrative of the local movement (Doernberg et al., 2016; Schreiber et al, 2021):

- It becomes possible to reveal the impact of food systems on the environment and the degree of vulnerability of societies to disruptions in food supplies (Peters et al., 2008).
- Existing interdependencies regarding resources and food security can be defined spatially (Schreiber et al, 2021).
- Through a better understanding of land resources, food demand and supply, it may contribute spatial planning decisions such as future infrastructure, ecological protection, recreation (Buchan et al., 2015; Wascher et al., 2014).
- It may contribute to improve climate resilience of food systems (Lengnick et al., 2015).
- At the highest level, it may contribute to sustainable and resilient futures of settlements and societies by ensuring food security and resilience (Sonnino, 2014).

FsA is still a new research area and has not yet found a place in the spatial planning system. Although there is no attempt by the administrations at the implementation level, academic studies are becoming more and more widespread. However, in these studies, there is still no consensus among the methods and terminology. Therefore, the objectives, methodology, and results of a range of quantitative data-based studies of food production and consumption at different spatial scales vary widely.

Consumption and demand-based models focus on the spatial dimension and production potential of agricultural land needed to provide food for cities & regions (Cardoso et al., 2017; Kurtz et al., 2020; Van Haren et al., 2023; Zasada et al., 2019).

In these studies, theoretical issues related to food-land footprint and self-sufficiency are evaluated with the criteria of local/regional population, current diets, land cover, available agricultural areas, and regional yield data (crop and soil) (Schreiber et al, 2021). Production-based models focus on current productive capacity of studied area and estimate population to be fed from these lands (Swiader et al., 2017; Zazo-Moratalla et al., 2019). Models combining food production and consumption assess the dependencies in food systems based on export and import data and explore how local AgrFS are affected and their level of vulnerability and potential (Kriewald et al., 2019; Sylla et al., 2022; Vicente-Vicente et al., 2021b).

In studies where research questions, data and methodologies differ, it is expected that the foodshed boundaries will also differ by considering the landscape character, geomorphological characteristics, cultural codes etc. of the region. However, these boundaries are represented either by administrative boundaries as they concern responsibilities in planning, or by buffers drawn according to certain geographical distances centred on the place where food is consumed. However, as Kloppenburg et al. (1996) stated, foodshed boundaries shouldn't be fixed and should be shaped according to the original values of the place. Taking the *"nature as a measure"* in the definition of the foodshed has been shown among the principles by the same authors.

By this means, the efficiency of spatial decisions that will ensure the sustainable development of AgrFS will increase. Food security and resilience levels will be strengthened for the future of societies.

The contribution of the ESs-based foodshed to the criteria highlighted here and to spatial planning is discussed in the next chapter.

3. Ecosystem Services-Based Foodshed Assessment in the Spatial Planning Tools/System

Although the emergence of the ESs approach can be traced back to the 1970s, it was only after the publication of the Millennium Ecosystem Assessment (2004) that work on this topic gained momentum (de Groot et al., 2010). There are many key studies in the literature about the integration of ESs in terms of spatial decision-making (Daily et al., 2011; de Groot et al., 2010; Egoh et al., 2008; Fisher et al., 2009; Goldstein et al., 2012; Gret-Regamey et al., 2017; Haase et al., 2012). In Turkey, there are many scientific studies related to the ESs integration in spatial planning in different contexts:

ESs-based watershed management (Albayrak, 2012; Tezer et al., 2012; Tezer et al., 2015; Tezer et al, 2020); ESs for climate change adaptation (Onur and Tezer, 2015), integration of soil ESs for climate change mitigation in spatial planning (Delibas et al., 2021). In terms of food security, it is seen that the study of ESs has grown very recently and there is a research gap related to explicitly outlining how the ESs framework can be utilized to achieve food security and environmental sustainability (Cruz-Garcia et al., 2016; Poppy et al., 2014b).

Food security *"exist when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"* is the definition of FAO (FAO, 1996). Four complementary pillars classified as:

i) availability,

ii) stability of supplies,

iii) access and

iv) biological utilization of food must need to be simultaneously assured in order to achieve food security (Poppy et al., 2014a). Availability of food is related to having enough supply of food. Food stability means that the pillars are fulfilled over time, e.g., seasonally and from year to year. Access to food refers to having sufficient access or economic capacity to get food. Biological utilization is related to having nutritional status and diversity and means that a person has the energy and nutrients that are necessary for being healthy (Cruz-Garzia et al., 2016; Poppy et al., 2014a).

Agricultural ecosystems simultaneously provide and rely on a variety of ESs (Zhang et al., 2007). They are managed by humans primarily for provisioning services such as food, fuel, fiber and timber (Poppy et al., 2014b). Aside from provisioning services, agricultural ecosystems are also related to regulating services such as climate regulation, soil erosion prevention and cultural ESs such as agro&eco-tourism, scientific research and indigenous local knowledge (Cruz-Garcia et al., 2016; Poppy et al., 2014b, IPBES, 2019). Also, the agricultural process depends on different ESs including both regulating and supporting services such as water, soil fertility and pollination (Zhang et al., 2017). In the complex relationship of ESs and agricultural systems, it can be seen that the term "ecosystem disservices" is used to describe the negative impacts of agricultural activities on ESs (Swinton et al., 2007; Zhang et al., 2017). Agricultural activities are considered as one of the major drivers of global environmental change in land use/land cover and the quality and quantity of freshwater ecosystems (Thiaw et al., 2011). These unintended effects of agriculture on ESs such as habitat loss, diversion of rivers, groundwater depletion, erosion, pest invasion and eutrophication are defined as ecosystem disservices with significant negative impacts (Swinton et al., 2007). ESs to/from agricultural ecosystems together with disservices is shown in Figure 1.

The ESs matrix approach, which defines landscapes' capacities to provide ESs-based on land use/land cover data with expert estimations (Jacobs et al., 2015), can also be a guideline to explain the relationships between agricultural ecosystems and ESs. In matrix approach, land cover classes/ecosystem types are associated with ESs through participatory expert-based scoring (Campagne and Roche, 2018); it is a widely used ES assessment method amongst others as it provides simple and easily mapable data (Jacobs et al., 2015) and a very flexible and adaptable model to different data sources (Campagne and Roche, 2018). The matrices developed by Burkhard et al. (2014) show different aspects of the relationships between agricultural ecosystems and ESs (Burkhard et al, 2014). The matrix correlating agricultural land cover classes with ESs potential is shown in Figure 2 (Burkhard et al., 2014). ES potential refers to an ecosystem's potential or capacity to produce services (Wang et al., 2022).

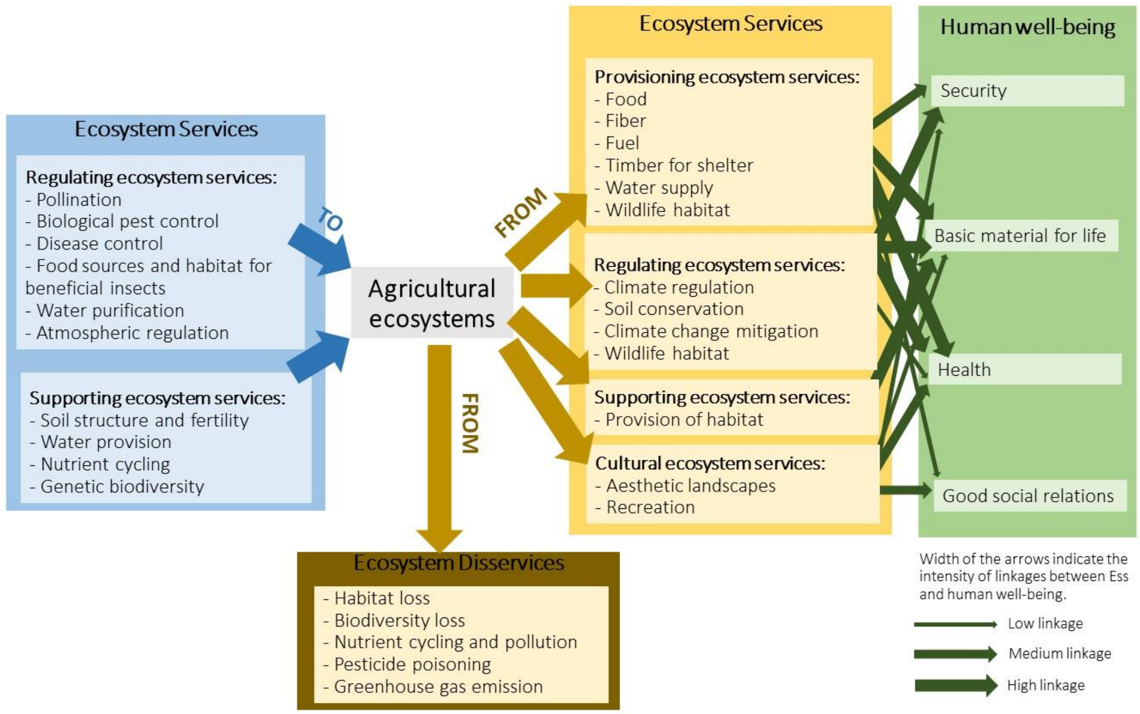

Figure 1. ESs to and from, ecosystem disservices from agriculture and linkages between human wellbeing from ESs provided by agriculture

Source: Adapted from Albayrak, 2012; Cruz-Garcia et al., 2016; Power, 2010; Thiaw et al., 2011; Zhang et al., 2007.

	Regulating ESs	Global climate regulation	Local climate regulation	Air quality regulation	Water flow regulation	Water purification	Nutrient regulation	Erosion regulation	Natural hazard regulation	Pollination	Pest and disease control	Regulation of waste
Non-irrigated arable land		1	2	1	2	0	1	0	1	1	2	2
Permanently irrigated land		1	3	1	1	0	1	0	1	1	2	2
Ricefields		0	2	1	1	0	1	0	0	1	1	2
Vineyards		1	1	1	1	0	1	1	0	1	1	1
Fruit trees and berries		2	2	2	2	1	2	2	2	5	3	2
Olive groves		1	1	1	1	1	1	1	0	1	2	2
Pastures		2	1	0	1	0	1	1	1	0	2	4
Annual and permanent crops		1	2	1	1	0	1	2	1	1	2	2
Complex cultivation patterns		1	2	1	1	0	1	1	1	2	3	2
Agriculture & natural vegetation		2	3	2	2	2	2	2	1	2	3	2
Agro-forestry areas		2	2	2	2	2	2	3	1	3	3	3

	Provisioning ESs	Crops	Biomass for energy	Fodder	Livestock (domestic)	Fibre	Timber	Wood fuel	Fish, seafood & edible algae	Aquaculture	Wild foods & resources	Biochemicals & medicine	Freshwater	Mineral resources	Abiotic energy resources
Non-irrigated arable land		5	5	5	0	5	0	0	0	0	1	3	0	0	2
Permanently irrigated land		5	1	2	0	4	0	0	0	0	1	3	0	0	1
Ricefields		5	1	2	0	0	0	0	0	0	0	0	0	0	0
Vineyards		4	1	0	0	0	0	1	0	0	0	0	0	0	0
Fruit trees and berries		4	1	0	0	0	2	2	0	0	0	2	0	0	0
Olive groves		4	1	0	0	0	2	2	0	0	0	2	0	0	0
Pastures		0	1	5	5	0	0	0	0	0	2	0	0	0	5
Annual and permanent crops		4	2	4	1	5	0	0	0	0	1	1	0	0	2
Complex cultivation patterns		4	2	2	1	4	0	1	0	0	1	2	0	0	1
Agriculture & natural vegetation		3	3	2	2	4	1	1	0	0	2	1	0	0	1
Agro-forestry areas		2	3	2	3	2	3	3	0	0	2	1	0	0	0

	Cultural ESs	Recreation & tourism	Landscape aesthetics & inspiration	Knowledge systems	Religious & spiritual experience	Cultural heritage & cultural diversity	Natural heritage & natural diversity
Non-irrigated arable land		1	1	2	0	3	0
Permanently irrigated land		1	1	2	0	3	0
Ricefields		1	1	2	0	3	0
Vineyards		3	2	3	0	5	0
Fruit trees and berries		3	2	2	0	4	1
Olive groves		2	2	2	0	4	0
Pastures		2	2	2	0	3	1
Annual and permanent crops		1	1	2	0	3	0
Complex cultivation patterns		2	2	2	0	3	0
Agriculture & natural vegetation		2	2	3	1	3	3
Agro-forestry areas		2	2	2	0	3	2

Figure 2. ES potential matrix. (Scale from 0/rosy = no relevant potential; 1/grey green = low relevant potential; 2/light green = relevant potential; 3/yellow green = medium relevant potential; 4/blue green =high relevant potential; 5/dark green = very high (maximum relevant potential) (Burkhard et al., 2014).

Figure 2 indicates that agriculture-related land cover classes are diverse and every each offers a variety of ESs with potentials at different scales. For example, nonirrigated arable land has the potential to offer very high levels of crops, biomass, fodder and timber as expected; but it also has the capacity to offer medium levels of biochemicals & medicine, cultural heritage & cultural diversity and relevant scale of potential for provisioning ESs such as local climate regulation, water flow regulation, pest & disease control and regulation of waste (Figure 2).

Burkhard et al. (2014) also provides matrices of ESs flow, demand, and flow & demand budget. The flow of an ES indicates the actual use of an ES or the amount of that ES delivered to people. ES demand is defined as the ESs currently consumed or used in a given area regardless of where ESs actually are provided (Wang et al., 2022). All agricultural activities demand highly for regulating ESs and they must be fulfilled by ES potentials (Burkhard et al., 2014). The ES flow and demand budget matrix provided by Burkhard et al. (2014) shows that the demand of ESs are exceeding the flow of services for most of the ESs related with agricultural ecosystems (Figure 3). For example, for the regulating ES water purification, there is a strong undersupply in relation to permanently irrigated land and rice fields accompanied by the strong undersupply of freshwater (Figure 3).

	Regulating ESs	Global climate regulation	Local climate regulation	Air quality regulation	Water flow regulation	Water purification	Nutrient regulation	Erosion regulation	Natural hazard regulation	Pollination	Pest and disease control	Regulation of waste
Non-irrigated arable land		-1	0	0	0		0	-3	-1	0	-2	-1
Permanently irrigated land		-1	1	0	1	-5	0	-2	-1	0	-2	-1
Ricefields		-3	0	0	-1	-5	0	-2	-2	0	-3	-1
Vineyards		0	-2	0	0	-4	-2	-4	-3	0	-3	-1
Fruit trees and berries		1	0	1	1	-1	-1	1	-1	0	-1	0
Olive groves		0	-1	0	0	-1	-2	0	-3	0	-2	0
Pastures		-2		-1	0	-2	-2	0	-1	0	-2	0
Annual and permanent crops		0	1	0	1	-2	-3	1	-2	0	-1	0
Complex cultivation patterns		0	1	0	1	-2	-3	0	-1	0	0	0
Agriculture & natural vegetation		0	2	1	1	-1	-1	1	0	0	0	0
Agro-forestry areas		0	1	1	1	-1	-2	2	-1	0	0	1

	Provisioning ESs	Crops	Biomass for energy	Fodder	Livestock (domestic)	Fibre	Timber	Wood fuel	Fish, seafood & edible algae	Aquaculture	Wild foods & resources	Biochemicals & medicine	Freshwater	Mineral resources	Abiotic energy resources
Non-irrigated arable land			-1									-1			
Permanently irrigated land			-1									-1	-5		
Ricefields			-1									-1	-5		
Vineyards			-1				-1					-2	-4		
Fruit trees and berries			-1				-1					-2	-3		
Olive groves			-1									-2	-1		
Pastures			-1	-1	2		-1					-1	-2		
Annual and permanent crops			-1									-1	-1		
Complex cultivation patterns			-1	1								0	-1		
Agriculture & natural vegetation			-1	1		1		1				0	-2		1
Agro-forestry areas			-1		1	1	1	1				0	-2		

	Cultural ESs	Recreation & tourism	Lancscape aesthetics &	Knowledge systems	Religious & spiritual	Cultural heritage & cultural	Natural heritage & natural
Non-irrigated arable land		1	1	0		0	
Permanently irrigated land		1	1	0		0	
Ricefields		1	1	-1		-1	
Vineyards		2	1	0		1	
Fruit trees and berries		2	1	-1		1	1
Olive groves		2	2	0		1	
Pastures		2	2	1		1	1
Annual and permanent crops		1	1	0		1	
Complex cultivation patterns		2	2	0		1	
Agriculture & natural vegetation		2	2	1	1	1	1
Agro-forestry areas		2	2	0		1	1

Figure 3. ES flow-demand budget matrix. (Scale from -5/brown red = demand exceeds flow significantly

= strong undersupply; via 0/rosy = demand = flow = neutral balance; to 5/dark green = flow exceeds the demand significantly = strong oversupply. Empty fields = neither a relevant flow of nor a relevant demand for the particular ES (Burkhard et al., 2014).

It is argued that if 50% more food, 50% more energy and 30% more fresh water are not provided by 2030, it is claimed that a simultaneous food, water, and energy nexus will be observed on a global scale (Poppy et al., 2014b). Managing the agricultural ecosystems and their interaction with natural ecosystems has become increasingly important because of the conflict between the aims of achieving/increasing food security and maintaining environmental sustainability and resilience (Poppy et al., 2014b). As shown in Figure 1, 2 and 3, the ESs framework offers the opportunity to both reveal the components and interrelationships associated with the sustainability of agricultural systems and to express the negative impacts of agricultural activities in terms of quality, quantity and spatially explicitly to manage land in order to achieve both food security and environmental sustainability (Poppy et al., 2014b). As can be concluded from all of this, food security is directly linked not only to increasing food supply, but also to ensuring the sustainability of the ESs associated with the four pillars of food security and essential for food supply.

A trade-off among ESs arises when a single ecosystem service decreases as a result of an increased use in another ecosystem service (Rodriguez et al., 2006). On the other hand, in the case of change in the same direction (positively or negatively) this relationship type is called as synergistic (Lee and Lautenbach, 2016). As ESs are generated simultaneously and continually by ecosystems; it is considered impossible to manage ecosystems to maximize the benefits from all kinds of services at the same time, resulting in trade-offs (King et al.2015). It is obvious that agriculture related ESs have the similar interrelation of synergy and trade-off as the other ESs (Figure 1). For instance, it is expected that an increased use in food ES to result in an increase (synergy) and decrease in some other ESs (trade-off). The typical trade-off among ESs for agricultural activities is between provisioning services (e.g., food, fibre, bioenergy) and regulating services (e.g., water purification, soil conservation, carbon sequestration) (Power, 2010).

Trade-offs are characterized along three dimensions: spatial scale, temporal scale, and reversibility (Rodriguez et al., 2006). The effects of the trade-off may be felt at a distant location (spatial scale); these effects may take place in a short or long term (temporal scale); and the perturbated ESs may/may not return to its original state after irreversible impacts (reversibility) (Rodriguez et al., 2006). Sometimes the trade-offs can occur between different stakeholders. For example, expanding irrigation schemes for improving agricultural production may result in an increase in one site but negatively may affect the fishermen's productivity as a result of degraded water sources (Cruz-Garcia et al., 2016). ESs framework enables the knowledge and awareness of the interactions between ESs and this knowledge is crucial to understand the quantitative, spatial, temporal, social and ecological consequences (intended and unintended) of the land and water management processes (Rodriguez et al., 2006).

In the literature, the evaluations on specific trade-offs between AgrFS (food) and other ESs are stated as biodiversity, water quality, soil quality, water availability for other present and future uses and carbon sequestration (Power, 2010; Rodriguez et al., 2006). On the other hand, it is clear that regulating and supporting ESs such as pollination, pest and disease control, water purification, nutrient cycling and biodiversity are crucial for the sustainability of agri-food ecosystems (Figure 1). In connection with this study, the development of an ES-based foodshed assessment planning tool that takes into account ESs that provide food, support food production and are important in food production in terms of climate change sensitivities is thought to contribute to the literature. In this context, the ESs proposed for the identification of foodsheds are shown in Table 1.

Table 1. The proposed ESs for the identification of ESs-based foodshed assessment.

Regulating ESs	Supporting ESs	Provisioning ESs	Cultural ESs
- Climate regulation - Water flow regulation - Water purification - Nutrient regulation - Pollination - Pest and disease control	- Soil structure and fertility	- Crops (Food) - Freshwater - Wildlife habitat	- Landscape aesthetics and inspiration

For this study, the integration of ESs in terms of AgrFS in spatial planning is investigated in order to achieve all pillars of food security and environmental sustainability. It is aimed to conduct research on the identification of foodsheds with the ESs approach and to make suggestions on how this integration can be realized at the level of planning tools through ESs-based FsA. In this context, the inclusion of ESs boundaries in the planning borders and the border based on geographical distance between production-consumption areas will reveal ecological sensitivity in relation to AgrFS. It will provide opportunities for ESs to ensure spatial connectivity and revitalisation/restoration for ESs disservices. The spatial representation of selected ESs related to agriculture will also contribute to the assessment of the ecological connectivity of the ESs. Spatial representation and identification of ecologically connected areas of ESs will support areas with high biodiversity and ESs potential and thus increase the resilience and sustainability of AgrFS. Thus, ESs-based foodshed assessment tool will be able to guide spatial planning to manage and reduce the effects of AgrFS that already have significant impacts on natural resources and the environment.

4. Case Study: Istanbul Metropolitan Area

Istanbul Metropolitan Area, with a population of more than 16 million, includes rural areas/neighbourhoods, approximately 12% of which still have agricultural activities, in an area of 5,461 km2. However, the need for new parcels for construction and large urban projects in Istanbul have triggered the transformation of agricultural lands in the periphery of the city and created a structure that is highly dependent on the outside of the city for food supply. Despite the occupation of agricultural lands by urban uses due to the decisions made by the administrations regarding transportation and land use plans, agriculture and livestock activities are observed in the rural areas of Istanbul.

However, this production is quite insufficient for the domestic consumption of Istanbul (Aslan and Demir, 2017; Solduk, 2012). Self-sufficiency studies for Istanbul show a similar situation not only in terms of current production values, but also in terms of production capacity and potential (Aslan and Demir, 2017; Yerkure Local Studies Cooperative, 2020).

It can be said that the food system of Istanbul has a very fragile structure due to its dependence on the outside of the city, and the logistics sector endanger ecological sustainability in terms of energy consumption and greenhouse gas emissions.

Concurrently, the unequal accessibility of food for all groups seriously threatens food security (Dinc & Tezer, in press). The inclusion of food in spatial planning is essential to mitigate the social, economic, and ecological risks caused by these conditions and to increase food resilience -and urban and community resilience-.

With Buchan et al.'s (2015) suggestion, it is difficult to effectively move towards for the identification of Istanbul Metropolitan Area's local AgrFS through the FsA unless it's known where the AgrFS is in the current spatial planning system. For the purpose of this study, it is important to analyse the existing spatial planning tools so that the FsA may provide input to spatial planning. Accordingly, it's analysed at what levels AgrFS has been covered within the legal instruments and policy documents guiding spatial planning activities. Due to the hierarchical structure of planning, the binding nature of upper-scale legal documents on spatial planning necessitates an inter-scale analysis.

Hence, planning tools that affect spatial decisions regarding food systems in the Istanbul metropolitan area have been examined at the national, regional, metropolitan, and urban scales.

Although concepts such as food safety, agricultural land protection and agricultural land use plans regarding AgrFS are encountered in spatial planning tools at the national scale, it is seen that they remain at the conceptual or strategic level and are not associated with spatial planning. Spatial Plan Making Regulation, which defines and binds spatial planning, clearly illustrates this deficiency. This regulation emphasizes the representation and the protection of agricultural lands in Environmental Plans, in the regional scale. On the urban scale, it is stated in the Master Plans to show only the agricultural land use within the planning boundary.

Environmental Plan is the most interactive tool at the regional scale demonstrating the relationship between AgrFS and spatial planning. In the plan, "marginal agricultural areas” and “agricultural areas that must be absolutely protected” are shown as areas whose agricultural quality will be preserved within the scope of sustainable development. In the areas where the natural and rural character will be preserved, it is envisaged that agricultural activities and rural settlements such as vineyardfarmhouses and hobby gardens will take place, and urban agriculture has been prioritized. It is mentioned that a land use plan for agricultural purposes should be prepared in order to meet the food needs of Istanbul (IMM, 2009).

Turkey Spatial Strategy Plan and Marmara Region Spatial Development Strategic Framework Document are the only official documents that deal with the concepts of food and ESs together. These documents stated that the status and width of critical ecological areas based on ESs (including critical ESs areas for food) should be determined in order to guide spatial planning decisions.

Although “Istanbul Food Strategy” document is valuable because it is the first document in Turkey that includes concepts such as food safety and the right to food, it has remained at the conceptual level. The areas where solutions need to be presented are still in the problem definition stage. In short, medium, and long-term recommendations for AgrFS, what needs to be done is not clearly stated. Most of the proposals and solutions are left vague, emphasizing only “the necessity of doing” it. In terms of spatial planning, the document states that the effective use of existing policy and planning tools -such as infrastructure and logistics, public procurement, land use planning- is necessary for the development of a resilient AgrFS. Emphasis is placed on making holistic and integrated land use planning with the ecosystem approach.

Various spatial activities such as urban agricultural park, ecological life centre, community gardens, ecological/organic markets related to AgrFS are recommended at the urban scale. However, in the upper scale planning documents, there is no point to refer to each other for local government activities, and there is no relationship with the concept of food between the definitions of master and implementation plans where spatial decisions are reflected in real life. This causes local planning processes to be fragmented, independent from each other and to prevent continuity.

Consequently, the relationship between AgrFS and spatial planning is not adequately defined in spatial planning tools. Although the spatial strategy plans at the national and regional scales include the AgrFS-ESs-spatial planning trio, which is the research topic of this study, they do not have reflections on the sub-scale plans or the implementation level yet. Although the environmental plan mentions the agricultural land use plan, it can be said that this relationship is insufficient due to the concern of crop pattern planning in these plans.

5. Cross-scale discussion

It is more difficult for agro-food systems to find a place in spatial planning in developing cities (Van Haren, 2023). Because planning systems are construction oriented. Even if there are sentences in the plans to support and develop the food system, it is possible to come across another contradictory decision in the same plan - e.g., with a regulation on the development of agricultural lands, the discourses of protection have no meaning-. In this case, the sustainability of ESs is also in danger, like in the Istanbul Environmental Plan.

This section discusses at what scale and how ESs-based FsA and its possible tools can be incorporated into the planning tools that guide the spatial planning of Istanbul.

Suggestions are made based on data and analyses that will inform inter-scale planning processes, especially land use decisions. The necessary regulatory changes for the full integration of the FsA will create the opportunity to start thinking about the transformation of the existing system.

- **National scale**

First, in Spatial Plan Making Regulation, where the scope and principles of all plans are defined, indicating the place of ESs and AgrFS at the plan levels is essential for the inclusion of foodsheds in the spatial planning system.

Due to the top-down nature of the planning system, it is important that the upper scale plans are binding for the FsA. Strategic planning can help integrate AgrFS into broader planning goals and objectives. It should include strategies to increase food access and safety and promote local food production and distribution by conceiving ecological values. The Spatial Strategy Plan of Turkey has a suitable basis for unifying the AgrFS and ESs strategies that it already points to within the scope of foodsheds.

The Agricultural Sheds Regulation, published in 2010, is an important example among legal regulations for the inclusion of foodsheds in the spatial planning system, although it has never been implemented. The Agricultural Sheds approach, which has been defined for the purpose of planning the crops pattern on a country level, has a content that can be developed within the scope of FsA with the objectives of future demand projections and the protection and sustainable use of natural resources. In particular, the identification of these sheds, conceiving the critical ESs for the AgrFS proposed in the study, will also ensure the achievement of the targets.

- **Regional scale**

It is clear that the food system of metropolitan areas in particular goes far beyond administrative borders. Moreover, it is unrealistic to expect the population of Istanbul to be adequately fed from limited production resources. Therefore, it is necessary to include the FsA in regional plans as an assessment tool and to define foodshed boundaries in a regional context. In this study, the region refers to the Marmara region.

In this context, the Marmara Region Spatial Development Strategic Framework document creates an important opportunity for FsA.

It is the agricultural capacity that will be considered in the evaluation of foodsheds at the regional scale. In other words, it is important to evaluate the agricultural production capacity that meets the demands of the population for a self-sufficient foodshed (Zasada et al., 2019). Accordingly, the use of production data at the regional scale comes to the fore. Agricultural land use and food production data can be used in the analyses to be made for the definition of foodsheds at the regional scale. This method is called carrying capacity by Peters et al. (2022).

In addition to statistical data, landscape characters, geomorphological features, and the spatial representation of ESs should also be evaluated within the scope of the analysis. For ESs-based FsA, it is very important to map the distribution and quality of ES and to define ecological connectivity through these maps. In addition to using GISbased tools for this mapping/inventory, surveys and data analyses evaluating the quality and quantity of ESs can be conducted.

- **Metropolitan scale**

FsA's strongest relationship with spatial planning should be at the metropolitan scale. This scale, in which self-sufficiency calculations are an important method, stands out because of the view that the level of rural-urban connections can affect the food selfsufficiency.

However, it is essential for this scale to establish a mutual relationship with the regional scale. The Environmental Plan will be the first plan level to include spatial decisions on AgrFS at the foodshed boundary to be defined in its legend, and to guide land use planning.

Analysis methods that can be used to assist the spatial decision-making process are listed below:

- Ecological Footprint: This method evaluates the environmental impact of human activities. It refers to the equivalent land area required for the energy and resource inputs required during food production and consumption (Peters et al., 2022; Wascher et al., 2015). This concept has been transformed by Jansma et al. (2013) as

"Urban Food Print". It discusses the environmental impact of agri-food lands by calculating the city's total food production and consumption capacity for each crop.

- Life Cycle Assessment: The method that assesses the environmental impact of products and processes can be used to assess the environmental impact of the farm to soil AgrFS (Notarnicola et al., 2017).
- Metropolitan Area Profile and Scenario (Zasada et al., 2014): It is a method that allows to generate demand scenarios at the level of administrative units based on different food consumption patterns.
- Metropolitan Foodscape Planner (Wascher et al., 2015): It is a method that reveals the supply balance at the level of landscape units.

When these methods are used together, an overview of the situation of potential supply and estimated demand can be developed. They offer a rich assessment of spatial data for foodsheds. At the same time, these methods support integrative spatial planning that allows resource management at the level of infrastructure, zoning, nature conservation and recreation, and AgrFS.

In the data sets required for metropolitan scale analysis, consumption capacity remarks as well as production capacity. It uses available spatial data such as land cover, administrative boundaries, distance of production areas to consumption areas, population and regional efficiencies (crops and soil) to map the spatial distribution of production and consumption. In order to evaluate the regional food demand, the dietary habits of the population are also examined within the consumption data.

ESs should be shown in AgrFS mapping, as well as at regional scale. In this way, land use planning decisions such as AgrFS infrastructures, allocation of land uses, and protected areas management will be informed. For example, ESs mapping can help identify areas that are important to certain services, such as biodiversity conservation, water treatment, and prioritize these areas for conservation or restoration. In addition, ESs can be used to evaluate trade-offs between different land use options. For example, a spatial plan might consider trade-offs between developing a particular parcel of land for housing and preserving it for its value as a food production area.

At the metropolitan scale, ESs-based FsA will guide spatial decision-making processes for ecosystem-based protection of agricultural lands, sustainable land use, local food production and consumption, reducing food waste and strengthening ESs.

- **Urban scale (Local scale)**

Cities attract the attention among the dynamics shaping the new global geography of food security (Sonnino, 2014) and the strategic roles defined for the development and management of sustainable and resilient food systems (MUFPP, 2015). It is not surprising, therefore, that the urban scale is becoming increasingly important in AgrFS.

However, due to the hierarchy of the plans, the local scale does not have the authority to impose specific sanctions on the plans in line with their potential.

In addition to the restrictiveness of the plan hierarchy, in Turkey, agricultural production has always been left outside the boundaries of spatial planning. The reason for this exclusion is not to increase the cost by enlarging the planning area or to prevent the use of agricultural areas as a development plot. However, the removal of agricultural lands beyond the planning boundaries creates problems in land management and the sustainability of these areas is endangered.

At the local level, special attention has been given to urban agriculture (Doernberg et al., 2019). On the other hand, as Sonnino et al. (2019) state, the new policy area in the role of planning and food system planning is related to urban design approaches.

These two findings intersect in urban design approaches such as productive urban landscapes or edible landscapes (Viljoen & Bohn, 2014; Viljoen et al, 2015). However, the difficulties encountered in applying these design approaches to existing policy and planning systems are noted (Doernberg et al., 2019).

For the urban scale, where the spatial reflections of the upper scale decisions are

seen, legal arrangements should be made, and the agricultural areas should be included in the master and implementation plans. This will also help the settlement to establish its relationship with foodsheds, and it will be possible to establish local food networks with zoning regulations, protection of agricultural lands and spatial decisions such as urban agriculture and community gardens.

6. Concluding Notes

AgrFS and spatial planning are often governed by different policies and regulations. This makes it difficult to coordinate planning efforts for the development of AgrFS. Spatial decisions are made in favour of profitable land uses, this increases the pressure on agricultural land and negatively affects local AgrFS. The spatial distribution of activities associated with the AgrFS is also affected in various ways by spatial planning. Therefore, effective integration of AgrFS into spatial planning is critical. Awareness and interest in foodsheds, which represent a geographical region that provides food resources for a community, is increasing day by day. As an assessment tool, the FsA has the potential to guide spatial decision-making regarding AgrFS.

FsA research has looked at whether the current agricultural production can meet the food needs of the region so far. In cases where it could not meet this gap, it was discussed how much to expand the agricultural lands and whether additional land resources were available. However, this approach will not go beyond deepening the problems, considering that AgrFS are the trigger of the climate crisis and responsible for the loss of biodiversity. Therefore, in this study, it is proposed to add the ESs approach to the existing definitions of the FsA tool. Thus, it will be possible to identify ecologically sensitive areas and ecological connectivity for the AgrFS. By considering trade-offs, the balance between ecological functions and AgrFS that will feed each other will be provided.

This study discusses integrating ESs-based FsA's as an assessment tool into the Istanbul metropolitan area planning tools. The scales where the FsA comes into play as a planning tool are the regional and metropolitan scales. Here, in the mutual relationship of the two scales, all analyses are made and the boundaries of the foodsheds are determined. The national scale for the FsA is descriptive, supportive, and binding. The metropolitan scale, where the upper scale spatial decisions are made, is followed by the urban scale at the implementation level. ESs-based FsA is promising for the future of cities and societies as it identifies the existing interdependencies between resources and food security and thus includes understanding the local impacts of AgrFS and opportunities for regional changes.

The fact that this discussion is being held for the first time for Istanbul shows that there is a long road ahead of the ES-based FsA model. It is planned to close existing gaps by including governance and practice of the model in future research.

References

Albayrak, İ. (2012). Ekosistem servislerine dayalı yönetim modelinin İstanbul-Ömerli Havzası örneğinde uygulanabilirliği (Doctoral Dissertation), Istanbul Technical University, Istanbul.

Aslan, B., Demir, Y. (2018). Organik Tarımla Beslenme: Türkiye ve İstanbul, beyond.istanbul, 03-2018, 56-60.

Battersby, J. (2017). Food System transformation in the Absence of Food System Planning: The Case of Supermarket and Shopping Mall Retail Expansion in Cape Town, South Africa. Built Environ., 43, 417–430.

Béné, C. (2020). Resilience of local food systems and links to food security – A review of some important concepts in the context of COVID-19 and other shocks. Food Security, 12(4), 805–822.

Brinkley, C. (2013). Avenues into food planning: a review of scholarly food system research. Int. Plan. Stud. 18(2), 243–266.
Buchan, R., Cloutier, D.S., Friedman, A. (2019) Transformative incrementalism: Planning for transformative change in local food systems. Prog. Plan., 134.
Burkhard, B., Kandziora, M., Hou, Y., Müller, F. (2014). Ecosystem service potentials, flows and demands – Concepts for spatial localisation, indication and quantification, Landscape Online, 34:1-32.
Cabannes, Y., Marocchino, C. (Eds.). (2018). Integrating food into urban planning. London, UCL Press, Rome, FAO.
Campagne, C. S., Roche, P. (2018). May the matrix be with you! Guidelines for the application of expert-based matrix approach for ecosystem services assessment and mapping, One Ecosystem 3: e24134.
Cardoso, A.S., Domingos, T., de Magalhaes, M.R., de Melo-Abreu, J., Palma, J. (2017). Mapping the lisbon potential foodshed in ribatejo e oeste: a suitability and yield model for assessing the potential for localized food production. Sustain 9.
Cruz-Garcia, G. S., Sachet, E., Vanegas, M., Piispanen, K. (2016). Are the major imperatives of food security missing in ecosystem services research?, Ecosystem Services, 19, 19-31.
Daily, G. C., Kareiva, P. M., Polasky, S., Ricketts, T. H., Tallis, H. (2011). Mainstreaming natural capital into decisions in Kareiva, Peter M., et al. (Eds), Natural Capital: Theory and Practica of Mapping Ecosystem Services, Oxford University Press, Oxford [England], New York, pp. 3-14.
Delgado, M. (2010). El sistema agroalimentario globalizado: Imperios alimentarios y degradación social y ecológica. Econ. Crit., 10, 32–61.
de Groot, R. S., Alkemade, R., Braat, L., Hein, L., Willemen, L. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making, Ecological Complexity, 7(3), 260-272.
Delibas, M., Tezer, A., Bacchin, T. K. (2021). Towards embedding soil ecosystem services in spatial planning, Cities, 113, 103150.
Dinc, S., Tezer, A. (in press). Sürdürülebilir Gıda Üretimi Çerçevesinde Gıda Dayanıklılığı ve Yenilenme Kapasitesi: İstanbul Kent Çeperi için Politika Önerileri.
Beykoz 2023 Kentsel Tarım Sempozyumu Tebliğler Kitabı.
Doernberg, A., Horn, P., Zasada, I., Piorr, A. (2019). Urban food policies in German city regions: An overview of key players and policy instruments, Food Policy 89.
Egoh, B., Reyers, B., Rouget, M., Richardson, D. M., Le Maitre, D. C., van Jaarsveld, A. S. Mapping ecosystem services for planning and management, Agriculture, Ecosystems and Environment, 127, 135
Fisher, B., Turner, R. K., Morling, P. (2009). Defining and classifying ecosystem services for decision making, Ecological Economics, 68, 643-653.

FAO-Food and Agriculture Organization. (1996). Rome Declaration on World Food Security, Italy.

Getz, A. (1991). Urban foodsheds. Permac. Act., 24, 26–27.

Goldstein, J. H., Caldarone, G., Duarte, T. K., Ennaanay, D., Hannahs, N., Mendoza, G., Polasky, S., Wolny, S., Daily, G. C. (2012). Integrating ecosystem-service tradeoffs into land-use decisions, Proceedings of the National Academy of Sciences of the United States of America, 109(19), 7565-7570.

Gret-Regamey, A, Altwegg, J., Siren, E. A., van Strien, M. J., Weibel, B. (2017). Integrating ecosystem services into spatial planning–A spatial deision support tool, Landscape and Urban Planning, 165, 206-219.

Hedden,W. (1929). How Great Cities are Fed, D.C. Health and Company: New York.

İMM (2009) İstanbul 1/100.000 Ölçekli Çevre Düzeni Planı Raporu, Büyükşehir Belediyesi İmar ve Şehircilik Daire Başkanlığı Şehir Planlama Müdürlüğü. İstanbul.

IPBES. (2019). Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Diaz, and H. T. Ngo (editors). IPBES secretariat, Bonn. Germany. 1148 pages.

IPES-Food, (2020). COVID-19 and the crisis in food systems: Symptoms, causes, and potential solutions. [Online]Available from: https://www.ipes-food.org/_img/upload/fles/COVID-19_Communique EN.pdf. Accessed 23/04/2023.

Jacobs, S., Burkhard, B., Daele, T. V., Staes, J., Schneiders, A. (2015). 'The Matrix Reloaded' : A review of expert knowledge use for mapping ecosystem services, Ecological Modelling, 295, 21-30.

Jansma, J.E., Veen, E.J., Sukkel, W., Visser, A.J. (2013). Urban Food Print: A tool to calculate the land needed to feed Dutch cities. In Proceedings of the 5th AESOP Sustainable Food Planning Conference: Innovations in Urban Food Systems, Montpellier, France, 28–29 October 2013.

King, E., Cavender-Bares, J., Balvanera, P., Mwampamba, T. H., Polasky, S. (2015). Trade-offs in ecosystem services and varying stakeholder preferences: evaluating conflicts, obstacles, and opportunities, Ecology and Society, 20(3):25.

Kloppenburg, J., Hendrickson, J., Stevenson, G.W. (1996) Coming in to the foodshed. Agriculture and Human Values 13:3, 33-42.

Kriewald, S., Pradhan, P., Costa, L., Ros, A.G.C., Kropp, J.P. (2019) Hungry cities: How local food self-sufficiency relates to climate change, diets, and urbanisation. Environ. Res. Lett.,14.

Kurtz, J.E., Woodbury, P.B., Ahmed, Z.U., Peters, C.J. (2020). Mapping U.S. food system localization potential: the impact of diet on foodsheds. Environmental Science & Technology 54(10), 12434–12446. https://doi.org/10.1021/ acs.est.9b07582.

La Notte, A. (2022). Ecologically intermediate and economically final: The role of the ecosystem services framework in measuring sustainability in agri-food systems, Land, 11(1).

Lee, H., Lautenbach, S. (2016). A quantitative review of relationships between ecosystem services, Ecological Indicators, 66, 340-351.

Lengnick, L., Miller, M., Marten, G. G. (2015) Metropolitan foodsheds: a resilient response to the climate change challenge? J. Environ. Stud. Sci., 5, 573–92.

Marsden, T., Sonnino, R. (2012). Human health and wellbeing and the sustainability of urban-regional food systems Current Opinion in Environmental Sustainability, 4, 427–30.

Menteşe, E. Y., Tezer, A., Demir, M. (2019). Development of a GIS Tool for the Identification of Environmental Sustainability Performance of Spatial Plans, Planning, 29(1).

MEA-Millennium Ecosystem Assessment. (2003). Ecosystems and Human Well-Being: AFramework for Assessment. Washington: Island Press.

MUFFP-Milan Urban Food Policy Pact (2015). Milan Urban Food Policy Pact and Framework for Action. [Online]Available from: http://www.foodpolicymilano.org/en/thetext-of-the-milanurban- food-policy-pact/ Accessed 26/04/2023.

Onur, A. C., Tezer, A. (2015). Ecosystem services based spatial planning decision making for adaptation to climate changes, Habitat International, 47, 267-278.

Oosterveer, P., Sonnenfeld, D.A. (2012). Food, Globalization and Sustainability, Routledge: New York.

Peters, C., Bills, N., Lembo, A.,Wilkins, J., Fick, G.(2008). Mapping potential foodsheds in New York State: A spatial model for evaluating the capacity to localize food production. Renew. Agric. Food Syst., 24, 72–84.

Peters, C.J., Bills, N.L., Wilkins, J.L., Fick, G.W. (2009). Foodshed analysis and its relevance to sustainability. Renewable Agriculture and Food Systems, 24(1), 1–7.

Peters, C. J. (2022). Foodshed analysis and carrying capacity estimation. Food Systems Modelling, 105-128.

Poppy, G. M., Jepson, P. C., Pickett, J. A., Birkett, M. A. (2014a). Achieving food and environmental security: new approaches to close the gap, Philosophical Transactions of the Royal Society B, 369.

Poppy, G. M., Chiotha, S., Eigenbrod, F., Harvey, C. A., Honzak, M., Hudson, M. D., Jarvis, A., Madise, N. J., Schreckenberg, K., Shackleton, C. M., Villa, F., Dawson, T. P. (2014b). Food security in a perfect storm: using the ecosystem services framework to increase understanding, Philosophical Transactions of the Royal Society B, 369.

Pothukuchi, K., Kaufman, J. (2000). The food system: a stranger to the planning field. J. Am. Plan. Assoc. 66(2), 113–124.

Power, A. G. (2010). Ecosystem services and agriculture: tradeoffs and synergies, Philosophical Transactions of the Royal Society B.

Raja, S., Born, B.M., Russell, J.K. (2008). A planners guide to community and regional food planning: transforming food environments, facilitating healthy eating. Planning Advisory Service report, no. 554, American Planning Association, Chicago, Ill.
Raja, S., Morgan, K., Hall, E. (2017). Planning for equitable urban and regional food systems. Built Environ., 43(3), 309–314.
Rodriguez, J. P., Beard, Jr., T. D., Bennett, E. M., Cumming, G. S., Cork, S. J., Agard, J., Dobson, A. P., Peterson, G. D. (2006). Trade-offs across Space, Time, and Ecosystem Services, Ecology and Society, 11(1):28.
Rusinamhodzi, L. (2019). Challenges in maximizing benefits from ecosystem services and transforming food systems, in Rusinamhodzi, L. (ed.) The Role of Ecosystem Services in Sustainable Food Systems, pp. 263-274.
Saavedra, A., Domingos, T., Raposo, M., De Melo-Abreu, J., Palma, J. (2017). Mapping the Lisbon potential foodshed in Ribatejo e Oeste: A suitability and yield model for assessing the potential for localized food production. Sustainability, 9, 2003.
Sali, G., Corsi, S., Monaco, F., Mazzocchi, C., Glavan, M., Pintar, M. (2014). Urbanrural relationships in feeding metropolis: A case study in Ljubljana metropolitan area. Adv. Eng. Forum, 11, 259–264.
Schreiber, K., Hickey, G.M., Metson, G.S., Robinson, B.E., MacDonald, G.K. (2020). Quantifying the foodshed: A systematic review of urban food flow and local food selfsufficiency research. Env. Res. Lett., 16.
Solduk, B. B. (2010). Sürdürülebilir kentsel gelişmenin sağlanması açısından kentsel tarımın rolü. Master Thesis. İstanbul Teknik Üniversitesi Fen Bilimleri Enstitüsü, İstanbul.
Sonnino, R. (2009). Feeding the city: towards a new research and planning agenda. Int. Plan. Stud., 14(4), 425–435.
Sonnino, R., Moragues-Faus, A., Maggio, A. (2014). Sustainable food security: An emerging research and policy agenda. International Journal of the Sociology of Agriculture and Food, 21(1), 173–188.
Sonnino, R. (2016). The new geography of food security. Exploring the potential of urban food strategies. Geograph. J., 182(2), 190–200.
Sonnino, R. (2023). Food system transformation: Urban perspectives. Cities 134.
Steel, C. (2008) Hungry City. How Food Shapes Our Lives, Chatto & Windus, Vintage: London, UK.
Stierand, P. (2012). Food Policy Councils: recovering the local level in food policy. In: Viljoen, A.M., Wiskerke, J.S.C. (Eds.), Sustainable Food Planning: Evolving Theory and Practice. Wageningen Acad. Publ., Wageningen, pp. 67–77.
Swiader, M., Szewranski, S., Kazak, J.K. (2018). Foodshed as an example of preliminary research for conducting environmental carrying capacity analysis. Sustain, 10.

Swinton, S. M., Lupi, F., Robertson, G. P., Hamilton, S. K. (2007). Ecosystem services and agriculture: Cultivating agricultural ecosystems for diverse benefits, Ecological Economics, 64, 245-252.

Sylla, M., Swiader, M, Vicente-Vicente, J. L., Arciniegas, G. (2022). Assessing food self-sufficiency of selected European Functional Urban Areas vs metropolitan areas. Landscape and Urban Planning 228.

Tezer, A., Sen, O. L., Cetin, N. I., Onur, A. C. T. (2012). Integrated planning for the resilience of urban riverine ecosystems: the Istanbul-Omerli Watershed case, Ecohydrology&Hydrobiology, Volume 12, Issue 2, 153-163.

Tezer, A., Çetin, N. İ., Onur, A. C., Menteşe, E. Y., Albayrak, İ., Cengiz, E. (2015). Ömerli Havzası'nda Ekosistem Servislerine Dayalı Bütünleşik Havza Yönetim Planının Geliştirilmesi Projesi, Nihai Rapor, İstanbul.

Tezer, A., Turkay, Z., Uzun, O., Terzi, F., Koylu, P., Karacor, E., Okay, N., Kaya, M. (2020). Ecosystem services-based multi-criteria assessment for ecologically sensitive watershed management, Environment, Development and Sustainability, 22, 2431-2450.

Thiaw, I., Kumar, P., Yashiro, M., Molinero, C. (2011). Food and Ecological Security: Identifying synergy and trade-offs, UNEP Policy Series, Issue 4.

UN, 2015. Sustainable Development Goals. Available from:https://sdgs.un.org/goals. Accessed 26/04/2023.

UN-Habitat (2016) New Urban Agenda. Available from:habitat3.org/wpcontent/uploads/New- Urban-Agenda-GA-Adopted-68th-Plenary-N1646655-E.pdf. Accessed 26/04/2023.

Van Haren, C., Kumar, I., Cormont, A., Terwisscha, C., Rooij, B., Islam, S., Verweij, P. (2023). The Role of Spatialisation and Spatial Planning in Improving Food Systems: Insights from the Fast-Growing City of Dhaka, Bangladesh. Sustainability 2023, 15.

Varyvoda, Y., Taren, D. (2022). Considering ecosystem services in food system resilience. Int. J. Environ. Res. Public Health, 19.

Vicente-Vicente, Jose Luis, Doernberg, Alexandra, Zasada, Ingo, Ludlow, David, Staszek, Damian, Bushell, Joanna, Hainoun, Ali, Loibl, Wolfgang, Piorr, Annette. (2021a). Exploring alternative pathways toward more sustainable regional food systems by foodshed assessment – City region examples from Vienna and Bristol. Environmental Science and Policy, 124, 401–412.

Vicente-Vicente, J.L., Sanz-Sanz, E., Napoléone, C., Moulery, M., Piorr, A. (2021b). Foodshed, Agricultural Diversification and Self-Sufficiency Assessment: Beyond the Isotropic Circle Foodshed—A Case Study from Avignon (France). Agriculture 2021.

Vittuari, M., Bazzocchi, G., Blasioli, S., Cirone, F., Maggio, A., Orsini, F., …De Menna, F. (2021). Envisioning the future of European food systems: approaches and research priorities after COVID-19. Frontiers in Sustainable Food Systems, 5(March), 1–9.

Wang, L., Zheng, H., Chen, Y., Ouyang, Z., Hu, X. (2022). Systematic review of ecosystem services flow measurement: Main concepts, methods, applications and future directions, Ecosystem Services, Volume 58, 101479.

Wascher, D., Zasada, I., Jeurissen, L., Arciniegas, G., de Kroes, J., Sali, G., Corsi, S., Monaco, F., Schmutz, U., Glavan, M., Pohle, D., van Eupen, M. (2014) D3.3 Indicators, Tools and Method for Metropolitan Footprint Tools.

Yerkure Local Studies Cooperative, 2020. İstanbul Nasıl Beslenir?: Üretici Odağında Alternatifler ve Olanaklar.

Zasada, I., Schmutz, U., Wascher, D., Kneafsey, M., Corsi, S., Mazzocchi, C., Monaco, F., Boyce, P., Doernberg, A., Sali, G. (2019). Food beyond the city— Analysing foodsheds and self-suffciency for different food system scenarios in European metropolitan regions. City Cult. Soc., 16, 25–35.

Zazo-Moratalla, A., Troncoso-Gonzalez, I., Moreira-Muńoz, A. (2019) Regenerative food systems to restore urban-rural relationships: insights from the concepción metropolitan rea foodshed (Chile), Sustainability, 11.

Zhang, W., Ricketts, T. H., Kremen, C., Carney, K., Swinton, S. M. (2007). Ecosystem services and dis-services to agriculture, Ecological Economics, 64, 253-260.