Urban Planning
2025 • Volume 10 • Article 10701
https://doi.org/10.17645/up.10701

cogitatio

ARTICLE

Open Access Journal

A Radical Reversal of Urban Bias to Create Resilient and Healthy Rural Food Environments

Marian Simón-Rojo [1], Nerea Morán Alonso [1], Rafael Córdoba Hernández [1], and Araceli Serrano-Pascual [2]

[1] Departamento de Urbanística y Ordenación del Territorio, Universidad Politécnica de Madrid, Spain
[2] Departamento de Sociología: Metodología y Teoría, Universidad Complutense de Madrid, Spain

Correspondence: Araceli Serrano-Pascual (aserrano@ucm.es)

Submitted: 7 May 2025 **Accepted:** 31 July 2025 **Published:** 1 October 2025

Issue: This article is part of the issue "Understanding Change in Urban Food Environments: The Contemporary Challenges of Conceptualization, Definition, and Measurement" edited by Claire Thompson (University of Hertfordshire) and Dianna Smith (University of Southampton), fully open access at https://doi.org/10.17645/up.i404

Abstract

Shaping a healthy food environment requires a comprehensive approach that goes beyond consumption, encompassing the entire system. Urban centers currently depend significantly on agricultural outputs from distant regions, a dynamic that negatively impacts the areas that feed the cities. In the global North, there is a growing awareness of the necessity to improve urban resilience; however, the rural paradox, characterized by persistent food insecurity in regions that are otherwise productive, has received inadequate focus. To uncover the potential ramifications of reversing the perspective, a study was carried out in the Community of Madrid, Spain (7 million inhabitants). We developed a spatial data model to analyze food supply capacity at a local level. Two simulations were run: the first focused on addressing the needs of the metropolitan area, while the second concentrated on the supply requirements of rural municipalities. Two scenarios were defined: one assigned the average legume intake according to statistics from the Ministry, and the other implemented dietary recommendations. Results were conclusive: If production is consumed in the capital, less than 8% of the territory would be covered. However, if larger cities are left out of the equation, food requirements can be met by local production in 62% of the territory. This concept remains theoretical, as most of the necessary facilities and equipment for storage, processing, and delivery are lacking. Establishing healthy food environments depends on realigning priorities and addressing deficiencies in essential components.

Keywords

biodistricts; food environments; legumes; local production; Madrid Region; resilient food systems; rural areas; short supply chains; sustainable diet

1. Introduction

Poor nutrition from an inadequate diet is a critical risk factor for chronic non-communicable diseases—the leading cause of death and disability worldwide (Habib & Saha, 2010). The impact of food deserts and food swamps on urban populations is well documented (Bridle-Fitzpatrick, 2015; Cooksey-Stowers et al., 2017). The case of limited access to healthy food in rural areas has received less attention and has its own specificities, with a combination of ageing and depopulation, territorial inequalities, lack of infrastructure and services, loss of small businesses, and fragility of markets (Bardenhagen et al., 2017; Camarero et al., 2009; Ramos Truchero, 2015). The concept of food deserts acquires a different dimension and is contested in rural areas, as these are areas of low population density and dispersed population. Residents are assumed to have access to motorized transport and rely on out-shopping—a phenomenon where rural residents travel outside of their local area to shop (Bardenhagen et al, 2017; Lebel et al., 2016)—but this does not apply to the whole population. The loss of small local shops and public transport creates inequalities in access to food, especially for the elderly population, those with reduced mobility, or those with low incomes who do not have a private car.

In Spain, there has not been a total de-structuring of food supply in rural areas; rather, strategies have been developed based on traditions (knowledge about growing and preserving food) and social relations (contacts and cooperation between neighbors, friends, and relatives; Ramos Truchero, 2020). The food distribution sector has also tried solutions in the form of other retail formats, such as mobile sales on regular delivery routes or private home delivery services. Itinerant commerce and fairs can be seen as an intangible cultural manifestation, which in rural areas generally takes place in spaces of cultural heritage, such as village squares, central spaces in the morphology of rural settlements. This combination turns the squares into spaces of collective sociability, with an economic and social multifunctionality (Tiemblo & Pita, 2023).

The food environment encompasses the physical, economic, political, and socio-cultural context in which consumers engage with the food system to make decisions about acquiring, preparing, and consuming food (Pingault et al., 2017). According to the FAO, a healthy food environment creates conditions enabling and encouraging people to access and choose healthy diets (Grace, 2016), a concept that encompasses both safe and nutritious food. Thus, ensuring access to healthy, affordable food in rural areas and their food environments is a crucial challenge if we are to be consistent with the objectives of territorial cohesion, a cornerstone of the European Union's philosophy. But a wider scope is needed to move from food accessibility and food insecurity in terms of retail and purchase options to consider the vulnerability of the whole system. Urban centers are currently highly dependent on agricultural products from distant regions. The vulnerability of their urban food systems has already been documented (Jensen & Orfila, 2021). This urban-centric perspective has led to numerous studies and methodologies aimed at assessing supply capacities concerning the needs of urban settings, as illustrated in recent meta-analyses about the topic (Payen et al., 2022; Schreiber et al., 2021). It is noteworthy that less attention is paid to rural areas, which are considered as production spaces, and often analyzed in terms of resilient agriculture. So, we should consider not only whether there is enough food, but also where it comes from and how it is produced.

This rural perspective, coupled with place-based approaches, can be found in the biodistrict concept implemented mainly in Italy, and to some extent also in the French territorialized projects (Lamine et al., 2023). By mainstreaming sustainable management of local resources, organic production, and local consumption, they contribute to developing more resilient food systems that can withstand and recover

from disruptions, ensuring a reliable supply of food accessible to all. In addition, by creating links between agriculture and other economic sectors and activities, they represent a potential to revitalize rural areas (Stefanovic & Agbolosoo-Mensah, 2023). In Spain, although such specific approaches are in their infancy (at best), elements in place as those explained above could contribute as building blocks for resilient food systems that prioritize food supply to areas close to production through short supply chains.

Promoting local sourcing would reduce dependence on global food flows and facilitate the creation of healthy food environments in rural areas. The analysis of a dual region, such as Madrid (Spain), with a very dense metropolitan area and peripheral rural areas with low population density, will serve to explore the influence and impact on the territory if the destination of production were first to satisfy the closest needs. It is not a rhetorical or theoretical approach; the analysis examines what the organizational and operational implications of reorienting food production towards the immediate local markets would be, as well as the difficulties in doing so.

2. Materials and Methods

The study stems from the assumption that the food system will be more resilient if local goods and short supply chains can be connected to lessen reliance on international food flows. Based on this supposition, the study investigates, on the one hand, the feasibility of relying on certain regional foods, examining the effects of the territorial organization, and whether urban or rural supply is given priority. However, with an emphasis on rural areas, it examines whether the circumstances are favorable for establishing a safe and resilient food system in which local production and consumption are connected.

2.1. Resilient Food Environments: Regional Potential Supply and Influence of Market Priorities

The analysis of self-sufficiency capacity was carried out by selecting only one major food group in a sustainable diet: pulses. Pulses are a rich source of high-quality plant-based protein, fibre, vitamins, minerals, and slow-release carbohydrates. They also improve soil health by providing and mobilizing nutrients such as nitrogen, phosphorus, and micronutrients. They help to increase the amount and diversity of microfauna in the soil and enhance its structure (Caon et al., 2016). So, we start with pulses as an essential component of a healthy and sustainable diet, but the approach can be replicated for other categories of food. The main legume crops in this area have traditionally been chickpeas, carob beans, peas, and broad beans. While these crops have played a central role in the Mediterranean diet, consumption has declined significantly, dropping from 12–14 kg per capita per year in the Madrid region in the 1960s to just 3.5 kg by 2013 (Lázaro & Pato, 2017) and 3 kg today.

Calculations are based on the study of land use and food production. Because it is essential for the research to address the food environment and the reality of access to healthy food, the analysis of land use has been detailed at the municipal level. Publicly available data from the Spanish Agricultural Plots Information System (SIGPAC) for 2024 is used. SIGPAC provides spatially referenced data on land use at the parcel level. Only arable land plots were considered. Since leguminous crops do not occupy all arable land, their proportion has been determined using the statistics on rainfed arable land distribution that are currently accessible at the Community of Madrid level. This detailed information on crops comes from the Survey of Areas and Yields (ESYRCE) of the Ministry of Agriculture, Fisheries and Food (MAPA). According to 2023 statistics

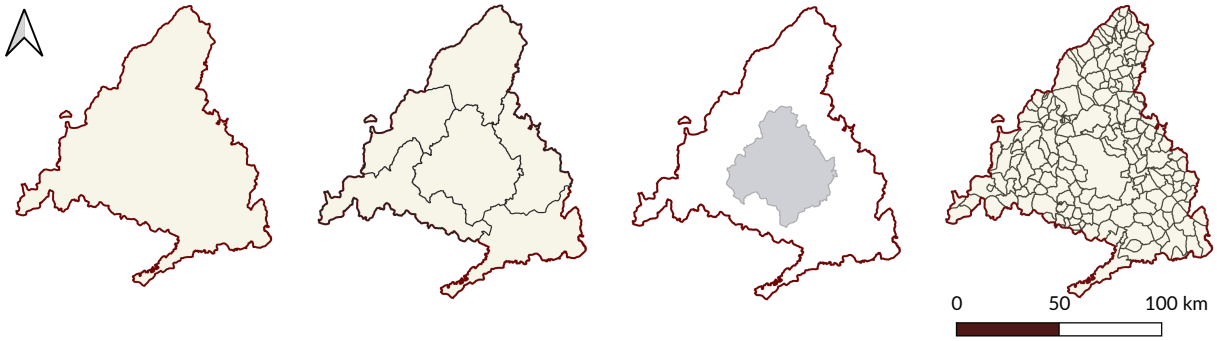
(Subsecretaría de Agricultura, Pesca y Alimentación, 2023), 20% of the rainfed arable land in the Community of Madrid is cultivated with leguminous crops.

Once these areas are known, the yields are calculated. As we are working with sustainable food environment scenarios, one of the factors in achieving these is organic production systems, which have a positive impact on the health of farmers, consumers, and ecosystems. Therefore, our calculations are based on the assumption that all production is organic, and we consider regional-level organic yield statistics published annually by MAPA. We determine the mean yield for the previous five years (2019–2024). We use the yearly consumption figures released by MAPA, which offer regionally broken-down values, to analyze demand. In the Community of Madrid, consumption of pulses is around 3 kg per person per year. In addition to using these actual numbers, the study also compares them to a scenario where the consumption levels—roughly 10 kg of legumes per person annually—that are recommended by the Spanish Agency for Food Safety and Nutrition are met (Ministerio de Consumo, 2022).

Following the collection of production and consumption data, the ability of regional production to satisfy demand is evaluated. At this point, two simulations were run, one concentrating on the supply needs of the metropolitan area, while the second focused on the supply needs of rural communities. Table 1 illustrates the various administrative units used for data collection and model implementation, helping readers to understand the methods and results. These units range from the regional level (Community of Madrid) to municipalities.

In the first scenario, it is assumed that the priority destination of production is the main cities of the metropolitan area, starting with the capital, Madrid, which has 3.4 million inhabitants. In the second scenario, the internal supply capacity of each municipality is first calculated, resulting in a municipal deficit or surplus. From here, a second estimate is made, redistributing the surpluses. This redistribution follows the criteria of proximity (with the nearest neighbor analysis tool of QGIS) and imposes a restriction that they belong to the same agricultural district. This restrictive criterion is because the county is the reference unit for redistribution; counties share structural characteristics and are the reference units for local development plans and local action groups.

Table 1. Madrid Region and the spatial units considered for the analysis.



Region: Community of Madrid	Agrarian District (Comara Agraria) (6)	Metropolitan Area of Madrid	Municipalities (179)

Notes: This research considers the Metropolitan Area to be an agrarian district containing 18 municipalities, but there are other ways of delimiting the Metropolitan Area. Unlike other metropolitan areas, Madrid has no governing structure.

The findings of the first analysis enable inferences about the effects of the production-distribution model. The scenarios for enhancing food security and optimizing areas that attain robust and wholesome food environments remain hypothetical. The processes for the current food supply in rural areas are presented in this second section. Analysis is done on public home-delivered services, mostly for the elderly, and outdoor markets. Together, the studies identify components that should be part of the food system and public policy (e.g., infrastructure and equipment for storage, processing, and distribution).

2.2. Context of the Case Study

Located at the heart of the Iberian Peninsula, the region of Madrid (Community of Madrid) exemplifies the profound territorial, economic, and environmental transformations experienced by metropolitan regions aspiring to global city status. With 7 million inhabitants, the Madrid region has strategically oriented its urban development since the 1980s towards becoming a major hub for services, investment, and international connectivity, constructing extensive transport infrastructures and promoting large-scale urban megaprojects (Córdoba Hernández & Morcillo Álvarez, 2020). As a result, the region has witnessed intense anthropization processes characterized by expansive land consumption and the subordination of traditional land uses, including agriculture, to market-driven urban growth dynamics (Morán Alonso et al., 2025; Observatorio de la Sostenibilidad, 2016).

Agriculture, historically a cornerstone of the region's identity and economy, now represents a marginal share of the regional GDP (0.10%) and workforce (0.75%). Madrid remains a major food consumption center, heavily reliant on external supply chains for its food provision, with imported food products accounting for 98% of its supply (Simón-Rojo et al., 2020). This profound dependence underscores the vulnerability and disconnection between the metropolitan demand for food and the capacity for local production, a pattern that reflects broader trends of agricultural intensification, land abandonment, and environmental degradation observed across the Mediterranean basin (Zimmerer et al., 2022).

The territorial changes associated with urban growth have a direct impact on regional ecosystems. Ecosystem assessments applied to spatial planning show that urban expansion, habitat fragmentation, and the abandonment of traditional agricultural activities are degrading key ecosystem functions (Córdoba Hernández & Camerin, 2024). Among the services most affected are provisioning services such as food production, availability of quality water, and maintenance of fertile soils. The substitution of agricultural uses by urban and peri-urban development reduces the capacity of ecosystems to maintain these essential services, increasing dependence on external supply chains and weakening the food and environmental security of the area (Córdoba Hernández & Camerin, 2023).

From the point of view of agricultural territorial organization, the Community of Madrid is divided into six agricultural districts (comarcas), recognized by the regional administration for rural analysis and planning (Figure 1): (i) Lozoya-Somosierra, to the north, with a strong forestry and extensive livestock orientation; (ii) Guadarrama, to the west, with a mountainous and mixed character; (iii) Área Metropolitana de Madrid, in the center, highly urbanized and with very residual agriculture; (iv) Campiña, to the east, dominated by non-irrigated arable crops; (v) Sur Occidental, in the south-west, with mixed agriculture and increasing urbanization; and (vi) Las Vegas, in the south-east, one of the most fertile areas thanks to the Tajo and Tajuña river systems.

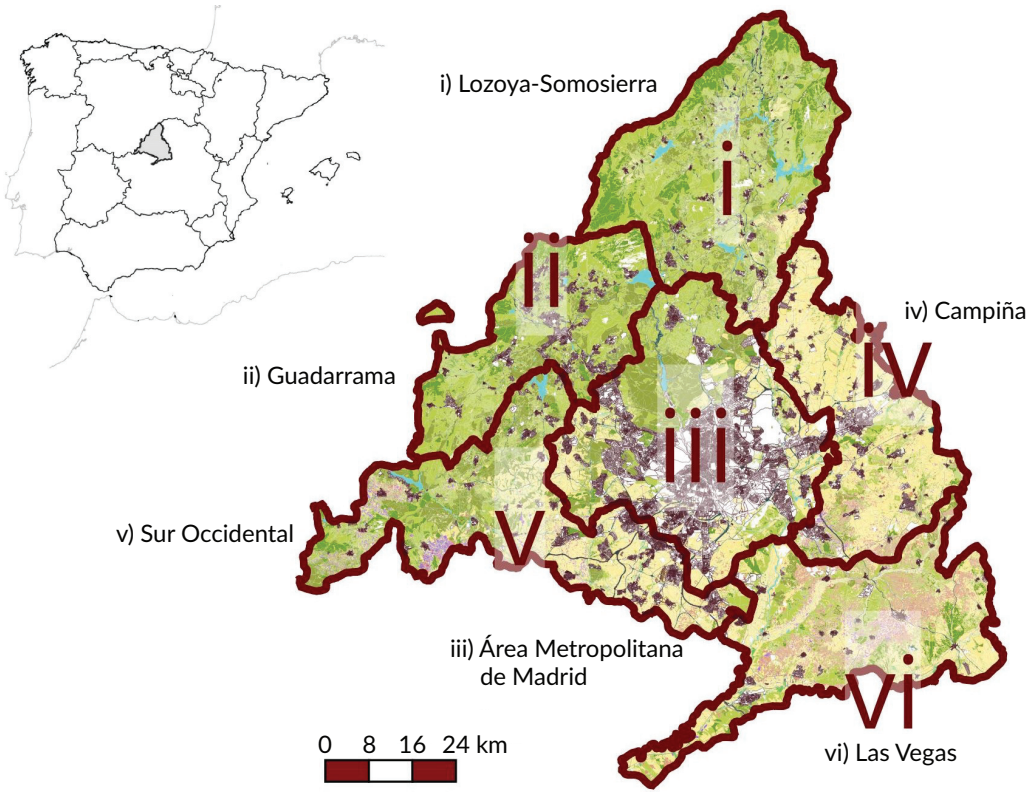


Figure 1. Location of the case study and distribution of agricultural districts (comarcas).

This division reveals profound territorial disparities between rural areas—more dependent on the natural environment and with low population densities—and the metropolitan area, where urban pressure and the abandonment of traditional agricultural uses prevail. Of the 179 municipalities that make up the Community of Madrid, 111 have fewer than 5,000 inhabitants (62.01%), reflecting a clear predominance of small rural towns in contrast to the densely urbanized metropolitan area around the capital, where ten municipalities account for six million inhabitants. Rural areas also have the highest proportion of elderly people. A significant proportion of small municipalities exhibit an elevated elderly ratio, defined as the proportion of individuals over the age of 65 relative to those below the age of 16. In 72% of the municipalities with a population of less than 1,000 inhabitants, the elderly ratio is over 150%. These patterns confirm a marked urban-rural duality, with very different socio-economic and land-use dynamics.

The Participatory Local Development Strategies 2023–27 for the Madrid region are the roadmaps for the allocation of LEADER funds. In the south-eastern comarcas (iv and vi), the strategy includes actions such as the creation of micro-enterprises for the processing and marketing of agricultural products, support for the retail trade of local products, the digitalization of commercial activities, or the promotion of new distribution channels for local products (ARACOVE, 2025). For its part, the Sierra Oeste region (v), with a group of 22 municipalities in the Association for Local Development, defined actions for strengthening links with the retail sector and creating direct sales outlets, as well as taking advantage of the proximity of urban Madrid as a consumption center (ADL Sierra Oeste de Madrid, 2025).

3. Results: The Effect of Place-Based Approaches That Prioritize Proximity

Two simulations were conducted, as previously mentioned: one aimed at first meeting the needs of the larger urban areas (Madrid capital city) and the other focused on the supply requirements of rural communities.

3.1. Current Pulse Consumption Scenario

In the Community of Madrid, the area dedicated to leguminous crops, considering organic yields, could produce food to meet the needs of almost 2,725,000 people, taking into account the current average consumption of 3 kg of pulses per person per year (i.e., 39% of the region's population). Based on these data, the first model prioritizes supply according to the demographic weight of the municipality. In other words, the priority destination of regional production would be the most populated areas, starting with the capital, Madrid.

The results presented in Figure 2a show that with the current production capacity of organic legumes on the current cultivated area, the demand of 2.7 million people could be satisfied, that is, 80% of the 3.4 million inhabitants of this city, according to the current consumption patterns of pulses. If the entire production were to be directed to the most populated nucleus, less than 8% of the territory of the Community of Madrid would be supplied. The remaining municipalities would not receive any local pulses. In other words, 92% of the territory and 61% of the population of the Community of Madrid would be completely unsupplied.

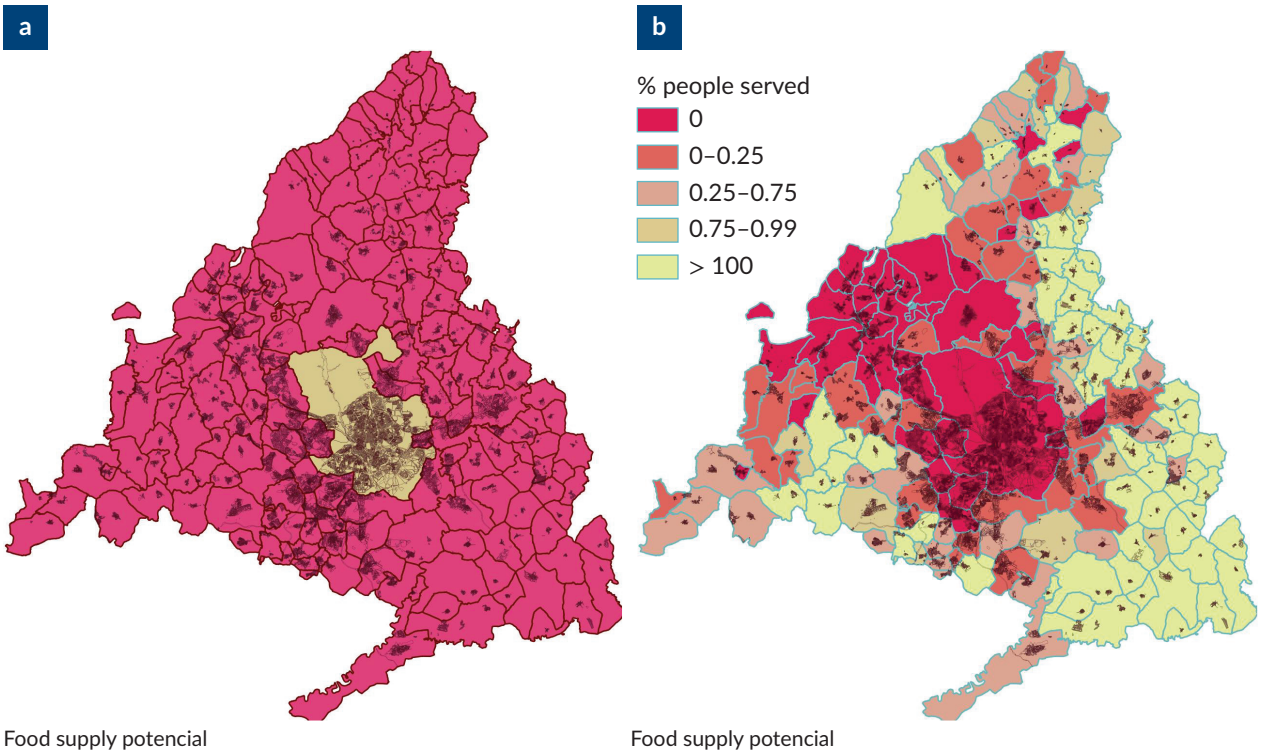


Figure 2. Pulses provision at the municipal level with current consumption level 2. Black dots represent the urban and rural settlements: (a) Supply priority to the capital city, Madrid, and (b) supply priority based on proximity. Source: Elaborated by the authors based on SIGPAC (https://sigpac.mapa.gob.es/fega/visor), ESYRCE (https://www.mapa.gob.es/es/estadistica/temas/estadisticas-agrarias/agricultura/esyrce), and INE statistics.

The map on the right (Figure 2b) depicts that in the case of local supply priority, so that pulses are consumed in the same municipality where they are produced, the number of municipalities where the demand for pulses is fully covered is 99, representing 52% of the territory and 39% of the population. There are significant differences between regions, with the metropolitan area being the most deficient, while those with better production capacity (such as Las Vegas and Campiña) or lower population density (Lozoyuela Somosierra) are better supplied.

3.2. Scenario of Pulse Consumption Based on Dietary Recommendations

If the recommended consumption of pulses (an average of 10 kg per person per year) is taken as a basis for calculations, regional production would only cover the needs of almost 820,000 people, or 12% of the population. If all production were directed to the main population center, the city of Madrid, it would cover the needs of 24% of its population. The remaining municipalities (178, 99% of the total) would not receive any local pulses (Figure 3a).

Giving priority to local supply, so that pulses are consumed first in the municipality where they are produced, would mean that with the recommended consumption of pulses, 61 municipalities (32% of the territory of the Community of Madrid) would be able to meet their needs (Figure 3b).

If a redistribution of municipalities with a surplus to nearby municipalities with a deficit is established, respecting the regional organization in Comarcas, the number of municipalities served would increase to 115 (62% of the territory; Figure 3c).

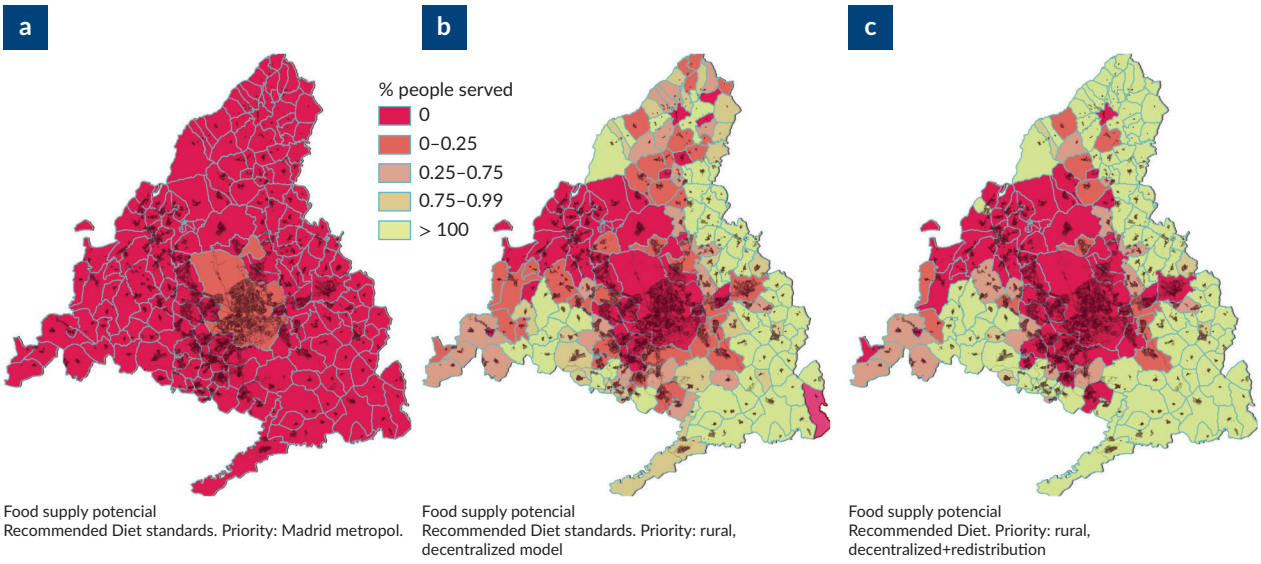


Figure 3. Pulses provision at the municipal level with recommended consumption levels: (a) Supply priority to the Metropolitan area; (b) supply priority based on proximity; and (c) supply priority based on proximity and redistribution. Source: Elaborated by the authors based on SIGPAC, ESYRCE, and INE statistics.

In short, the potential for self-sufficiency in an overpopulated region such as the Community of Madrid is limited. At current consumption levels of pulses, it could meet the needs of 39% of the population, a figure that falls to 12% if the per capita consumption levels recommended by health authorities are reached. Beyond

these totals, the study shows that depending on the distribution model and supply priority chosen, there is a significant impact on the extension of the territory covered. In the centralized model, a single municipality, the capital, could absorb the entire production and would still have to import 20% or 80% of the pulses consumed, depending on the diet considered. The rest of the municipalities (92% of the territory) would be completely dependent on external supplies. In the second model, which prioritizes local production, the needs of 52% of the territory can be met at current consumption levels and 62% at recommended consumption levels with a redistribution scheme between close municipalities.

3.3. Food Access, From Farmers' Markets to Itinerant Rural Markets

Farmers' markets play a key strategic role in promoting healthy food environments in both urban and rural areas. In the Community of Madrid, La Despensa de Madrid (Madrid's Pantry) is organized by the regional government. They take place on weekends between May and October in rotation between 19 municipalities, most of which are in the metropolitan area. Each municipality hosts one of these markets once a year, providing a platform for local farmers to sell their produce directly. Their main aim is to promote local and "zero-kilometer" agri-food production, allowing people to taste, buy, and discover products such as meat, beer, vegetables, dairy products, honey, teas, oils, bread, and traditional sweets, many of which have a designation of origin. This type of activity functions as a showcase to spark interest and raise awareness. Notwithstanding its present limited frequency, these markets are a component of the regional government's plan to support locally produced, high-quality goods that are designated as "M Certified Products." The ultimate objective of this plan is to encourage healthier and more sustainable eating habits, stimulate the rural economy, and help to create local jobs.

Itinerant outdoor markets, on the other hand, are regular and permanent throughout the year, with fixed days and locations determined by each town council. They cover most of the region's municipalities and provide a complementary way of improving access to fresh food and encouraging the consumption of local produce. They offer a wide range of products, from food and clothing to household items. In contrast to La Despensa de Madrid, these markets have a commercial rather than a promotional focus, and their accessibility makes them a key element in the daily supply of many households, especially in areas with little commercial infrastructure. Conversely, these markets do not specialize in local or organic produce. This difference in periodicity, purpose, type of product, and level of institutionalization underlines their complementarity within the Madrid food system. As shown in Figure 4, coverage of these markets is extensive, with only the northern highlands and a few scattered municipalities devoid of one.

4. Discussion

The results highlight the potential impact of adopting a food environment perspective that takes into account not only the availability of food, but also its origin, with rational distribution criteria. In the Madrid region of Spain (7 million inhabitants), an assessment of the production and human consumption of pulses shows that if priority is given to meeting the needs of the metropolitan area, only the capital (1 out of 179 municipalities) can meet them, and only partially. If the big cities are left out of the equation, the food needs of 62% of the territory can be met by local production, even by an increase in pulse consumption to adapt it to healthy diet recommendations. This would imply a more sustainable management of local resources through organic production and short food supply chains, in line with the principles guiding the design of biodistricts (Dias

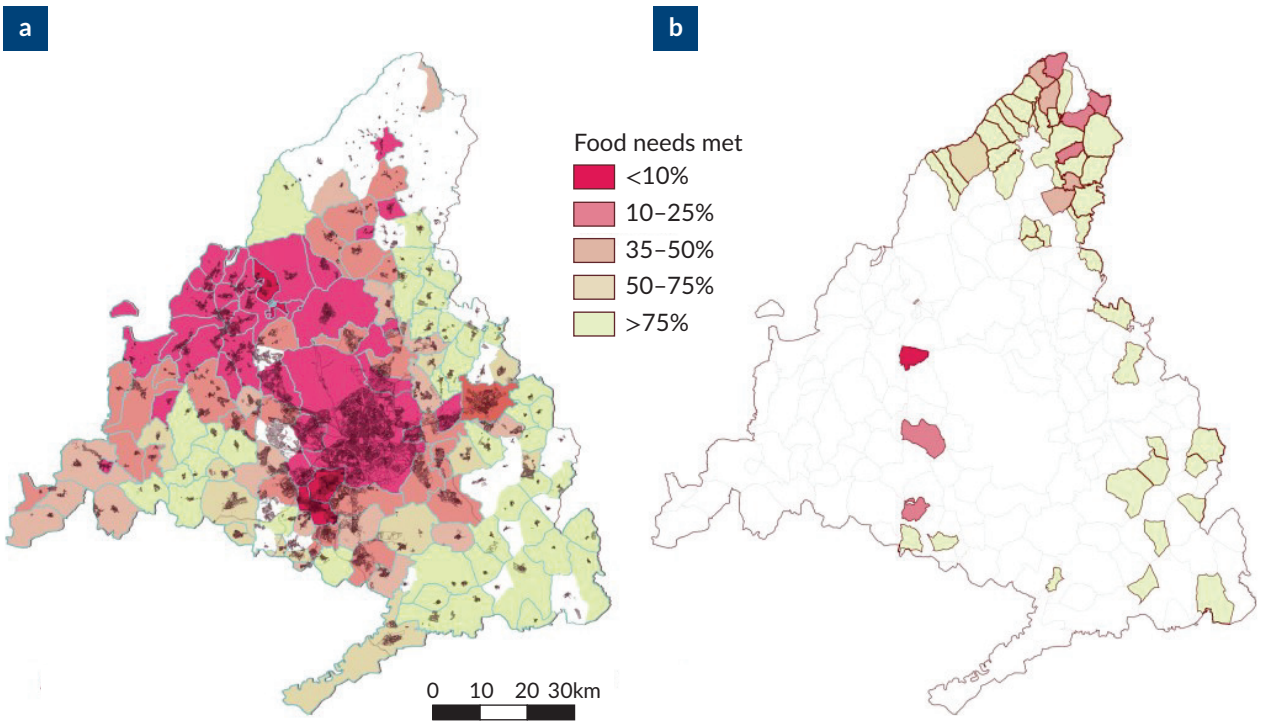


Figure 4. Food access through itinerant outdoor markets (scenario of current pulse consumption patterns and proximity priority for supply): (a) Municipalities with one or more weekly open markets and (b) municipalities with no open market. Source: Elaborated by the authors based on Infosierrademadrid (2025).

et al., 2021; Lamine et al., 2023). The number of people that can be fed does not change, but the area that must be covered by food from outside, with all the transport and logistical implications, is reduced.

These findings have three possible implications for territorial governance, food system policy, and rural and urban planning: (a) the spatial requirements for pulse production coherent with the recommended healthy diet; (b) the territorial reorganization to facilitate short supply chains; and (c) the potential consequences of such a reorganization if incorporated into sectoral policies. First, the results suggest that ways of improving productive capacity in order to meet food needs should be explored. Previous studies explain the complementary opportunity offered by a dietary and agroecological transition (Aguilera & Rivera-Ferre, 2022). A dietary pattern that prioritizes lean meat and limits consumption to three to four servings per week (350 g) could significantly reduce the amount of land currently devoted to feed production—mainly fodder and cereals—used in intensive livestock systems. This shift in demand would allow extensive cropland to be redirected towards the production of food for direct human consumption. However, previous research has shown that this is not applicable in Madrid, where local production capacity, dedicated to extensive livestock farming, only covers 5.4% of dairy and meat needs (Álvarez del Valle, 2017).

The hypothesis that more agricultural land would become available because it would no longer be needed for growing animal feed proved false. However, other alternatives emerge: Recognizing the strategic importance of currently underutilized or abandoned agricultural land is one of the steps to boost productive capacity. The concentration of production, the structural marginalization of rural areas, and market dynamics oriented towards urban centers are driving the abandonment of agricultural land (Schuh et al., 2020). However, a significant proportion of these areas still have soil and ecological conditions suitable for agricultural

production, making them viable candidates for recovery through agro-ecological approaches (Simón Rojo et al., 2021). Revitalizing these underutilized areas could contribute not only to strengthening food security and diversifying production but also to revitalizing rural economies by creating decent jobs, supporting population maintenance, and preserving agricultural landscapes (Stefanovic & Agbolosoo-Mensah, 2023). Given the aging population and the lack of generational renewal, an additional concern is who will live and farm in rural areas. The Madrid Regional Government is aware of this problem and has a Revitalization Plan (Comunidad de Madrid, 2025), which includes a strategic pillar aimed at incorporating young people through subsidy programs. While it is interesting to note that the agroecological sector has a lower average age of farmers, it requires specific support policies. These policies include public investment in infrastructure and equipment to provide complementary services to production and facilitate logistics (Simón Rojo, 2022), a measure that the plan already mentions concerning livestock farming and is directly linked to the following idea of territorial re-organization. Secondly, place-based approaches and short supply chains to connect production and consumption in rural areas imply territorial restructuring (Winarno et al., 2020).

The creation of food hubs serving agricultural districts—providing logistics services and aggregating production to create a commercial offer of proximity—would be an interesting avenue for development that has yet to be pursued. Without them, the concept of boosting local production remains theoretical, as most of the necessary facilities and equipment for storage, processing, and delivery are lacking. Establishing healthy food environments, of which safe food is an essential component (Grace, 2016), depends on realigning priorities and addressing the deficiencies in essential components. Nevertheless, the Participatory Local Development Strategies 2023–27 in the region of Madrid (ARACOVE, 2025), while mentioning the diversification of marketing channels and the promotion of short channels, do not specifically mention the distribution model.

Thirdly, it should be mentioned that the local consumption model will not work if it is not profitable for small retailers and traveling merchants. In this sense, a major problem with local sourcing is the low turnover typical of rural areas and the consequent loss of food quality. This is one of the main reasons (along with price) for the preference for out-shopping: "Out-shopping can negatively affect the local rural economy, as revenues shift from local to outside businesses, whereas money that is spent in the local area can provide an economic multiplier effect and help sustain an area's economy" (Bardenhagen et al., 2017, pp. 10–11). Faced with the need to look for alternatives, public policies could draw on other elements typical of the cultural context, such as bars and bar-shops. They already serve as supply spaces and could expand their functions in rural contexts. Just as there is the concept of social agriculture with its support programs, there would be social retail (social bars) with its own lines of financing, creating a virtuous circle (Dias et al., 2021).

Finally, shaping a healthy food environment requires a comprehensive approach that goes beyond consumption, encompassing the entire system. The Communities of Care project in six rural Spanish municipalities identified access to health, social, and commercial services, especially food and medicines, as one of the main problems of the aging population. The institutional response is to provide transport services on demand to go to the health center or, in some cases, to buy food. This project proposed how to increase food autonomy through local spaces, such as a warehouse or shop that could host collective purchasing initiatives from consumer groups (Comunidades de Cuidados, 2022).

Home-delivered food programs for the elderly and people with complex dependency needs can contribute to strengthening the links between local production and consumption and generate local employment, supported by the social economy, through initiatives such as rural cooperatives of proximity services (Fajardo & Escribano, 2020) or community-supported agriculture initiatives such as ASDECOBA's Manos Verdes project, which produces, transforms, and distributes its products in rural areas. Public procurement can play a role in providing stability for farmers, boosting the articulation of the agroecological ones in the Region (Simón-Rojo et al., 2020).

In Brazil, the federal Food Acquisition Program and the National School Feeding Program are paradigmatic examples of the potential of programs of food public procurement and proactive policies "in providing market space for family farmers and to strengthen the position of the family farm sector" (Wittman & Blesh, 2017, p. 86).

5. Conclusion

The research is innovative in its approach, going beyond the urban-centric perspective commonly applied when assessing supply capacities concerning the needs of urban settlements. The innovative approach is implemented on three levels: (a) proximity supply is prioritized; (b) the scope of the food environment is expanded to consider not only the availability of food but also the origin and connection to the territory; and (c) a territorial lens is aimed to reconsider public policies to prioritize proximity supply as a way to build resilient food systems.

Results are conclusive: If production is consumed in the capital, less than 8% of the territory would be covered; if larger cities are left out of the equation, food requirements can be met by local production in 62% of the territory. Although only one food group (pulses) has been analyzed and the scope of the research needs to be extended, these findings already have strong policy implications. Moving towards a more resilient and healthier food environment requires re-orientation, an interweaving of food policies with social, development, and agricultural policies. Policies should be translated into strategic activation of facilities, backed up with specific public measures.

Funding

This research was supported by Surcos Urbanos's project "Urbanismo y ordenación del territorio en la transición hacia sistemas alimentarios relocalizados (Urbanism and land use planning in the transition towards relocalized food systems)." We acknowledge cooperation from [URB_inT] Strategies for the ecosocial transition of large Spanish urban areas in a context of climate crisis and resource scarcity (PID2021-126190OB-I00), funded by Ministerio de Ciencia, Investigación y Universidades, Gobierno de España.

Conflict of Interests

The authors declare no conflict of interests.

Data Availability

The database on food needs and provision, detailed at the municipal level, can be found here: https://doi.org/10.21950/CCF03Y. Further inquiries can be directed to m.simon@upm.es.

References

ADL Sierra Oeste de Madrid. (2025). *Estrategia de desarrollo local participativo. Periodo 2023–2027*. https://www.sierraoeste.org/estrategia-23-27

Aguilera, E., & Rivera-Ferre, M. G. (2022). *La urgencia de una transición agroecológica en España. Análisis de escenarios, estrategias e impactos ambientales de la transformación del sistema agroalimentario español*. Amigos de la Tierra.

Álvarez del Valle, L. (2017). Alimentación de proximidad. Territorializaciones posibles de una alianza entre los mercados municipales y el territorio agrario periurbano de Madrid. *Territorios en Formación*, *2017*(12), 3–24. https://doi.org/10.20868/tf.2017.12.3645

ARACOVE. (2025). *Estrategia de desarrollo local participativa 2023–2027*. https://www.aracove.com/docs/EDL/EDL2023-2027/EDLP_ARACOVE_Consolidada_final_V04.pdf

Bardenhagen, C. J., Pinard, C. A., Pirog, R., & Yaroch, A. L. (2017). Characterizing rural food access in remote areas. *Journal of Community Health*, *42*, 1008–1019.

Bridle-Fitzpatrick, S. (2015). Food deserts or food swamps?: A mixed-methods study of local food environments in a Mexican city. *Social Science & Medicine*, *142*, 202–213.

Camarero, L. A., Cruz, F., González, M., del Pino, J., Oliva, J., & Sampedro, R. (2009). *La población rural en España. De los desequilibrios a la sostenibilidad social*. Fundación La Caixa.

Caon, L., Vargas, R., & Wiese, L. (2016). *Soils and pulses: Symbiosis for life*. FAO. https://openknowledge.fao.org/server/api/core/bitstreams/083a0b41-703e-4977-b50f-6cf870d22538/content

Comunidad de Madrid. (2025). *Plan de dinamización del sector primario en la Comunidad de Madrid*. cma-ma-plan-dinam-sector-prim-cm.pdf

Comunidades de Cuidados. (2022). *Diagnóstico social en materia de cuidados, envejecimiento y dependencia del municipio de Maranchón*. https://comunidadesdecuidados.org/wp-content/uploads/2023/01/INFORME-DIAGNOSTICO-MARANCHON-Enero23-1.pdf

Cooksey-Stowers, K., Schwartz, M. B., & Brownell, K. D. (2017). Food swamps predict obesity rates better than food deserts in the United States. *International Journal of Environmental Research and Public Health*, *14*(11), 1366.

Córdoba Hernández, R., & Camerin, F. (2023). Assessment of ecological capacity for urban planning and improving resilience in the European framework. *Cuadernos de Investigación Geográfica*, *49*(2), 119–142. https://doi.org/10.18172/cig.5638

Córdoba Hernández, R., & Camerin, F. (2024). The application of ecosystem assessments in land use planning: A case study for supporting decisions toward ecosystem protection. *Futures*, *161*, 103399. https://doi.org/10.1016/J.FUTURES.2024.103399

Córdoba Hernández, R., & Morcillo Álvarez, D. (2020). Marco territorial de la producción de espacio en la región funcional de Madrid. *Ciudades*, *23*, 71–93. https://doi.org/10.24197/CIUDADES.23.2020.71-93

Dias, R. S., Costa, D. V., Correia, H. E., & Costa, C. A. (2021). Building bio-districts or eco-regions: Participative processes supported by focal groups. *Agriculture*, *11*(6), 511.

Fajardo, G., & Escribano, J. (Eds.). (2020). *Despoblamiento y desarrollo rural. Propuestas desde la economía social*. CIRIEC-España, Centro Internacional de Investigación e Información sobre la Economía Pública, Social y Cooperativa.

Grace, D. (2016). *Influencing food environments for healthy diets through food safety*. FAO.

Habib, S. H., & Saha, S. (2010). Burden of non-communicable disease: Global overview. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *4*(1), 41–47.

Infosierrademadrid. (2025). *Los mercadillos más populares que hay hoy en los pueblos de Madrid*. https://www.infosierrademadrid.es/mercadillos-pueblos-de-madrid

Jensen, P. D., & Orfila, C. (2021). Mapping the production-consumption gap of an urban food system: An empirical case study of food security and resilience. *Food Security*, *13*(3), 551–570.

Lamine, C., Pugliese, P., Barataud, F., Berti, G., & Rossi, A. (2023). Italian biodistricts and French territorial food projects: How science-policy-experience interplays shape the framings of transitions towards sustainable territorial food systems. *Frontiers in Sustainable Food Systems*, *7*, 1223270.

Lázaro, A., & Pato, F. J. T. (2017). Las legumbres en la tradición de Madrid. In A. Lázaro, I. Goñi, A. Redondo, & C. De Lorenzo (Eds.), *Legumbres: Salud sostenible* (pp. 31–45). IMIDRA.

Lebel, A., Noreau, D., Tremblay, L., Oberlé, C., Girard-Gadreau, M., Duguay, M., & Block, J. P. (2016). Identifying rural food deserts: Methodological considerations for food environment interventions. *Canadian Journal of Public Health*, *107*, eS21–eS26.

Ministerio de Consumo. (2022). *Recomendaciones dietéticas saludables y sostenibles complementadas con recomendaciones de actividad física para la población española*. https://www.aesan.gob.es/AECOSAN/docs/documentos/nutricion/RECOMENDACIONES_DIETETICAS.pdf

Morán Alonso, N., Viedma Guiard, A., Simón Rojo, M., & Córdoba Hernández, R. (2025). Agricultural land suitability analysis for land use planning: The case of the Madrid Region. *Land*, *14*(1), 134. https://doi.org/10.3390/land14010134

Observatorio de la Sostenibilidad. (2016). *25 años urbanizando España: La generación que duplicó la superficie urbana*. https://docplayer.es/73666875-25-anos-urbanizando-espana-la-generacion-que-multiplico-la-superficie-artificial-de-una-forma-insostenible-urb16.html

Payen, F. T., Evans, D. L., Falagán, N., Hardman, C. A., Kourmpetli, S., Liu, L., Marshall, R., Mead, B.R., & Davies, J. A. (2022). How much food can we grow in urban areas? Food production and crop yields of urban agriculture: A meta-analysis. *Earth's Future*, *10*(8), e2022EF002748.

Pingault, N., Caron, P., Kalafatic, C., Allahoury, A., Fresco, L. O., Kennedy, E., Khan, M., Kliksberg, B., Mei, F., Murphy, S., & Zurayk, R. (2017). *Nutrition and food systems*. Committee on World Food Security.

Ramos Truchero, G. (2015). El acceso a la alimentación: El debate sobre los desiertos alimentarios. *Investigación y Desarrollo*, *23*(2), 391–415. https://doi.org/10.14482/indes.23.2.6970

Ramos Truchero, G. (2020). Dinámicas de abastecimiento alimentario en las zonas rurales españolas: Resolviendo la comida diaria cuando faltan las tiendas. *Panorama Social*, *31*, 87–100.

Schreiber, K., Hickey, G. M., Metson, G. S., Robinson, B. E., & MacDonald, G. K. (2021). Quantifying the foodshed: A systematic review of urban food flow and local food self-sufficiency research. *Environmental Research Letters*, *16*(2), 023003. https://doi.org/10.1088/1748-9326/abad59

Schuh, B., Dax, T., Andronic, C., Derszniak-Noirjean, M., Gaupp-Berghausen, M., Hsiung, C. H., Münch, A., Machold, I., Schroll, K., & Brkanovic, S. (2020). *The challenge of land abandonment after 2020 and options for mitigating measures*. European Parliament Policy Department for Structural and Cohesion Policies.

Simón Rojo, M. (2022). *Planeamiento urbanístico de sistemas alimentarios agroecológicos*. Red de Municipios por la Agroecología. https://oa.upm.es/76624/1/GuiaUrbanismo-Sistemas-Agroecologicos_b.pdf

Simón Rojo, M., Parra, D., Morán Alonso, N., Córdoba Hernández, R., de Labra López, E., Godín, A., Martínez Núñez, L., Redondo, R., & Sota, R. (2021). *Suelos agrarios abandonados en el Área Metropolitana de Madrid y estrategias de recuperación*. Instituto Juan de Herrera. https://oa.upm.es/69118

Simón-Rojo, M., Couceiro, A., del Valle, J., & Fariña Tojo, J. (2020). Public food procurement as a driving force for building local and agroecological food systems: Farmers' skepticism in Vega Baja del Jarama, Madrid (Spain). *Land*, *9*(9), 317. https://doi.org/10.3390/land9090317

Stefanovic, L., & Agbolosoo-Mensah, O. A. (2023). Biodistricts as a tool to revitalize rural territories and communities: Insights from the biodistrict Cilento. *Frontiers in Sustainable Food Systems*, *7*, 1267985.

Subsecretaría de Agricultura, Pesca y Alimentación. (2023). *Encuesta sobre superficies y rendimientos de cultivos. Año 2023*. MAPA. https://www.mapa.gob.es/dam/mapa/contenido/estadisticas/temas/estadisticas-agrarias/2.agricultura/1.-encuesta-sobre-superficies-y-rendimientos-de-cultivos--esyrce/2023/boletin20231.pdf

Tiemblo, T., & Pita, M. (2023). Análisis de la contribución del patrimonio cultural inmaterial al desarrollo sostenible en la Comunidad de Madrid. In D. Rejano Peña & M. Beltrán (Eds.), *Patrimonio inmaterial y sostenibilidad. Tradición, cultura y legado en la Comunidad de Madrid* (pp. 12–39). Subdirección General de Patrimonio Histórico; Comunidad de Madrid.

Winarno, H., Perdana, T., Handayati, Y., & Purnomo, D. (2020). Food hubs and short food supply chain, efforts to realize regional food distribution center. *International Journal of Supply Chain Management*, *9*(3), 338–350.

Wittman, H., & Blesh, J. (2017). Food sovereignty and *Fome Zero*: Connecting public food procurement programmes to sustainable rural development in Brazil. *Journal of Agrarian Change*, *17*(1), 81–105. https://doi.org/10.1111/joac.12131

Zimmerer, K. S., Olivencia, Y. J., Rodríguez, L. P., López-Estébanez, N., Álvarez, F. A., Olmo, R. M., Ochoa, C. Y., Pulpón, Á. R. R., & García, Ó. J. (2022). Assessing social-ecological connectivity of agricultural landscapes in Spain: Resilience implications amid agricultural intensification trends and urbanization. *Agricultural Systems*, *203*, 103525. https://doi.org/10.1016/j.agsy.2022.103525

About the Authors

Marian Simón-Rojo is an associate professor in the Department of Urban Planning and Land Management (ETSAM, UPM, Spain). She combines academic and applied research work with strong engagement in local social movements. She focuses on urban ecology and land use planning, just and resilient agri-food systems, and agroecology.

Nerea Morán Alonso is an associate professor in the Department of Urban Planning and Land Management (ETSAM, UPM, Spain). She has participated in projects and networks related to agri-food systems, sustainability, and urban and territorial resilience. Her research interests lie in the domains of urban renaturalization, food planning, and the bioregional perspective.

Rafael Córdoba Hernández is an associate professor in the Department of Urban Planning and Land Management (ETSAM, UPM, Spain). He mainly focuses on urban planning processes, space regeneration, and public land use policies. He incorporates both technical-scientific analysis with multi-stakeholder cooperation to promote innovative and socially inclusive urban models.

Araceli Serrano-Pascual is a sociologist and professor of social research methods and techniques at UCM, Spain. Her research focuses on the study of poverty and social exclusion as well as on public policies targeting these problems. In her teaching, she is developing collaborative learning programs in the field of food justice.