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► To cite this version:

Brigitte Nougaredes, Romain Melot, Laurie Vanel, Myriam Campardon, Roy Hammond, et al.. Do planning practices hinder on-farm diversification in peri-urban Mediterranean France?. Land Use Policy, 2024, 147, 16 p. 10.1016/j.landusepol.2024.107361 . hal-04843272

HAL Id: hal-04843272

<https://hal.science/hal-04843272v1>

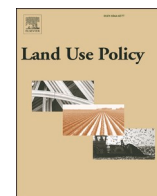
Submitted on 18 Dec 2024

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Do planning practices hinder on-farm diversification in peri-urban Mediterranean France?

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ARTICLE INFO

Keywords:

Agriculture
Farm buildings
Building permit
Farmland conversion
Rural planning
Multifunctionality

ABSTRACT

At the crossroads of spatial planning and agriculture, this article explores how planning practices impact on-farm diversification strategies in peri-urban Mediterranean France. It focuses on farm building permit applications, statistically analyzing a database of 860 buildings applied for and interviewing local authorities and farmers' representatives. Results show the large proportion of applications related to reterritorialization of food systems, development of recreational activities, and production of green energy. These on-farm diversification trends highlight the transformation of peri-urban areas from a natural or agricultural landscape into a multifunctional landscape, posing several planning challenges. Planners don't know how to assess whether a new building is really essential for farming, or to find the right trade-offs to support farming dynamics while limiting soil sealing. Their assessment criteria generally favor large, full-time, and economically viable farms. Comparing two provinces' planning practices, we observe significant differences in interpretation of national law, with incoherent or unharmonized criteria applied especially when assessing professional farming activities, new dwellings, and solar energy projects. We also highlight two potential obstacles to farmers' generational renewal and agroecological or food transitions: i) lack of transparency regarding the rules and the decision-making processes behind building permit assessment, and ii) the frequent rejection of applications for multi-purpose premises and lightweight, mobile, or dismantlable structures. Such results point to the role of planners in transforming peri-urban landscapes and the need for more consistent regulation of new farm buildings, supporting and not hindering farm adaptation strategies and the multifunctionality of peri-urban areas.

1. Introduction

This article explores how planning practices impact on-farm diversification strategies in peri-urban Mediterranean France. The issue is at the crossroads of spatial planning and agriculture.

In spatial planning, it is key to the debate on how current European planning systems can deal with the complex processes of transformation to come (Koreman and Korthals Altes, 2023), with the peri-urban landscape transforming from a natural or agricultural production landscape into a residential, service, and, in some cases, even knowledge-based economy (Andersson et al., 2009). Peri-urban areas are often characterized by a complex entanglement of land uses and a diversity of development patterns (Gallent, 2006). This is particularly challenging for spatial planning policies, traditionally aimed at more

dense territories (Randolph, 2004) with delineation of zones intended for a specific and homogeneous type of use or development (Tassinari et al., 2013). Moreover, scholars have shown that planning instruments are not only technical guidelines, but also the long-term result of competing interests within the local land system (Gerber et al., 2018). Similarly, legal sociologists conducting empirical inquiries on environmental planning (Van Dijk and Beunen, 2009) or farmland planning (Holtslag-Broekhof et al., 2014) stress that planning regulations are embedded in social interactions. How planning decision-makers actually consider agricultural interests has been investigated (Nichol, 2003; Wachter and Wytzens, 2022). In France, public authorities in charge of issuing planning permits in agricultural areas face complex trade-offs, especially in peri-urban areas. While they must avoid landscape degradation and further soil sealing, new buildings may be essential to

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<https://doi.org/10.1016/j.landusepol.2024.107361>

Received 26 October 2023; Received in revised form 26 June 2024; Accepted 10 September 2024

Available online 20 September 2024

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farming, food system reterritorialization, or on-farm diversification (Rouquier et al., 2023; Nougariès et al., 2023). The need for more renewable energy sources (photovoltaics, methanization) is also leading to new building applications (Goldberg, 2023). Issuing building permits in peri-urban agricultural areas can become a real challenge for local planning authorities, more used to assessing building permits for residential and urban infrastructures than for farm buildings.

In agricultural research, the impact of planning regulations on on-farm diversification is an issue in the long-running debate on the conditions for maintaining agriculture in peri-urban areas (Bryant, 1986; Bryant and Johnston, 1992). The literature has principally addressed authorization of new farm buildings in terms of their impact on farmland conversion (Perrin et al., 2020). Scholars have described how agricultural modernization led to increased size and standardization of farm buildings (Schmitt, 2003; Madeline, 2006; Tassinari et al., 2007). Architects evaluated the quality of the new buildings (Torreggiani and Tassinari, 2012; Dąbkowski et al., 2018), their integration into the landscape (di Fazio, 1989; Tassinari et al., 2007), and their interactions with the rural environment (Picuno, 2022). Only a few studies, however, have explored how the spatial planning regulatory framework may impact peri-urban farms' activities. Strict regulations have been shown to favor hobby farming at the expense of commercial farming (Gosnell et al., 2011; Perrin, 2013). The impact on on-farm diversification has rarely been considered (Nichol, 2003).

Scholars have highlighted the multiple benefits of on-farm diversification to help farmers adapt in peri-urban areas (Ilbery, 1991; Inwood and Sharp, 2012). Under on-farm diversification, we consider new activities, including i) new food products (for instance, when a market gardener decides to produce poultry), ii) the integration of on-farm processing and conditioning of products, distribution hubs, and on-farm shops for relocation of food systems, and iii) "non-farming farm-based and -related activities" (Tacconi et al., 2022, referring to van der Ploeg et al., 2009) such as agritourism, educational and recreational services, and bio-energy production. Most of these activities require indoor space to develop, yet this is not mentioned among the constraints listed in a recent review on on-farm diversification (Tacconi et al., 2022). In peri-urban areas, this may be an issue. Land and real estate prices are high, due to the demand for land and buildings by non-farmers (Verhoeve et al., 2015). The frequent conversion of farms and barns into housing is documented (Perrin et al., 2018), as well as the commercial and entrepreneurial re-use of vacant, redundant farm buildings in Flanders (Verhoeve et al., 2012), the Netherlands (van der Vaart, 2005; Koreman and Korthals Altes, 2023), or Denmark (Kristensen et al., 2019). Architects point out that diversification strategies may help to preserve old farm buildings as rural cultural heritage (Fuentes et al., 2010; Branduini et al., 2020). However, there appears to be no recent research specifically addressing the impact of planning permits on on-farm diversification in peri-urban areas. Our hypothesis is that current planning practices may limit farmers' capacity to diversify their activities in peri-urban areas.

To address this question, we considered 571 building permit applications in southern France, corresponding to 860 buildings applied for in peri-urban agricultural areas. We performed multiple correspondence analysis (MCA) followed by hierarchical ascending clustering (HAC). The results of this statistical approach were discussed during qualitative interviews with officials responsible for issuing building permits and representatives of farmers' organizations. Our method is original: to our knowledge, only one paper (Eveland et al., 2005) previously analyzed a large database of farm building permits to elucidate the trend in construction of new farm buildings at a territorial scale.

The paper is organized as follows: in the next section, we describe the context, materials, and methods. In the results section, we first present a typology of building permits highlighting the major trends in construction in peri-urban agricultural areas. Then we compare what drives two provinces' public decisions on building permits in agricultural areas. In the fourth section, we discuss the significance of our results in

the light of several key issues currently on the European political agenda concerning soil sealing, urban-rural reconnection, and the renewal of farming generations. This suggests new avenues for research on planning that takes into account the multifunctionality of peri-urban agricultural areas.

2. Context, materials, and methods

This section presents the geographical context, the legal framework, and the methods of our study.

2.1. French Mediterranean countryside under urban and tourism pressure

The study site is located on the French Mediterranean coast (Fig. 1), covering two provinces (*départements*, NUTS3 European administrative unit¹) called Bouches-du-Rhône (BDR) and Hérault. Around Marseille and Montpellier respectively, both provinces have experienced rapid demographic growth over the last 50 years, especially Hérault, where the population has doubled (Table 1). Such growth is mainly due to work and amenity migrations from other French regions. Around many villages, the urban envelope has become fuzzy, with no clear spatial delineation between housing and farmland (Perrin et al., 2018). The French Mediterranean countryside is historically marked by strong urban sprawl and scattered buildings, to the detriment of vineyards and market gardening, the two main farming systems in the coastal plain (Abrantes et al., 2010; Jarrige et al., 2013). Most of the two provinces is considered urban and peri-urban by the national statistical institute INSEE in 2024 (cf. Fig. 1). The few municipalities still categorized as "rural" and left blank on the map are facing similar pressure on farmland, due to secondary homes and lifestyle migrations.

In Hérault, grape monocropping still occupies most agricultural areas and 84 % of farms (Table 1), but uprooted vineyards have left space available for the diversification of production (cereals, vegetables). In BDR, agriculture is very dynamic and more diversified, with a majority of farms growing fruits, vegetables, or wine grapes. Farms are larger in BDR, 38 ha on average, and have more employees than in Hérault, where farms are 22 ha on average.

In both provinces, local spatial planning practices have been under pressure. Municipalities diverge in their choices, and there are disagreements between municipalities and provincial authorities over preservation of agricultural and natural areas (Chanel et al., 2014; Prévost and Robert, 2016). This has been attributed to high urban pressure on farmland: speculation by landowners and developers based on future possible conversion of farmland to urban (or tourism) uses, and non-farmers bargaining with local mayors to obtain building permits for houses, sometimes pretending to start a farm to obtain the permit (Perrin and Nougariès, 2022).

2.2. Legal framework for new farm buildings

The two provinces chosen for this study were the first in France with a multi-stakeholder advisory committee that wrote a guideline to local assessment of building permits in zones classified as agricultural under land-use plans.

In France, municipal or inter-municipal authorities are the main land-use planning authorities, under the supervision of provincial government representatives. The conversion of farmland to urban uses is regulated through binding municipal (or inter-municipal) land-use plans that distinguish development zones, agricultural zones (for exclusive farm use), and natural zones (where natural spaces must be preserved). Since 2000, the national law provides that, apart from buildings of public interest, the only new constructions authorized in agricultural

¹ France is divided into 13 regions (NUTS2) composed of 101 provinces (*départements* NUTS3) and 34 955 municipalities.

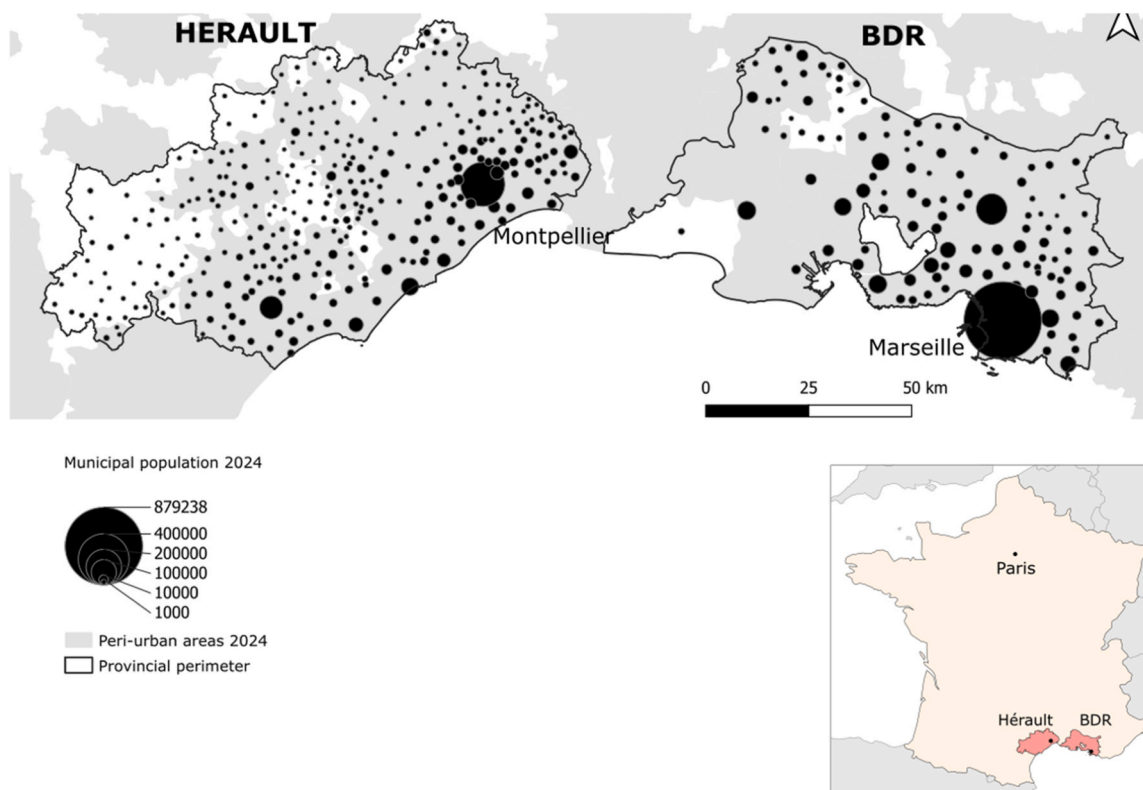


Fig. 1. Location of the two provinces (data sources: INSEE for population 2024 and for peri-urban areas 2024, IGN for administrative perimeters). At this mapping scale, urban areas are covered by the black circles of municipal population. Rural areas are left blank.

zones are “buildings and structures or facilities required for farming” or “for the processing, packaging and marketing of agricultural products, where these activities are an extension of the production process”². This includes horse-breeding and methanization units (with some limitations³). However, the law does not precisely define “farm,” or “farm buildings”, nor explain how to assess the building’s “essential” link to the agricultural activity when handling building permit applications.

The law’s implementation has thus often been subject to local negotiations, leading to a diversity of interpretations—such as specific local criteria that must be met before a farmer is allowed to build a dwelling (Perrin and Nougariès, 2022). Many provinces set up committees composed of the provincial authority, one mayor representing all the municipal authorities, and farmers’ representatives to negotiate local implementation of the law. These multi-stakeholder committees wrote provincial guidelines for local assessment of building permit applications in agricultural zones. The two first provinces where such committees were established and wrote guidelines were BDR in 1973 (Perrin, 2015) and Hérault in 2005 (Perrin and Nougariès, 2022). Half the French provinces had such informal multi-stakeholder committees by 2010 (Nougariès, 2020), when the national government decided to

create more formal committees in every province under the responsibility of the provincial authority. These formal regulatory committees monitor the compliance of municipal and inter-municipal planning decisions with national laws and with provincial guidelines, if any. They meet every month and assess both planning documents and a small share of the applications for building permits in agricultural areas. In some provinces, like BDR, the former informal multi-stakeholder committee nevertheless continues to meet in order to give an informal legal opinion on almost all applications for building permits in agricultural areas. The formal committee and local planning authority generally follow this advice, which is accompanied by a short statement of reasons, when deciding whether or not to issue the permit.

2.3. Materials and methods

This paper is based on mixed methods. Its originality lies in the quantitative approach, rarely conducted on farm building permits (Eveland et al., 2005). A complementary qualitative approach based on document analysis, observation, and a small range of interviews helps us interpret the results of the quantitative approach, shedding light on how the provincial committees operate and justify their legal opinions on building permit applications.

2.3.1. Quantitative analysis of a database of building permits

2.3.1.1. Data collection. Obtaining precise data on planning permission in agricultural areas, on legal opinions, and on the rationale behind them is a real challenge. The two committees considered here were the only ones that agreed to share their data with us, in paper-only (not digital) format. Despite repeated requests, we could not obtain more recent data.

Thus, our sample contains only planning permission applications in agricultural areas (for new buildings or the transformation of existing

² Code de l’Urbanisme, art. L151–11.

³ According to *Article du code rural et de la pêche maritime*, “all activities involving the control and exploitation of a biological cycle of a plant or an animal, and constituting one or more stages necessary to the unfolding of this cycle, as well as activities carried out by a farmer which are an extension of the act of production, or which take place on the farm, are deemed agricultural. (...) The same applies to activities involving the preparation and training of domestic equidae (...), with the exception of entertainment activities. The same applies to the production and, where applicable, marketing, by one or more farmers, of biogas, electricity, and heat through methanization, when at least 50 % of this production is derived from materials originating from farms.” (our translation).

Table 1

Key statistical data on population and agriculture in the two provinces (data sources: Ministry for Agriculture 2010 and 2020 and INSEE for population 1975 and 2024).

	Hérault	Bouches-du-Rhône
Population 2024	1 232 800	2 078 400
Population 1975	648 000	1 630 000
(growth rate in 50 years)	(+90.2%)	(+27.5%)
Number of farms 2020	7 900	3 900
2010	9 900	4 900
(growth rate)	(−20.5%)	(−20.2%)
Utilized agricultural area in ha, 2020	175 800	148 600
2010	185 200	145 700
(growth rate)	(−5%)	(+ 1.9%)
Main type of production (percentage of farms featuring this production in 2020)	Viticulture 84%	Fruit 38%
	Fruit 16%	Vegetables 30%
	Vegetables 6.5%	Viticulture 22%
	Cereals 7%	Cereals 15%
		Sheep or goats 5%

buildings). This planning permission subsample is almost exhaustive in BDR but partial in Hérault, due to the differing nature and functions of the two committees. In BDR, the data came from the multi-stakeholder advisory committee, which receives 95 % of planning permit applications located in agricultural areas (in agricultural zones for municipalities with a valid land-use plan, outside urban areas for municipalities without a valid land-use plan). In Hérault, the data was collected from the formal regulatory committee, which receives and assesses only a small share (around 10 %) of applications in agricultural areas (only in municipalities with specific environmental issues, like coastal areas, or without a valid municipal land-use plan). The BDR sample is therefore much larger and more representative of all municipalities than the Hérault sample. In BDR, we obtained 492 applications (covering 742 buildings) located in 77 (out of 119) municipalities, submitted from March 2017 to September 2018. In Hérault, we obtained 79 applications (covering 118 buildings), submitted from February to December 2018, located in 60 (out of 342) municipalities. These were mainly small peri-urban or rural municipalities under tourism pressure; the more densely-populated localities usually have valid land-use plans, and hence do not need to send their farm building permit applications to the Hérault formal regulatory committee.

For each building permit application, we had access to the applicant's professional status (full-time farmer, part-time, new entrant, non-farmer), the characteristics of the farm (type of production, location) and of the buildings applied for (future use, surface area, etc.). We were also provided with the arguments behind the positive or negative legal opinion given by the provincial committee. All these data were entered manually into a database, for descriptive and multivariate statistical analysis.

2.3.1.2. Statistical data analysis. Following a descriptive analysis, the information collected was used to perform a multivariate analysis and a hierarchical classification via the FactoMineR package (Lê et al., 2008; Husson et al., 2023) with R (v.4.3.1). The missMDA package (Josse and Husson, 2016) was used to impute missing data.

First, we performed a multiple correspondence analysis (MCA) for the 860 buildings involved, based on 5 variables retrievable from the building permit applications, all related to building characteristics: future use (6 categories), surface area (5 classes), type of application (new construction or transformation), presence of solar panels (yes/no), lightweight and dismantlable structures (yes/no). There were no missing values, except for surface area (n=38, 4.4 %). For future use and type of application, categories with small counts were agglomerated into macro-categories (cf. Table 2). The MCA was performed on these macro-

categories, and the detailed types of buildings used as supplementary variables (description of variables and categories in Appendix B). Included in supplementary variables (Appendix C) are the committee's opinion on the permit application (positive/negative) and other variables as descriptors concerning farm activities, based on the existing literature and relevant previous qualitative research by the research team (Nougariès, 2020; Perrin and Nougariès, 2022).

Second, the results of the MCA were used to perform hierarchical cluster analysis (HCA). The scree plot led us to select as HCA input variables the first 3 dimensions of the MCA, representing an inertia of 41.7 % (Blasius and Greenacre, 2014).

2.3.2. Qualitative approach combining document analysis, observation, and interviews

This research is also based on document analysis, direct observation of committee meetings and public exchanges, and in-depth interviews. We analyzed the following documents: national law⁴ and Hérault and BDR guidelines (GTUA, 2011; CDPENAF, 2018). In 2018, we conducted 8 in-depth semi-structured interviews with several members of the committees (one elected official and one provincial authority official in each province) and with representatives of farmers' organizations (Chamber of Agriculture in BDR, farmers' union in Hérault). In addition, we interviewed the president of the association of mayors in BDR and a municipal planning department employee in Hérault. These 8 interviews were aimed at better understanding the provincial context (urban pressure on farmland, agricultural dynamics), the negotiations regarding guidelines, the reasons behind decisions to approve or reject planning permission applications. They also sought to elucidate the relationships between provincial committees and the provincial authority, mayors, municipal or inter-municipal urban planning departments, and farmers' organizations. All interviews were recorded and transcribed. Discourse was analyzed according to the same analytical grid (local context, planning implementation, trends in applications for farm building permits, new types of buildings applied for and their assessment).

The discussion of the results is also informed by our long-term direct observation of the Hérault committee meetings (2006–2013, as part of PhD research) and other qualitative interviews in both provinces from 2004 to 2023 on issues related to farm buildings and farmland preservation conducted with farmers, elected officials, and farmers' organizations (Nougariès, 2020; Nougariès et al., 2023; Nougariès et al., n.d). This paper is the first to combine such qualitative results with quantitative data on building permits, and to reveal the explicit rationales provided by the committees to justify their legal opinions.

3. Results

3.1. Buildings applied for reveal several on-farm diversification trends

Table 2 shows the great diversity of future uses of the buildings applied for, pointing to several contradictory trends in peri-urban agricultural areas.

First, building permit applications reflect the provincial specialization of farming systems. Plastic tunnels and glass greenhouses combined account for 65 % of the surface area applied for in BDR, where market gardening dominates. Second, our results confirm the current trend toward diversification of agricultural production. Examples include applications for animal housing (14 %), evidence of new small-scale food livestock farming (poultry, pigs). Third, we find clear signs of farm diversification to include non-farming activities, with applications for

⁴ Loi relative à la solidarité et au renouvellement urbains n° 2000-1208

Table 2
Descriptive statistics for the analytic sample (n=860).

Future use of buildings applied for	Bouches-du-Rhône		Hérault		Total			
	N°	– surface area in m ²	N°	– surface area in m ²	N°, % of total n°		Surface area in m ² , % of total surface area	
Dwellings	186	27252	25	2823	211	24.5 %	30075	2.9 %
For the applicant	135	16057	22	2643	157	18.3 %	18700	1.8 %
For employees	31	3191	2	180	33	3.8 %	3371	0.3 %
Holiday accommodation / agritourism	20	8004	1	n.a.	21	2.4 %	8004	0.8 %
Storage and logistics	236	101849	32	5153	268	31.2 %	107002	10.1 %
Sheds and facilities for the storage of equipment and produce	214	100041	27	4236	241	28.0 %	104277	9.9 %
Service / technical facilities	22	1808	5	917	27	3.1 %	2725	0.3 %
Processing, packaging, offices, sales	142	59654	28	11329	170	19.8 %	70983	6.7 %
Vegetable processing	4	232	0	0	4	0.5 %	232	0.0 %
Meat processing	4	419	1	213	5	0.6 %	632	0.1 %
Cheese, dairy	3	304	0	0	3	0.4 %	304	0.0 %
Wine-making	9	3949	3	655	12	1.4 %	4604	0.4 %
Egg packaging	2	222	1	n.a.	3	0.4 %	222	0.0 %
Vegetable packaging	7	2967	2	49	9	1.1 %	3016	0.3 %
Oil mill	2	427	0	0	2	0.2 %	427	0.0 %
Honey processing	5	700	0	0	5	0.6 %	700	0.1 %
Multi-purpose premises	72	46251	15	9765	87	10.1 %	56016	5.3 %
Sales and reception	13	1779	2	280	15	1.7 %	2059	0.2 %
Offices	21	2404	4	367	25	2.9 %	2771	0.3 %
Greenhouses for market gardening	58	681693	2	536	60	7.0 %	682229	64.7 %
Plastic tunnels	31	280530	1	96	32	3.7 %	280626	26.6 %
Glass greenhouses	27	401163	1	440	28	3.3 %	401603	38.1 %
Animal shelters	97	49342	22	4784	119	13.9 %	54126	5.1 %
Sheep	8	7962	4	633	12	1.4 %	8595	0.8 %
Cattle	2	642	1	120	3	0.4 %	762	0.1 %
Goats	1	530	0	0	1	0.1 %	530	0.1 %
Poultry	24	1287	12	3768	36	4.2 %	5055	0.5 %
Plastic tunnel used as animal shelter	2	570	2	160	4	0.5 %	730	0.1 %
Rabbits	1	99	0	0	1	0.1 %	99	0.0 %
Equines: stable, box	28	6165	2	18	30	3.5 %	6183	0.6 %
Equines: riding arenas	20	30389	0	0	20	2.3 %	30389	2.9 %
Dogs: kennels, nursery	11	1698	1	85	12	1.4 %	1783	0.2 %
Non-agricultural activities	23	104610	9	5937	32	3.7 %	110547	10.5 %
Collective gardens, animal parks	2	41794	0	0	2	0.2 %	41794	4.0 %
Fences, gates	3	n.a.	0	0	3	0.4 %	n.a.	0.0 %
Public facilities	4	3840	3	5723	7	0.8 %	9563	0.9 %
Ground elevation	4	57590	0	0	4	0.5 %	57590	5.5 %
Ground photovoltaics	0	0	2	9	2	0.2 %	9	0.0 %
Heat cogeneration, methanization	10	1386	0	0	10	1.2 %	1386	0.1 %
Industrial premises	0	0	1	114	1	0.1 %	114	0.0 %
Antennas, pylons	0	0	3	91	3	0.4 %	91	0.0 %
Total	742	1024400	118	30562	860	100.0 %	1054962	100.0 %

recreational activities (dwellings for agritourism, horse shelters, or riding arenas) and with 9 % of applications involving the production of green energy (solar panels,⁵ methanation units). Finally, we note a trend toward the reterritorialization of agri-food chains, reflected in applications for food processing, sales, as well as in the 10 % of applications for multi-purpose buildings combining several uses (e.g. offices, food processing, storage, sometimes housing).

The 5 clusters of buildings resulting from the MCA-HAC allow us to more finely identify major transformations underway in agriculture (cf. Appendix A, B, and C).

- Cluster 1 “dwellings” (n=226) is characterized by dwellings (90 % of the cluster) and by small buildings (less than 200 m²). It features many applications for the renovation, change of use or extension of existing buildings (38 % of this cluster). More than half its

⁵ Only ground photovoltaic are mentioned in Table 2, but solar panels can cover all types of buildings. The presence of solar panel on the roof is an active variable in the MCA (cf. Appendix B).

applications were given a negative opinion by the provincial committee, which is significantly more than in any other cluster.

- Cluster 2 “multi-purpose buildings” (n=326) is characterized by mid-size buildings (200–500 m²), especially storage facilities and multi-purpose premises combining several uses (processing units, offices, direct sales). The rate of positive opinions is 52.4 but is not significant.
- Cluster 3 “large buildings with solar panels” (n=140) is characterized by many applications to construct new large facilities (500–3000 m²) covered with solar panels. Although most are for storage sheds, there are also animal (sheep) shelters and horse-riding arenas. Most (67 %) of this cluster’s applications were assessed positively.
- Cluster 4 “small dismantlable structures” (n=99) is characterized by many applications for small (96 % < 100 m²), lightweight, and mobile or dismantlable structures (57 %), mainly animal shelters, for poultry or horses. A third of applications are by new entrant farmers. The rate of positive opinions is 55.6 but is not significant.
- Cluster 5 “greenhouses” (n=68) is characterized by applications for huge structures (71 % > 3000 m²), mainly by market gardeners for

Table 3
Rationales used in providing legal opinions.

Committee's rationales behind opinions, self-reported		Number of buildings for which this rationale is mentioned			
		Total n° (% of total n°)	positive opinion	negative opinion	No opinion given
The farm as a business					
Proof of existence of the farm	yes, with an agricultural project	464 (54 %)	377	67	20
	yes, with a non-agricultural project	124 (14 %)	6	104	14
	Lack of proof of existence of a farm	94 (11 %)	3	68	23
Applicant's status	Farmer	11 (1 %)	5	6	0
	Non-farmer	72 (8 %)	0	70	2
For new-entrant farmers	Economically viable project	40 (5 %)	36	1	3
	Non-viable project	28 (3 %)	0	28	0
For existing farms	Economically viable	39 (5 %)	36	1	2
	Not economically viable	84 (10 %)	0	78	6
	Age of farm	20 (2 %)	6	14	0
Justification for the building					
Necessity of the building for the operation or development of the farm	Necessity and suitability of the building for farming operations	378 (44 %)	359	7	12
	Not needed for farming operations	173 (20 %)	2	169	2
	Needed for the creation of a new workshop	18 (2 %)	16	0	2
	Safety, working conditions, and health standards	8 (1 %)	6	1	1
Necessity of the building for local dynamics	Decrease in population and risk of closure of a school.	9 (1 %)	2	6	1
Territorial impact					
Impact on the landscape	Architectural quality of the building	40 (5 %)	32	8	0
	Lack of landscape integration	26 (3 %)	2	24	0
	Compliance with specific standards in protected areas	32 (4 %)	19	11	2
Impact on soil sealing	Limited additional soil sealing	25 (3 %)	23	2	0
	Major additional soil sealing	22 (3 %)	0	22	0
Impact on farmland functionality	Limited new scattering of buildings	14 (2 %)	11	3	0
	Risk of scattering	46 (5 %)	11	30	5
Impact on the environment	Low environmental impact	7 (1 %)	7	0	0
	Risk of biodiversity reduction	10 (1 %)	3	7	0

greenhouses (plastic tunnels and glass greenhouses). Most of these applications were assessed positively (79 %).

These 5 clusters are thus differentiated primarily by building size and future use, while the presence of photovoltaic panels sets cluster 3 apart, and the lightweight or temporary nature of some of the buildings is specific to clusters 4 and 5. Descriptive statistics conducted on the supplementary variables (Appendix C) show significant differences. Committee opinions are significantly different for 3 classes in particular: negative for dwellings (C1), positive for large buildings with solar panels (C3) and for greenhouses (C5). For the remaining 2 classes, opinions are mixed but not significant in the HAC. We also note the large numbers of new farmers (31 %) in class C4, corresponding to lightweight, dismantlable structures, while full-time professional farmers are significantly over-represented in class C3 (photovoltaics).

Such results indicate the coexistence of different agricultural dynamics. Applications for the construction of large industrial farm buildings, such as greenhouses, storage facilities, sheds, and stalls, increasingly covered with photovoltaic panels, testify to highly productive farms in a process of (sometimes green) industrialization. In contrast, some applications attest to a new trend: applications for small, lightweight, and dismantlable buildings (photos 1, 2, 3, 4, 5, Appendix D), and for multi-purpose buildings. The numbers of such applications are rising, according to the committee officials we interviewed; they relate this trend to new farmers looking for affordable access to buildings, and to the reterritorialization of agri-food chains.

3.2. What drives public decisions on building permits in agricultural areas?

Of the 860 buildings under application in our database, 54 % were

given a positive opinion by the provincial committees, 39 % a negative opinion, and no opinion was reported on the remaining 7 %.⁶ We analyzed the reasons cited for such evaluations, and also compared how the different types of buildings were treated by the two provincial committees, as the rate of negative opinions is much higher in Hérault (52 %) than in BDR (37 %).

3.2.1. Opinions are mainly based on economic factors: farmer's status and farm size

The committees justify their legal opinion with a short text statement. We coded these justifications into categories to identify the main reasons for positive or negative opinions (Table 3).

National law authorizes in agricultural zones only “buildings and structures or facilities required for farming” or “for the processing, packaging, and marketing of agricultural products, where these activities are an extension of the production process”. However, the data collected on legal opinions show that the two committees in fact use a wide range of criteria to assess building permit applications. Some criteria are cited in the provincial guidelines; others are used as arguments by the committee in the files we consulted, although not explicitly appearing in the provincial guidelines. These results show that the provincial guidelines and committees go further than national legislation, using criteria that are not legally binding.

First, in line with national law, both provincial guidelines require proof that the new building is needed for the operation or development of the farm. No other building suitable for the same purpose must remain unused on the farm. The applicant must explain the function of the new

⁶ No opinion means either not reported in the files we collected or reported as postponed.

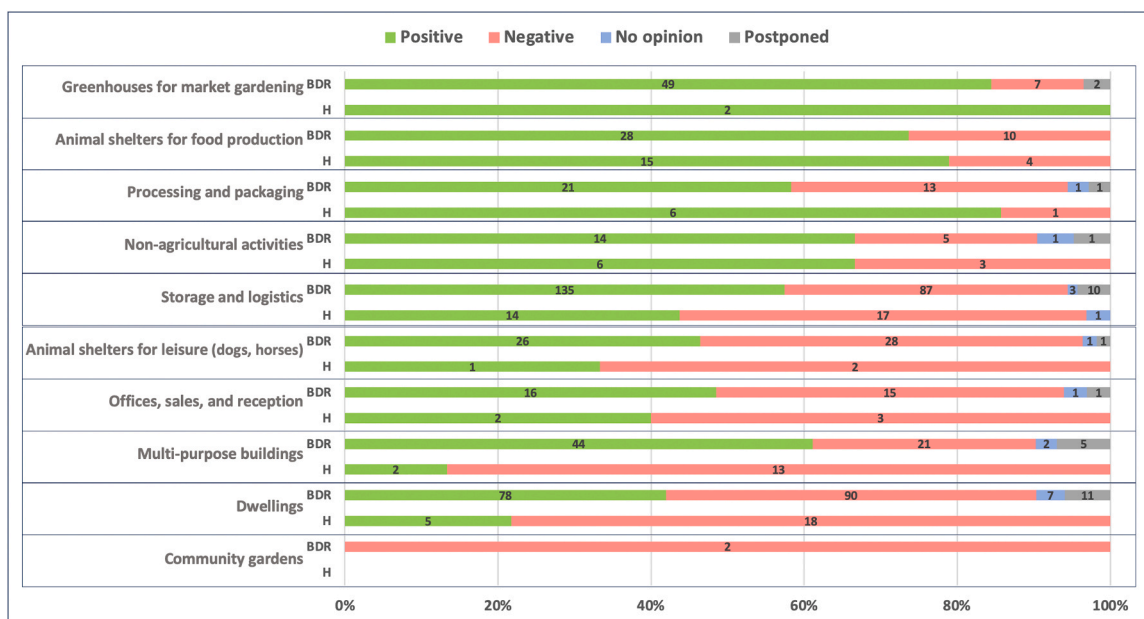


Fig. 2. Opinion given by the committees by type of building and province (BDR= Bouches-du-Rhône; H= Hérault) in total number of building permit applications and in percentage.

building through a business plan, and demonstrate the appropriacy of its size, to avoid oversized buildings. Such arguments are regularly used to reject building permit applications (cf. Table 3 below).

Second, the farmer’s status is used as a first proxy to assess the permanent character and the economic viability of the farm. Negative opinions of building permits are much more frequent when the applicant is not a professional farmer and when farming is not his or her main occupation. Opinions are negative for only 30 % of the 602 buildings applied for by full-time professional farmers, but 60 % of the 18 buildings applied for by part-time professional farmers, and 70 % of the 45 buildings applied for by hobby farmers, as well as 70 % of the 152 buildings applied for by new-entrant farmers.

These categories (full-time, part-time, hobby, new-entrant) are distinguished by the State to provide differentiated access to economic subsidies, the tax system, and social protection. Both committees consider them in the evaluation of farm building permit applications, even though national law does not limit authorization for new buildings to professional farmers. Committee members explained in interviews that such criteria are aimed at avoiding what they consider as non-essential buildings in agricultural areas, related to fake farming projects or recreational activities.

Third, in both provinces, farm size is also used as an indicator of the economic viability of the business. Both provincial guidelines require a minimum farm size (surface area farmed or quantity of livestock), based on a framework set yearly at provincial level, for each farming sector. However, committee members admit that such criteria may not be appropriate for new-entrant farmers. They also admit often lacking the agricultural knowledge and economic references required to adapt this criterion to specific types of production (such as snails, domestic rabbits, or aromatic and medicinal herbs) or to value-added production marketed through short food supply chains.

Many other criteria are also mentioned, as illustrated in Table 3 below. For new-entrant farmers, both guidelines additionally require a three-year business plan/forecast. The Hérault committee’s opinions cite a wider variety of rationales, such as land-take, urban sprawl, landscape integration, or environmental impact (especially on biodiversity).

3.2.2. Legal opinions vary according to type of building

In addition to applicant’s status, our data show that building type

drives provincial committees’ opinions (cf. Fig. 2). Applications are mainly for new buildings (73 % of permit applications, 56 % approved). In our database, only 10 % of applications are for a change of use of an existing building, for instance from a shed to housing (only 50 % approved), and 8 % are for the extension of existing buildings (61 % approved).

3.2.2.1. Building a new house easier in BDR. Dwellings are the most difficult to assess. To avoid non-farmers settling in agricultural zones, both committees use additional (non-legally-binding) criteria and give similar reasons for negative opinions: the non-farming status of the applicant, the non-viability of the farming project, the absence of clear agricultural activity, no clear proof of need for the new building for farming operations, or the impact on urban sprawl.

The Hérault committee is much more reluctant to give a positive opinion (only 2 houses approved out of 25 applications) than the BDR committee (47 % or 78 out of 170). In Hérault, guidelines are very strict: only one new dwelling can be applied for per farm, only after 3 years in operation and only linked to the supervision of wine processing or of livestock for food (not including chickens), on full-time professional farms. Hence, other farmers, such as market gardeners, cannot apply to build a house. A provincial authority official, also a member of the committee explains: “The presence of a dwelling on a farm induces a risk of sale to non-farmers and of further soil sealing, while farm buildings without dwellings are not attractive to non-farmers” (personal communication, May 11, 2018).

In BDR, the guidelines are much more flexible: new dwellings can be authorized for all professional farmers, as well as for permanent or seasonal employees or agritourism activities. The president of the BDR multi-stakeholder advisory committee explains: “sometimes, the BDR formal regulatory committee doesn’t agree with our opinion and rejects the building permit application. It’s often because they don’t have enough information. Once we give them additional information, they change their opinion” (personal communication, September 6, 2018). In BDR, members of the informal multi-stakeholder advisory committee sometimes visit the farms to check the actual need for a new dwelling before giving their opinion, while formal regulatory committees only assess written applications and never visit farms. This difference may partly explain why more building permit applications for houses were evaluated

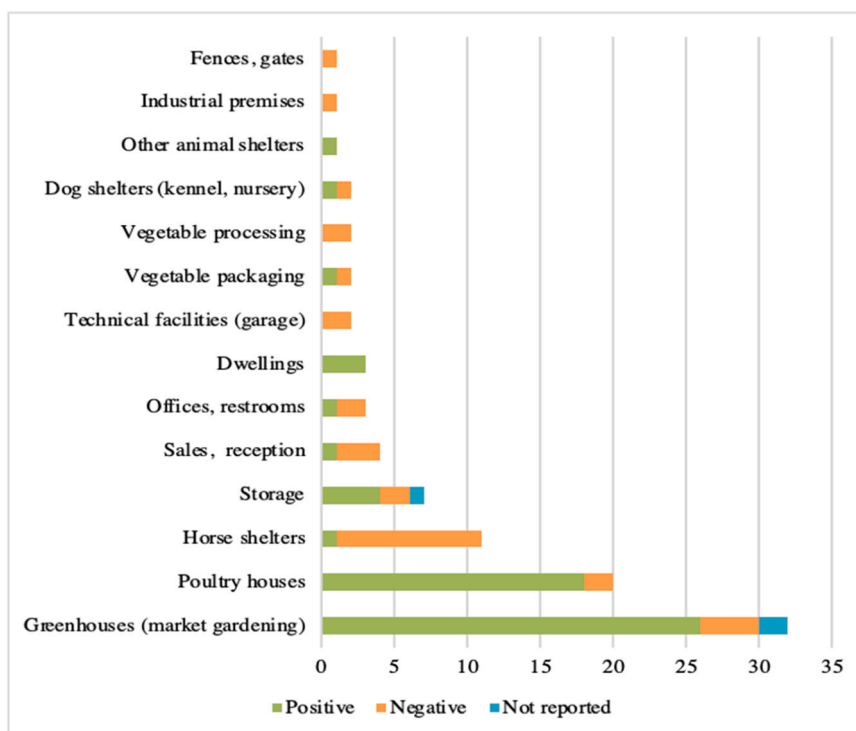


Fig. 3. Intended uses of lightweight, mobile, and dismantlable structures, with the committee’s opinion (positive, negative, or not reported).

Table 4
Key divergences between the 2 committees.

	BDR	Hérault
Guidelines	Flexible but the committee controls all building permit applications	Precise and restrictive but the committee controls only a small portion of applications (assessment is decentralized at (inter) municipal level)
Dwellings	Yes, for farmer or employees, and all types of farms	Max of 1 dwelling per farm, only for livestock or wine processing. Not allowed for market gardeners. Three years of farm existence
Photovoltaic panels	Yes, on farm buildings or on the ground	Only on rooftops, building size must be consistent with its use

negatively by the formal regulatory committee in Hérault than by the advisory committee in BDR. Another explanation mentioned in interviews is that the large BDR farms employ much more seasonal labor and put pressure on planning authorities to provide dwellings for farm workers.

3.2.2.2. Building for green energy production easier in BDR. Green energy projects are mentioned in 90 applications: methanation units (9 out of 10 applications approved), solar panels on the ground (1 of the 2 applications approved), and solar panels on the roof of farm buildings (78, mainly on multi-purpose buildings, greenhouses, and horse shelters). The impact of such green energy production projects on farmland conversion is considerable: while they represent only 9 % of the total number of building permit applications, they account for 26 % of the total surface area involved, with an average 3 600 m² per project.

Building for green energy production is easier in BDR. The BDR committee approved 46 out of 71 applications (65 %) for buildings covered with solar panels. The Hérault committee was more reluctant to do so, giving a negative opinion on 5 out of 7 applications for buildings with on-roof solar panels. Their arguments included the impact on soil sealing, the poor architectural quality of some projects, their lack of landscape integration, or the frequent mismatch between building size and purpose (sheds with solar panels may be oversized to maximize energy revenues).

3.2.2.3. Multi-purpose buildings viewed more favorably in BDR. Multi-purpose buildings account for 87 applications. The Hérault committee’s opinion was negative for 13 out of 15 applications, most of which concerned wine processing units combined with spaces for offices, direct sales, storage, and sometimes dwellings. The main rationale was that these new buildings were not really required for the development of the farm. In contrast, the BDR committee gave a positive opinion on 60 % of 72 applications for multi-purpose buildings for wider-ranging food production and for the reterritorialization of agri-food chains. They feature animal shelters (for sheep, chicken, or horses) often combined with dwellings for farmers or employees, offices, and storage facilities. Other multi-purpose buildings include vegetable or meat processing and conditioning facilities, often combined with direct sales, offices, and storage facilities.

3.2.2.4. Both committees have difficulty assessing lightweight, mobile, and dismantlable structures. In addition to concrete and brick buildings, 91 applications concern lightweight, mobile or dismantlable structures. Most are plastic tunnels for vegetable production (n=32, 28 evaluated positively). Lightweight structures for other uses (cf. Fig. 3) are more likely to be rejected, because national urban planning law only authorizes lightweight structures for 3 months, not for long-term use. The rationale given for positive opinions of such lightweight structures, despite national law, is better landscape integration and a lower impact on soil sealing.

Summing up these results, Table 4 highlights the main differences found between the opinions given by the two commissions. BDR follows more flexible guidelines than Hérault, and significant divergences appear in the evaluation of dwellings and photovoltaic projects.

4. Discussion

Our study helps to address the lack of empirical data (both qualitative and quantitative) on farm building permits and confirms a range of trends in on-farm diversification. We show how this research feeds into topics like soil sealing, urban/rural reconnection, farmers' generational renewal, and the planning of multifunctional peri-urban areas. Finally, we discuss possible limitations.

4.1. Impact of farm building permits on soil sealing

First, our results contribute to the debate on how to limit soil sealing. Demand for new farm buildings constitutes a major issue in the light of the national and European target of no net land-take by 2050⁷ (Gardi et al., 2015). In France, Madeline (2006) estimated that farm buildings accounted for 31 % of new non-residential building surface areas between 1980 and 2002. He stressed the impact of the post-world-war-II modernization of French agriculture, with intensive production requiring large barns and storage facilities. We are unable to provide similar figures for our period of inquiry, as we only have data on farm buildings and not on all building permit applications. However, our sample represents a total of over one million square meters of surface area just for one year. The high rate (39 %) of negative opinions given by the committees confirms the high pressure on farmland. Moreover, most applications involving large buildings to be used for production were accepted.

Our results highlight the considerable surface areas devoted to glass greenhouses and a range of buildings covered with photovoltaics. Energy production is now an important source of additional farm income in France (Anzalone and Mazaud, 2021), as in many countries (Goldberg, 2023). Photovoltaic projects have proliferated on farms in southern France (Kasmi et al., 2023): roof-top panels on buildings, as already illustrated by our results from 2018 and confirmed by Rouquier et al. (2023), or more recently, agrivoltaics (panels on the ground, but raised to maintain crops or livestock below) (Gorjian et al., 2022; Le Velly and Jarrige, 2022). Our findings should increase awareness of the impact of such projects on soil sealing for at least the past 5 years. They may be of interest to French land-use policy-makers, who need to find the right trade-off between limiting soil sealing and accelerating the production of renewable energies, now a national political priority (law n° 2023-175 of March 10, 2023).

Compared to the impact of energy projects, residential building permits are not a major issue in terms of soil sealing according to our results: all new buildings for non-farmers were rejected by both committees in 2018. Nevertheless, change of use of farm buildings remains a threat, especially when farmers sell redundant, under-used spaces to non-farmers. Such sales are common in France and in many other countries (van der Vaart, 2005; Verhoeve et al., 2012; Koreman and Korthals Altes, 2023), although they can be prohibited, as in some parts of Tuscany (Perrin, 2013).

Finally, our results point to the need to promote premises which could significantly reduce the impact of farm buildings on soil sealing. Applications for lightweight structures or multi-purpose buildings are often rejected, especially when they include a dwelling. Yet integrating dwellings and technical premises into multi-purpose buildings avoids resale to non-farmers. Moreover, the literature shows that lightweight

structures (e.g. mobile homes, dismantlable wooden animal shelters) avoid definitive soil sealing. Meanwhile, they offer affordable solutions, at least temporarily, and under certain conditions, can address environmental preservation, agroecological transition, or animal welfare objectives (Nougaredes et al., 2023). Our interviews reveal that committee members found it difficult to handle such applications by eco-smallholdings in 2018, despite two laws⁸ authorizing lightweight premises in specific zones since 2014.

4.2. Urban/rural reconnection

Apart from energy production, our results attest to two trends toward on-farm diversification that are more specific to the rural-urban interface (Inwood and Sharp, 2012).

First, the large number of applications for shelters for non-food animals (especially horses) and riding arenas confirms the increase in recreational activities on peri-urban farms. This diversification is in line with the literature documenting the "proliferation of recreational horse keeping" (Sutherland, 2021) related to gentrification processes in Scotland (*ibid.*), as well as to urban-rural reconnection in Flanders (Bomans et al., 2011) or around Berlin (Zasada et al., 2013). The high rate of rejection of such applications supports the already identified need (Hammer et al., 2017) for planning processes to better take into account the full range of ecosystem services that such recreational services may bring.

Second, food is an indisputable driver of rural-urban reconnection, with increasing enthusiasm for reterritorialization of food and for short food supply chains (Enthoven and Van den Broeck, 2021). Contrary to what Nichol (2003) found in England twenty years ago, our results show that in France in 2018, most building permit applications were accepted when they concerned storage, processing premises, and packing rooms – except those involving multi-purpose buildings and lightweight structures. This is a remaining obstacle, with planning decisions possibly limiting the establishment and development of small new farms in local short food supply chains, which rely on such building types.

4.3. Farmers' generational renewal

Generational renewal is a key issue for the future of agriculture and food production (Žmija et al., 2020). The "young farmer problem" identified in Europe (Zagata and Sutherland, 2015) is a major issue in France, where many new entrants are not from a farming background and start out with few resources on small diversified farms (Jeanneau and Latruffe, 2023). As Nichol (2003) found, "new entrants present particular difficulties for planners and planning committees, because they challenge the conventional conception of what farmers and farm businesses are like". Our results indicate that the functional and financial criteria used to assess farm building permits *de facto* exclude new entrants who are small-scale, part-time, or with limited resources, unable to demonstrate the economic viability of their new business. Moreover, criteria vary between provinces, especially for professional farming and new dwellings; not all criteria are listed in the provincial guidelines; and some go beyond the requirements of national law. Finding the right information can therefore be a real challenge for all applicants, and a major barrier for new-entrant farmers.

We propose three possible explanations for such planning issues faced by new entrants and eco-smallholdings in France. First, planning committees want to avoid granting permission for new construction to as yet unproven agricultural projects. Second, it is easier for them to support already running agricultural projects, integrated into existing and well-structured sectors, than to consider applications for new/rare

⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A357%3AFIN> ou <https://www.eea.europa.eu/ims/net-land-take-in-cities#footnote-WPLQAK6F>

⁸ Law n° 2014-366 from 24 March 2014 for access to housing and renewed urbanism and Law n° 2014-1170 from 13 October 2014 for the future of agriculture, food and forestry.

types of production or workshops (or constructive solutions). And third, historically dominant agricultural sectors (wine in Hérault, fruit and vegetables in BDR) have influenced the provincial guidelines *via* the active lobbying of farmers' unions (Perrin and Nougariès, 2022). Our results hence suggest that local farmers already running a farm control access to building rights, just as they control access to farmland through other provincial committees (Piet et al., 2012, 2021; Sencébé et al., 2013).

The divergences we found between the provincial guidelines and the opinions given by the two committees confirm this, illustrating the room for maneuver in planning regulations (Gerber et al., 2018). Given France's loose national law, decentralization, and multilevel governance of planning, local authorities have substantial flexibility in assessing building permit applications. This flexibility enables them to adapt to the local agricultural and demographic context, and to support (or not) green energy or more diversified local food production. However, it also creates socio-spatial inequalities in access to building rights, reproducing the power relations between farmers that already hinder access to land for small-scale agroecological farmers in France. In addition to land, therefore, access to farm buildings should receive more attention in research addressing agroecological and food transitions, which are often driven by new entrants, most without a farming background (Horst and Gwin, 2018).

4.4. Multifunctionality of peri-urban areas: a challenge for planning

This work may contribute to academic debates regarding the multifunctionality of peri-urban areas. As underlined by Gu et al. (2019), multifunctionality is well identified as a key issue in urban planning and rural development, but planners (both planning authorities and practitioners) still have to acknowledge its relevance for peri-urban areas. Insights from research on rural planning could be applied to peri-urban areas, characterized by intertwined residential and agricultural spaces: according to Frank and Reiss (2014), rural planning is a fitting platform for socio-ecological sustainability and resilience through fostering multifunctional agriculture.

Our results show that planning authorities in peri-urban areas are still reluctant to consider as relevant complex building projects for farming activities. However, identifying levers for the resilience and sustainability of peri-urban areas is a major issue for research and public policy-making. Small-scale multifunctional farming could be one such lever, promoting agricultural systems integrated into place-based planning practices (Zasada, 2011) and delivering a wide range of ecosystem services (Brinkley, 2012; Mulya et al., 2023). This multifunctionality has to be designed both at farm and territorial levels to avoid two types of functional specialization in peri-urban areas: the residential function (peri-urban areas as a mere reservoir for urban sprawl) and the productive function (farming activities reduced to production of a limited range and without diversification activities like on-site processing of agricultural products, on-farm shops, and agri-tourism) (Liu et al., 2024). Furthermore, multifunctionality may be a key driver of the sustainable retrofitting of peri-urban spaces inherited from 1960s and 1970s urban sprawl, seeking to improve their resilience in the face of climate change, biodiversity loss, and the need for energy efficiency (Alexander and Gleeson, 2020; Holmgren, 2018). Further research would help suggest how local planning authorities can better take into consideration the multifunctionality of peri-urban areas.

4.5. Limitations: the need for more transparency in planning

Attention should be drawn to certain limitations of this research, chief of which is that the data are relatively old (2017 – 2018). This explains why we interpreted our results in the light of more recent qualitative studies in the same region (Le Velly and Jarrige, 2022; Rouquier et al., 2023, Nougariès et al., *in press*). The added value of the present research is twofold. First, our results provide a snapshot of

the situation at a given point in time, which can be used to compare with future quantitative studies; for instance, we identified early signs of the photovoltaic trend already present in 2018. Second, our results help to quantify the pressure on farmland, the total surface area involved in applications for new farm buildings, and the respective weight of diverse trends, based on planning permits corresponding to different agricultural sectors and farming styles. This quantification would be impossible to achieve with interview surveys.

We therefore believe that our study contributes interesting insights in terms of implications for land-use policy-making. While building permits are approved at a very local scale, quantitative studies like this demonstrate to decision-makers the impact their decisions have on landscapes and agricultural sectors. In particular, our results show the impact on soil sealing and the specific obstacles to new entrants and to alternative farming sectors or styles.

Our approach could serve other researchers as well as decision-makers. Making data on planning permission available would enable the monitoring of land-use dynamics to be more finely tuned, and provide valuable insights to enhance planning policies. If local governments agreed to share their data, these dynamics could be spatialized month by month, and compared between different areas. This article traces our approach as applied to two provinces for one year and our results show strong divergences in the assessment of similar projects. We are aware, however, of the limited scope of a comparative study of this type, with very disparate samples due to the differing nature and role of the two committees. This study could usefully be supplemented with more data from more provinces. However, accessing quantitative data on building permit applications, on evaluations, and on the rationale behind them is a real challenge. This limitation therefore points to a more general issue: the lack of transparency surrounding the process of issuing planning permits. Our study hence points to the need to provide access to data on the permits issued and information on the criteria actually used in planning decisions.

5. Conclusion

This article joins the few empirical studies analyzing new farm buildings through individual planning permits, at the territorial level. We sought insights on how the public regulation of the construction of new farm buildings impacts on-farm diversification strategies in peri-urban Mediterranean France. Our hypothesis that local planning practices may limit farmers' capacity to diversify is partially confirmed by our results. Building permit applications confirm on-farm diversification trends related to the reterritorialization of food systems, the development of recreational activities, and the production of green energy. These trends highlight the transformation of peri-urban areas from a natural or agricultural landscape into a multifunctional landscape, creating several planning challenges. How can planners assess whether a new building is really essential for farming? Local planning committees try to find the right trade-offs to support farming dynamics and on-farm diversification while limiting soil sealing. They have substantial room for maneuver, which can be interpreted both as a useful flexibility and as a source of socio-spatial inequalities. To assess applications, they consider many criteria that generally favor large, full-time, and economically viable farms. Comparing two provinces, we observed significant differences in the interpretation of national law and incoherent or unharmonized spatial planning criteria, especially as applied to assessing professional farming activities, new dwellings, and solar energy projects. Our research also highlights two obstacles that may hinder farmers' generational renewal and agroecological or food transitions: lack of transparency regarding the rules and the decision-making processes behind building permit assessment, and the frequent rejection of applications for multi-purpose premises and lightweight, mobile, or dismantlable structures. This underlines the role of planners in peri-urban landscape transformation and the need for more consistent regulation of new farm buildings, supporting and not hindering farm

adaptation strategies and the multifunctionality of peri-urban areas. Researchers can help planners monitor ongoing dynamics by analyzing building permit data, thus providing an overall picture of the territorial and sectoral impact of the sum of individual planning permits.

CRedit authorship contribution statement

Myriam Campardon: Visualization, Formal analysis, Data curation. **Laurie Vanel:** Visualization, Investigation, Data curation. **Romain Melot:** Writing – review & editing, Formal analysis. **Brigitte Nougaredes:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Coline Perrin:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization. **Béatrice Mesini:** Writing – review & editing. **Roy J. Hammond:** Data curation. **Dyhia**

Brahimi: Investigation, Data curation.

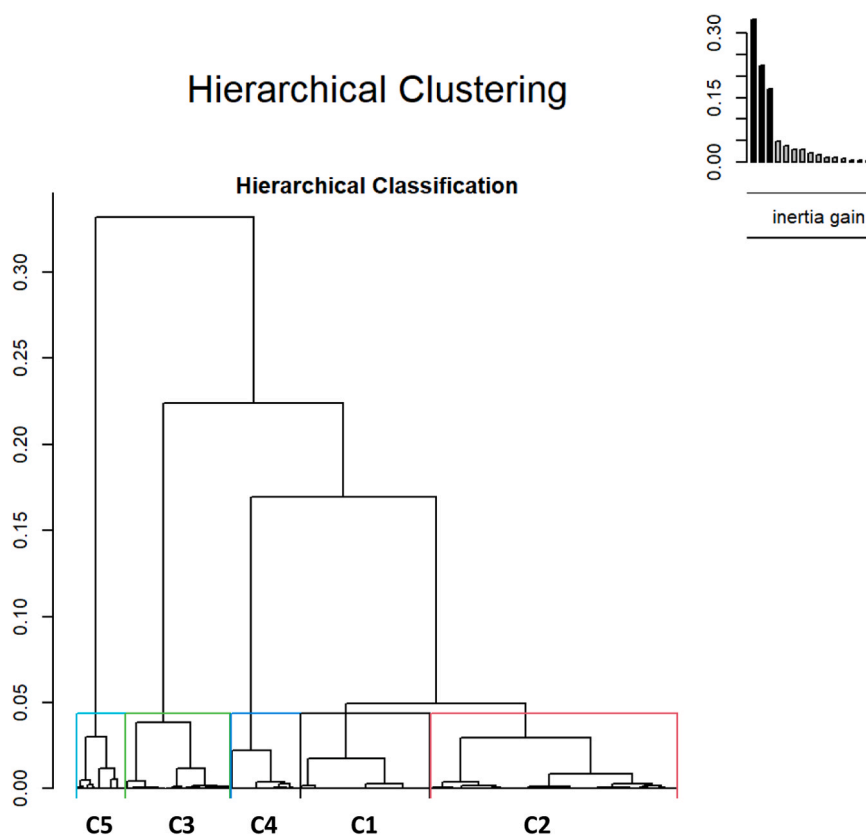
Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Brigitte Nougaredes reports financial support was provided by Fondation de France Fondation D. & N. Carasso (Research Grant 2018 BâtiAlim: Expérimentations pour une gestion durable du bâti alimentaire). Other authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Dendrogram of hierarchical clustering performed on the outputs of the MCA



Appendix B. Table of active variables

	Total n=860		C1 n=226 dwellings		C2 n=326 multi-purpose buildings		C3 n=140 large buildings with solar panels		C4 n=99 small, dismantlable structures		C5 n=68 greenhouses	
	(n)	(%)	(%)		(%)		(%)	(%)	(%)	(%)	(%)	
Future use of the building												
Dwellings	212	24.65	89.87	***	0.92	***	0.71	***	3.03	***	1.47	***
Storage and logistics	268	31.16	4.41	***	52.15	***	57.14	***	7.07	***	1.47	***

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	Total n=860		C1 n=226 dwellings		C2 n=326 multi-purpose buildings		C3 n=140 large buildings with solar panels		C4 n=99 small, dismantlable structures		C5 n=68 greenhouses	
	(n)	(%)	(%)		(%)		(%)		(%)		(%)	
Multiple uses (processing, packaging, offices, retailing)	169	19.65	4.85	***	35.89	***	22.15	ns	10.1	**	0	***
Greenhouses for market gardening	60	6.98	0	***	0.31	***	0	***	0	***	86.76	***
Animal shelters	119	13.84	0	***	8.9	***	20	*	60.61	***	2.94	**
Non-agricultural activities	32	3.72	0.88	**	1.84	*	0	**	19.19	***	7.36	ns
Surface area of the building (m²)												
0–100	305	35.47	41.41	*	34.66	ns	0.71	***	95.96	***	2.94	***
100–200	196	22.79	50.66	***	21.78	ns	2.86	***	3.03	***	4.41	***
200–500	154	17.91	7.93	***	39.26	***	1.43	***	1.01	***	7.35	*
500–3000	157	18.26	0	***	4.29	***	95	***	0	***	14.71	ns
3000 +	48	5.58	0	***	0	***	0	***	0	**	70.59	***
New construction												
Yes	673	78.26	62.11	***	75.77	ns	90.71	***	94.95	***	94.12	***
No: transformation of an existing building (extension, change of use, renewal, etc.)	187	21.74	37.89	***	24.23	ns	9.29	***	5.05	***	5.88	***
Temporary structure												
No: hard, in concrete, bricks, etc.	769	89.42	100	***	99.69	***	98.57	***	43.43	***	52.94	***
Yes: Lightweight, dismantlable, mobile structures	91	10.58	0	***	0.31	***	1.43	***	56.57	***	47.06	***
Photovoltaic												
Yes	76	8.84	0	***	0.61	***	46.43	***	0	***	13.24	ns
No	784	91.16	100	***	99.39	***	53.57	***	100	***	86.76	ns

* means p-value <0.05; ** p-value <0.01; *** p-value <0.001 %; n.s.: non-significant.

Appendix C. Table of supplementary variables

	Total n=860		C1 n=226 dwellings		C2 n=326 multi-purpose buildings		C3 n=140 large buildings with solar panels		C4 n=99 small dismantlable structures		C5 n=68 greenhouses	
	(n)	(%)	(%)		(%)		(%)		(%)		(%)	
COMMITTEE EVALUATION												
Positive	468	54.42	41.41	***	52.45	ns	67.14	***	55.56	ns	79.41	***
Negative	343	39.88	50.66	***	42.33	ns	27.86	**	40.4	ns	16.18	***
Other (not reported, postponed)	49	5.7	7.93	ns	5.22	ns	5	ns	4.04	ns	4.41	ns
APPLICANT												
New-entrant farmer												
Yes	112	13.02	7.05	**	12.88	ns	7.86	*	31.31	***	17.65	ns
No	748	86.98	92.95	**	87.12	ns	92.14	*	68.69	***	82.35	ns
Full-time professional farmer												
Yes	676	78.6	81.06	ns	76.07	ns	87.86	**	68.69	*	77.94	ns
No (part-time or hobby farmer)	184	21.4	18.94	ns	23.93	ns	12.14	**	31.31	*	22.06	ns
PRODUCTIONS OF THE FARM												
Food production	591	68.72	68.72	ns	70.86	ns	63.57	ns	55.56	**	88.24	***
Only non-food agricultural products/services (e.g. horses)	163	18.95	13.66	*	17.48	ns	30	***	31.31	**	2.94	***
Non-agricultural activities	106	12.33	17.62	**	11.66	ns	6.43	*	13.13	ns	8.82	ns
Grapes												
Yes	118	13.72	16.74	ns	19.02	***	11.43	ns	2.02	***	0	***
No	742	86.28	83.26	ns	80.98	***	88.57	ns	97.98	***	100	***
Market gardening-Horticulture-Specialized crops												
Yes	292	33.95	33.48	ns	29.75	*	23.57	**	29.29	ns	83.82	***
No	568	66.05	66.52	ns	70.25	*	76.43	**	70.71	ns	16.18	***
Arboriculture-Oleiculture												
Yes	143	16.63	16.74	ns	20.55	*	13.57	ns	5.05	***	20.59	ns
No	717	83.37	83.26	ns	79.45	*	86.43	ns	94.95	***	79.41	ns
Cereals-Forage												
Yes	154	17.91	18.06	ns	16.56	ns	35	***	6.06	***	5.88	**
No	706	82.09	81.94	ns	83.44	ns	65	***	93.94	***	94.12	**
Multiple crops												
Yes	237	27.56	24.67	ns	27.61	ns	36.43	*	23.23	ns	25	ns
No	623	72.44	75.33	ns	72.39	ns	63.57	*	76.77	ns	75	ns
Livestock												
Yes	168	19.53	14.1	*	17.79	ns	28.57	**	38.38	***	0	***
No	692	80.47	85.9	*	82.21	ns	71.43	**	61.62	***	100	***
Non-professional breeding												
Yes	54	6.28	4.85	ns	9.82	**	0	***	11.11	ns	0	*
No	806	93.72	95.15	ns	90.18	**	100	***	88.89	ns	100	*

(continued on next page)

(continued)

	Total n=860		C1 n=226 dwellings		C2 n=326 multi-purpose buildings		C3 n=140 large buildings with solar panels		C4 n=99 small dismantlable structures		C5 n=68 greenhouses		
	(n)	(%)	(%)		(%)		(%)		(%)		(%)		
Horse breeding	Yes	141	16.4	12.33	ns	13.8	ns	30	ns	24.24	*	2.94	***
	No	719	83.6	87.67	ns	86.2	ns	70	***	75.76	*	97.06	***
FUTURE USE OF BUILDING UNDER APPLICATION (detailed)													
Dwelling for the applicant		158	18.37	66.96	***	0.61	***	0.71	***	3.03	***	0	***
Dwelling for employees		33	3.84	14.54	***	0	***	0	**	0	*	0	ns
Holiday accommodation, agritourism		21	2.44	8.37	***	0.31	***	0	*	0	ns	1.47	ns
Storage of equipment and products		241	28.02	2.64	***	45.71	***	56.43	***	6.06	***	1.47	***
Service/technical facilities		27	3.14	1.76	ns	6.44	***	0.71	ns	1.01	ns	0	ns
Vegetable processing		4	0.47	0	ns	0.61	ns	0	ns	2.02	ns	0	ns
Meat processing		5	0.58	0	ns	1.53	**	0	ns	0	ns	0	ns
Cheese. Dairy		3	0.35	0	ns	0.92	ns	0	ns	0	ns	0	ns
Wine-making		12	1.4	0.88	ns	2.76	*	0.71	ns	0	ns	0	ns
Egg packaging		3	0.35	0	ns	0.92	ns	0	ns	0	ns	0	ns
Vegetable packaging		9	1.05	0.44	ns	1.53	ns	1.44	ns	1.01	ns	0	ns
Oil mill		2	0.23	0	ns	0.61	ns	0	ns	0	ns	0	ns
Honey processing		5	0.58	0	ns	1.53	**	0	ns	0	ns	0	ns
Multi-purpose premises		86	10	2.2	***	16.26	***	20	***	0	***	0	***
Sales, reception		15	1.74	0.88	ns	2.76	ns	0	ns	4.04	ns	0	ns
Offices		25	2.91	0.44	**	6.44	***	0	*	3.03	ns	0	ns
Plastic greenhouses		32	3.72	0	***	0	***	0	**	0	*	47.06	***
Glass greenhouses		28	3.26	0	***	0.31	***	0	**	0	*	39.71	***
Sheep shelter		12	1.4	0	*	1.23	ns	5	**	1.01	ns	0	ns
Cattle shelter		3	0.35	0	ns	0.31	ns	0.71	ns	1.01	ns	0	ns
Goat shelter		1	0.12	0	ns	0	ns	0.71	ns	0	ns	0	ns
Poultry shelter		36	4.19	0	***	1.23	***	1.44	ns	30.3	***	0	*
Plastic tunnel used as animal shelter		4	0.47	0	ns	0.61	ns	0	ns	2.02	ns	0	ns
Rabbit breeding		1	0.12	0	ns	0	ns	0	ns	1.01	ns	0	ns
Equines: stables, boxes		30	3.49	0	***	2.76	ns	2.14	ns	18.18	***	0	ns
Equines: riding arenas		20	2.33	0	**	0.92	*	10	***	1.01	ns	2.94	ns
Dogs: kennels, nursery		12	1.4	0	*	1.84	ns	0	ns	6.06	**	0	ns
Community gardens, animal parks		2	0.23	0	ns	0	ns	0	ns	1.01	ns	1.47	ns
Fences, gates		3	0.35	0	ns	0	ns	0	ns	3.03	**	0	ns
Public facilities		6	0.7	0.44	ns	0.92	ns	0	ns	1.01	ns	1.47	ns
Ground elevation		4	0.47	0	ns	0	ns	0	ns	1.01	ns	4.41	**
Ground photovoltaics		2	0.23	0	ns	0	ns	0	ns	2.02	*	0	ns
Heat generation, methanization		10	1.16	0.44	ns	0.92	ns	0	ns	6.06	***	0	ns
Industrial premises		1	0.12	0	ns	0	ns	0	ns	1.01	ns	0	ns
Antennas, pylons		4	0.47	0	ns	0	ns	0	ns	4.04	***	0	ns

* means p-value <0.05; ** p-value <0.01; *** p-value <0.001 %; ns: non-significant. The missMDA package (Josse and Husson, 2016) was used to impute missing data, explaining why counts might slightly differ from Table 2.

Appendix D. photos of some small, lightweight, and mobile buildings



Photo1. Lightweight mobile sheep shelter © O. Rouquier.



Photo 2. Mobile hen houses © Producteurs du Diois.



Photo 3. Wooden shelters for horses © C. Perrin.

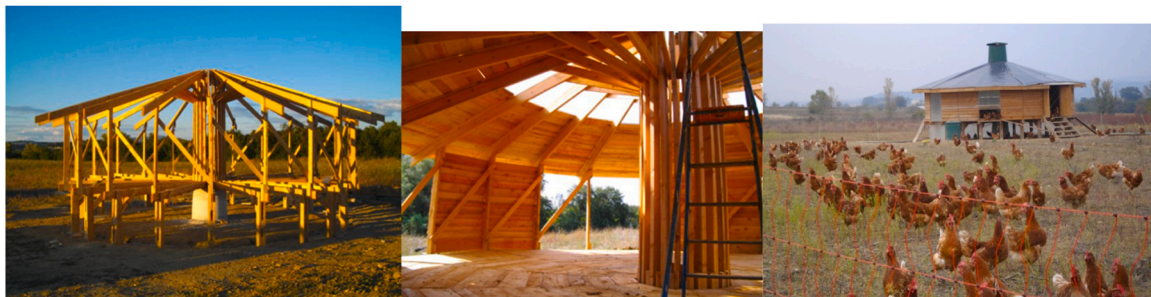


Photo 4. Lightweight wooden hen house © J. Peron.



Photo 5. Mobile hen house, automated and energy-autonomous, purchased in Germany © H. Grosjean.

References

- Abrantes, P., Soulard, C., Jarrige, F., Laurens, L., 2010. Dynamiques urbaines et mutations des espaces agricoles en Languedoc-Roussillon (France). *Cybergeo* 485, 1–19.
- Alexander, S., Gleeson, B., 2020. Suburban practices of energy descent. *Am. J. Econ. Sociol.* 79, 907–940. <https://doi.org/10.1111/ajes.12337>.
- Andersson, K., Eklund, E., Lehtola, M., 2009. Farmers, businessmen or green entrepreneurs? Producers of new rural goods and services in rural areas under urban pressure. *J. Environ. Policy Plan.* 11, 29–43. <https://doi.org/10.1080/15239080902774960>.
- Anzalone, G., Mazaud, C., 2021. L'énergiculteur, figure de la diversification en agriculture. *La Nouv. Rev. du Trav.* <https://doi.org/10.4000/nrt.8299>.
- Blasius, J., Greenacre, M., 2014. *Visualization and Verbalization of Data*. CRC Press.
- Bomans, K., Dewaelheyns, V., Gulinc, H., 2011. Pasture for horses: an underestimated land use class in an urbanized and multifunctional area. *Int. J. Sustain. Dev. Plan.* 6, 195–211. <https://doi.org/10.1016/j.ecolecon.2008.04.003>.
- Branduini, P., Perrin, C., Nougaredès, B., Colli, E., 2020. Cultural Heritage Preservation and Resilience in Urban Agriculture Through the Lens of Social Justice: A Case Study in Milan. In: Thornton, A. (Ed.), *Urban Food Democracy and Governance in North and South*, International Political Economy Series. Springer International Publishing, Cham, pp. 101–122. https://doi.org/10.1007/978-3-030-17187-2_7.
- Brinkley, C., 2012. Evaluating the benefits of peri-urban agriculture. *J. Plan. Lit.* 27, 259–269. <https://doi.org/10.1177/0885412211435172>.
- Bryant, C.R., 1986. Farmland conservation and farming landscapes in urban-centered regions - the case of the Ile-De-France region. *Landscape Urban Plan.* 13, 251–276. [https://doi.org/10.1016/0169-2046\(86\)90041-1](https://doi.org/10.1016/0169-2046(86)90041-1).
- Bryant, C.R., Johnston, T.R.R., 1992. *Agriculture in the city's countryside*. University of Toronto Press, Toronto; Buffalo.
- Chanel, O., Delattre, L., Napoleone, C., 2014. Determinants of local public policies for farmland preservation and urban expansion: a French Illustration. *Land Econ.* 90, 411–433.
- CDPENAF, 2018. *Construction en zone agricole: guide des bonnes pratiques à l'attention des collectivités territoriales*, Bouches-du-Rhône, janvier 2018, 13 pages. https://www.bouches-du-rhone.gouv.fr/content/telechargement/48509/275123/file/Guide_constructions_zone_agricole_180104.pdf.
- Dąbkowski, N., Olszewska, B., Chalecki, M., 2018. Houses on organic farms in north-east Mazovia: existing material and construction solutions. *Ecol. Quest.* 29, 69–80. <https://doi.org/10.12775/EQ.2018.031>.
- Enthoven, L., Van den Broeck, G., 2021. Local food systems: reviewing two decades of research. *Agric. Syst.* 193, 103226 <https://doi.org/10.1016/j.agsy.2021.103226>.
- Eveland, C., Weersink, A., Caldwell, W., Yang, W., 2005. Spatial trends in barn building permits. *Gt. Lakes Geogr.* 12, 19–27.
- Fazio, S.D., 1989. *Designing agricultural buildings in relation to the landscape*. In: *Agricultural Engineering Volume 2: Agricultural Buildings*. CRC Press.
- Frank, K.I., Reiss, S.A., 2014. The rural planning perspective at an opportune time. *J. Plan. Lit.*, 0885412214542050 <https://doi.org/10.1177/0885412214542050>.
- Fuentes, J.M., Gallego, E., García, A.I., Ayuga, F., 2010. New uses for old traditional farm buildings: the case of the underground wine cellars in Spain. *Land Use Policy* 27, 738–748. <https://doi.org/10.1016/j.landusepol.2009.10.002>.
- Gallent, N., 2006. The Rural-Urban fringe: a new priority for planning policy? *Plan. Pract. Res.* 21, 383–393. <https://doi.org/10.1080/02697450601090872>.
- Gardi, C., Panagos, P., Van Liedekerke, M., Bosco, C., De Brogniez, D., 2015. Land take and food security: assessment of land take on the agricultural production in Europe. *J. Environ. Plan. Manag.* 58, 898–912. <https://doi.org/10.1080/09640568.2014.899490>.
- Gerber, J.-D., Hengstermann, A., Viallon, F.-X., 2018. *Land policy - How to deal with scarcity of land? Instruments of Land Policy: Dealing with Scarcity of Land*. Routledge, London, pp. 7–28.
- Goldberg, Z.A., 2023. Solar energy development on farmland: three prevalent perspectives of conflict, synergy and compromise in the United States. *Energy Res. Soc. Sci.* 101, 103145 <https://doi.org/10.1016/j.erss.2023.103145>.
- Gorjian, S., Ebadi, H., Jathar, L.D., Savoldi, L., 2022. Chapter 1 - Solar energy for sustainable food and agriculture: developments, barriers, and policies. In: Gorjian, S., Campana, P.E. (Eds.), *Solar Energy Advancements in Agriculture and Food Production Systems*. Academic Press, pp. 1–28. <https://doi.org/10.1016/B978-0-323-89866-9.00004-3>.
- Gosnell, H., Kline, J.D., Chrostek, G., Duncan, J., 2011. Is Oregon's land use planning program conserving forest and farm land? A review of the evidence. *Land Use Policy* 28, 185–192. <https://doi.org/10.1016/j.landusepol.2010.05.012>.
- GTUA, 2011. *Parcours à la construction agricole*. Hérault. Groupe de travail agriculture et urbanisme Hérault. 30 p. <https://www.herault.gouv.fr/content/download/7523/41248/file/EtapesConstructionsParcourAgricole.pdf>.
- Gu, X., Xie, B., Zhang, Z., Guo, H. (David), 2019. Rural multifunction in Shanghai suburbs: Evaluation and spatial characteristics based on villages. *Habitat Int.* 92, 102041 <https://doi.org/10.1016/j.habitatint.2019.102041>.
- Hammer, M., Bonow, M., Petersson, M., 2017. The role of horse keeping in transforming peri-urban landscapes: a case study from metropolitan Stockholm, Sweden. *Nor. Geogr. Tidsskr. - Nor. J. Geogr.* 71, 146–158. <https://doi.org/10.1080/00291951.2017.1340334>.
- Holmgren, D., 2018. *Retrosuburbia; the downshifters guide to a resilient future*. Melliodora Publishing.
- Holtslag-Broekhof, S.M., Beunen, R., van Marwijk, R., Wiskerke, J.S.C., 2014. "Let's try to get the best out of it" understanding land transactions during land use change. *Land Use Policy* 41, 561–570. <https://doi.org/10.1016/j.landusepol.2014.04.016>.
- Horst, M., Gwin, L., 2018. Land access for direct market food farmers in Oregon, USA. *Land Use Policy* 75, 594–611. <https://doi.org/10.1016/j.landusepol.2018.01.018>.
- Husson, F., Josse, J., Le, S., Mazet, J., 2023. *FactoMineR: Multivariate Exploratory Data Analysis and Data Mining*.
- Ilbery, B.W., 1991. Farm diversification as an adjustment strategy on the urban fringe of the West Midlands. *J. Rural Stud.* 7, 207–218. [https://doi.org/10.1016/0743-0167\(91\)90085-7](https://doi.org/10.1016/0743-0167(91)90085-7).
- Inwood, S.M., Sharp, J.S., 2012. Farm persistence and adaptation at the rural-urban interface: Succession and farm adjustment. *J. Rural Stud.* 28, 107–117. <https://doi.org/10.1016/j.jrurstud.2011.07.005>.
- Jarrige, F., Chery, J.-P., Buyck, J., Gambier, J.P., 2013. The Montpellier Agglomération New Approaches for Territorial Coordination in the Periurban. In: Nilsson, K., Pauleit, S., Bell, S., Aalbers, C., Sick Nielsen, T.A. (Eds.), *Peri-Urban Futures: Scenarios and Models for Land Use Change in Europe*. Springer, Berlin, Heidelberg, pp. 241–274. https://doi.org/10.1007/978-3-642-30529-0_10.
- Jeanneaux, P., Latruffe, L., 2023. Les enjeux de la transmission agricole en France. *Regards Croisés*. sur l'Econ. 33, 113–121. <https://doi.org/10.3917/rce.033.0113>.
- Josse, J., Husson, F., 2016. missMDA: a package for handling missing values in multivariate data analysis. *J. Stat. Softw.* 70, 1–31. <https://doi.org/10.18637/jss.v070.i01>.
- Kasmi, G., Saint-Drenan, Y.-M., Trebosc, D., Jolivet, R., Leloux, J., Sarr, B., Dubus, L., 2023. A crowdsourced dataset of aerial images with annotated solar photovoltaic arrays and installation metadata. *Sci. Data* 10, 59. <https://doi.org/10.1038/s41597-023-01951-4>.
- Koreman, M.C.J., Korthals Altes, W.K., 2023. Re-using vacant farm buildings for commercial purposes: two cases from the Netherlands. *Land Use Policy* 132, 106823. <https://doi.org/10.1016/j.landusepol.2023.106823>.
- Kristensen, S.B.P., Præstholm, S., Busck, A.G., Winther, L., Fertner, C., Vesterager, J.P., Vejre, H., 2019. On-farm business structure diversification in Greater Copenhagen—farmers in an urban landscape or entrepreneurs in a rural landscape? *Land Use Policy* 88, 104093. <https://doi.org/10.1016/j.landusepol.2019.104093>.
- Lê, S., Josse, J., Husson, F., 2008. FactoMineR: an R package for multivariate analysis. *J. Stat. Softw.* 25, 1–18. <https://doi.org/10.18637/jss.v025.i01>.
- Le Velly, R., Jarrige, F., 2022. Le développement du photovoltaïque sur des terres agricoles, entre régulations publiques et jeux d'acteurs. *Vertigo* 23, 2. <https://doi.org/10.4000/vertigo.40813>.
- Liu, T., Melot, R., Wallet, F., 2024. Integrating land and food policy to transform territorial food systems in the context of coexisting agri-food models: case studies in France. *Elem.: Sci. Anthr.* 12, 00063 <https://doi.org/10.1525/elementa.2023.00063>.

- Madeline, P., 2006. L'évolution du bâti agricole en France métropolitaine: un indice des mutations agricoles et rurales. *L'Inf. Géographique* Vol. 70, 33–49.
- Mulya, S.P., Putro, H.P.H., Hudalah, D., 2023. Review of peri-urban agriculture as a regional ecosystem service. *Geogr. Sustain.* 4, 244–254. <https://doi.org/10.1016/j.geosus.2023.06.001>.
- Nichol, L., 2003. Local food production: some implications for planning. *Plan. Theory Pract.* 4, 409–427. <https://doi.org/10.1080/1464935032000146264>.
- Nougaredes, B., 2020. Regrouper les constructions agricoles. Des innovations pour préserver le foncier dans un contexte viticole. In: Perrin, C., Nougaredes, B. (Eds.), *Le foncier agricole dans une société urbaine: innovations et enjeux de justice*. Cardère, Avignon, France, pp. 67–100.
- Nougaredes, B., Letulle, C., Melot, R., Mésini, B., Perrin, C. (n.d.) (in press). Construire sur les terres agricoles: ordres juridiques localisés et nouveaux enjeux alimentaires. In J. Aldhuy et al. (Eds) *Droits et territoires. Regards croisés des sciences juridiques et territoriales* (in press).
- Nougaredes, B., Rouquier, O., Laurens, L., Madeline, P., Mésini, B., Perrin, C., 2023. Le bâti alimentaire territorial: un nouveau concept pour anticiper les besoins en constructions des filières alimentaires territoriales. *Norois* 267, 31–54.
- Perrin, C., 2015. La gouvernance du foncier agricole périurbain. Le primat ancien de l'urbanisme municipal en Provence et en Toscane (1960–2010). *Pôle Sud.* 42, 11–27.
- Perrin, C., 2013. Regulation of farmland conversion on the urban fringe: from land-use planning to food strategies. insight into two case studies in Provence and Tuscany. *Int. Plan. Stud.* 18, 21–36. <https://doi.org/10.1080/13563475.2013.750943>.
- Perrin, C., Clément, C., Melot, R., Nougaredes, B., 2020. Preserving farmland on the urban fringe: a literature review on land policies in developed countries. *Land* 9, 223. <https://doi.org/10.3390/land9070223>.
- Perrin, C., Nougaredes, B., 2022. An analytical framework to consider social justice issues in farmland preservation on the urban fringe. Insights from three French cases. *J. Rural Stud.* 93, 122–133. <https://doi.org/10.1016/j.jrurstud.2020.07.007>.
- Perrin, C., Nougaredes, B., Sini, L., Branduini, P., Salvati, L., 2018. Governance changes in peri-urban farmland protection following decentralisation: A comparison between Montpellier (France) and Rome (Italy). *Land Use Policy* 70, 535–546. <https://doi.org/10.1016/j.landusepol.2017.09.027>.
- Picuno, P., 2022. Farm buildings as drivers of the rural environment. *Front. Built Environ.* 8.
- Piet, L., Latruffe, L., Le Mouël, C., Desjeux, Y., 2012. How do agricultural policies influence farm size inequality? The example of France. *Eur. Rev. Agric. Econ.* 39, 5–28. <https://doi.org/10.1093/erae/jbr035>.
- Piet, L., Melot, R., Diop, S., 2021. What drives competition on the farmland market? A case study in Brittany (France). *Eur. Rev. Agric. Econ.* 48, 60–96. <https://doi.org/10.1093/erae/jbaa019>.
- Prévoist, A., Robert, S., 2016. Local spatial planning practices in four French Mediterranean coastal territories under pressure. *Land Use Policy* 56, 68–80. <https://doi.org/10.1016/j.landusepol.2016.04.034>.
- Randolph, B., 2004. The changing Australian city: new patterns, new policies and new research needs. *Urban Policy Res.* 22, 481–493. <https://doi.org/10.1080/0811114042000296362>.
- Rouquier, O., Perrin, C., Pouzenc, M., Olivier-Salvagnac, V., 2023. Farm buildings and agri-food transitions in Southern France: mapping dynamics using a stakeholder-based diagnosis. *Geogr. Sustain.* <https://doi.org/10.1016/j.geosus.2023.10.003>.
- Schmitt, H., 2003. Landschaftbezogenes Bauen in Baden-Württemberg (Landscape-related building in Baden-Württemberg). *Landtechnik* 2, 88–89.
- Sencébé, Y., Pinton, F., Alphanéry, P., 2013. Le contrôle des terres agricoles en France. Du gouvernement par les pairs à l'action des experts. *Sociologie* Vol. 4, 251–268.
- Sutherland, L.-A., 2021. Horsification: embodied gentrification in rural landscapes. *Geoforum* 126, 37–47. <https://doi.org/10.1016/j.geoforum.2021.07.020>.
- Tacconi, F., Waha, K., Ojeda, J.J., Leith, P., 2022. Drivers and constraints of on-farm diversity. A review. *Agron. Sustain. Dev.* 42, 2. <https://doi.org/10.1007/s13593-021-00736-6>.
- Tassinari, P., Torreggiani, D., Benni, S., 2013. Dealing with agriculture, environment and landscape in spatial planning: a discussion about the Italian case study. *Land Use Policy* 30, 739–747. <https://doi.org/10.1016/j.landusepol.2012.05.014>.
- Tassinari, P., Torreggiani, D., Paolinelli, G., Benni, S., 2007. Rural buildings and their integration in landscape management. *Agric. Eng. Int.: CIGR Ejournal* 9, 1–20.
- Torreggiani, D., Tassinari, P., 2012. Landscape quality of farm buildings: the evolution of the design approach in Italy. *J. Cult. Herit.* 13, 59–68. <https://doi.org/10.1016/j.culher.2011.06.002>.
- van der Ploeg, J.D., Laurent, C., Blondeau, F., Bonnafous, P., 2009. Farm diversity, classification schemes and multifunctionality. *J. Environ. Manag., Multifunct. Agric. - Farm Diagn. Farm Des. Inst. Innov.* 90 (Supplement 2), S124–S131. <https://doi.org/10.1016/j.jenvman.2008.11.022>.
- van der Vaart, J.H.P., 2005. Towards a new rural landscape: consequences of non-agricultural re-use of redundant farm buildings in Friesland. *Landsc. Urban Plan. Rural Landsc.: Process. Future Strateg.* 70, 143–152. <https://doi.org/10.1016/j.landurbplan.2003.10.010>.
- Van Dijk, T., Beunen, R., 2009. Laws, people and land use: a sociological perspective on the relation between laws and land use. *Eur. Plan. Stud.* 17, 1797–1815. <https://doi.org/10.1080/09654310903322314>.
- Verhoeve, A., De Roo, N., Rogge, E., 2012. How to visualise the invisible: Revealing re-use of rural buildings by non-agricultural entrepreneurs in the region of Roeselare-Tielt (Belgium). *Land Use Policy* 29, 407–416.
- Verhoeve, A., Dewaelheyns, V., Kerselaers, E., Rogge, E., Gulincx, H., 2015. Virtual farmland: grasping the occupation of agricultural land by non-agricultural land uses. *Land Use Policy* 42, 547–556. <https://doi.org/10.1016/j.landusepol.2014.09.008>.
- Wachter, M., Wytzens, H.K., 2022. Barn or building lot? A cross-case comparison viewing the role of agricultural interests in Austria's local spatial planning processes. *Land Use Policy* 122. <https://doi.org/10.1016/j.landusepol.2022.106347>.
- Zagata, L., Sutherland, L.-A., 2015. Deconstructing the 'young farmer problem in Europe': towards a research agenda. *J. Rural Stud.* 38, 39–51. <https://doi.org/10.1016/j.jrurstud.2015.01.003>.
- Zasada, I., 2011. Multifunctional peri-urban agriculture—a review of societal demands and the provision of goods and services by farming. *Land Use Policy* 28, 639–648. <https://doi.org/10.1016/j.landusepol.2011.01.008>.
- Zasada, I., Berges, R., Hilgendorf, J., Piorr, A., 2013. Horsekeeping and the peri-urban development in the Berlin Metropolitan Region. *J. Land Use Sci.* 8, 199–214. <https://doi.org/10.1080/1747423X.2011.628706>.
- Žmija, K., Fortes, A., Tia, M.N., Šūmane, S., Ayambila, S.N., Žmija, D., Satola, L., Sutherland, L.-A., 2020. Small farming and generational renewal in the context of food security challenges. *Glob. Food Secur.* 26, 100412 <https://doi.org/10.1016/j.gfs.2020.100412>.