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Group farming in France: Why do some regions have more cooperative ventures than others?

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Abstract

The global debate on food security and the kinds of farming systems that could prove economically and ecologically sustainable has focused overwhelmingly on small family farms versus large commercial farms, with little attention being given to alternative models based on farmer cooperation. France offers a significant but under-researched and internationally little-recognized model of group farming – the GAEC (*Groupement Agricole d'Exploitation en Commun*) – based on farmers pooling land, labour and capital. This model is of considerable contemporary interest for both France and other countries. Catalysed by a 1962 law, GAECs accounted for 7.6% of farms and 15% of agricultural adult work units in 2010, but their incidence varied greatly across regions. Using data from the French agricultural census and other sources, this paper identifies the factors – economic, ecological, social and demographic – underlying this regionally uneven development of GAECs (and comparatively of EARLs – *Exploitations Agricoles à Responsabilité Limitée* – another type of group farm introduced in 1985). Regions with a higher incidence of group farms are found to be those that were historically dominated by middle-sized farms, had a local ecology favouring labour-intensive animal breeding, especially pastures, a higher proportion of agricultural graduates, greater economic equality and social institutions that promote community cohesion, among other factors. These results illuminate not only the conditions favourable to the emergence of group farming in France, but also the conditions under which such farmer cooperation could take root in other (including developing) countries, subject to context-specific modifications of the French model.

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Keywords

Group farming, cooperation, France, GAEC, institutional innovation, regional variations

Introduction

In recent years, an increasing weight is being placed internationally on small family farms as vehicles for enhancing food security, equity and ecological sustainability (FAO, 2014; HLPE, 2013). This emphasis brings together two dominant features of farms today: most are family run – globally at least 88% of all farms are assessed to be family farms (FAO, 2014); and most are small in size – an estimated 84% of farms across 111 countries operate under 2 hectares (FAO, 2014; see also HLPE, 2013).¹ Critics who see such farms as non-viable present large commercial farms as the alternative (Collier and Dercon, 2014). Both models, however, leave serious concerns unaddressed. On the one hand, small family farms face significant constraints linked with scale, fragmentation and resource access, which are difficult to overcome. On the other hand, large commercial farms have low prospects of providing jobs either to the vast numbers of people still dependent on agriculture, or to new entrants to the rural labour force (Dorin, 2017; Dorin et al., 2013; Imai et al., 2017). Clearly, we need to think about other models of farming. In this context, group farming, wherein farmers pool their land, labour and capital and share costs and profits, could be of particular interest. This model, which has received rather little attention either in policy or research, is based on voluntary cooperation, without farmers forfeiting their private property rights, in sharp contrast to the collective farms created through forced collectivization under socialist regimes.

The lack of attention to voluntary group farming is surprising, given that there are contemporary examples in many countries. In France, for instance, group farming has existed at least since the 1960s, and today there are over 100,000 group farms. Elsewhere, joint farm enterprises began to emerge in the 1980s and 1990s, such as for cattle upkeep and milk production in Norway (Almas, 2010) and Ireland (Macken-Walsh and Roche, 2012), and crop production, especially rice, in Japan (Sarkar and Itoh, 2001). It also emerged in many post-socialist countries after de-collectivization of agriculture in the 1990s, including in East Germany, Kyrgyzstan, Romania and Nicaragua.² Since the early 2000s, it has been promoted successfully by state governments and civil society in several parts of India (Agarwal, 2010a; 2018). Reasons for the neglect of this alternative model are likely to lie in the adverse experience of collectivization under socialist regimes;³ the poorly designed and hence largely unsuccessful efforts to promote cooperative farming in the 1950s and 1960s in the post-colonial, newly independent developing countries of Asia, Africa and Latin America;⁴ and, most of all, in the pessimism embedded in economic theory on the possibility of people cooperating, given tendencies to free-ride (see Olsen, 1965, among others).

In recent decades, however, a substantial body of empirical work has demonstrated that communities are successfully cooperating for governing common-pool resources, leading to improved conservation outcomes (Agarwal, 2010b; Ostrom, 1990). Service cooperatives, especially for marketing, sharing machines, or procuring inputs, are also widespread globally.⁵ But cooperation for governing common-pool resources differs from cooperation for agricultural production, which involves complex forms of daily interaction. Similarly, marketing cooperatives do not require everyday cooperation in the production process itself. For instance, family farms can produce milk, meat or crops individually, while using cooperatives only for selling these items. In contrast, pooling land, labour and capital for

agricultural production requires what Agarwal (2014) terms ‘multipurpose comprehensive cooperation’. This is much less common, and even less studied.

A study of group farming, based on such multipurpose cooperation, acquires particular relevance today, given that people in many countries (both developing and developed) are seeking diverse pathways to carve out viable livelihoods within agriculture. This includes not only existing farmers looking for more lucrative and sustainable farming options,⁶ but also new job seekers who (as noted) have limited non-farm outlets, as well as those who want to make agriculture a lifestyle choice.⁷ In this search for alternatives, it would be especially timely to examine farming models based on cooperation in production.

Here the experience of France is of particular relevance. It has perhaps the oldest and numerically the most important example of voluntarily constituted and legally enabled group farms, as embodied in GAECs (*Groupements Agricoles d'Exploitation en Commun*) and, to some extent, in EARLs (*Exploitations Agricoles à Responsabilité Limitée*). France can thus provide particular insights on the characteristic features of these group farming models and the contexts in which they emerge. This is not only because of their long existence and numerical strength, but also because of their regional clustering: GAECs are much more concentrated in north-western and central-eastern France, than elsewhere (see Figures 1 and 2). This begs the question: do regions with more GAECs have features

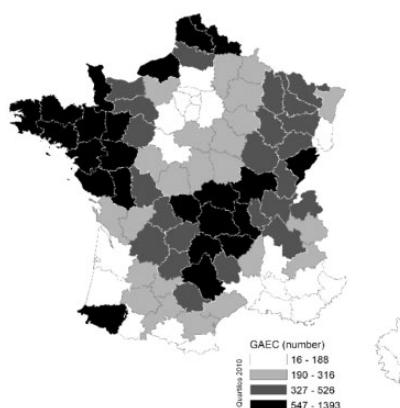


Figure 1. GAECs number in 2010.

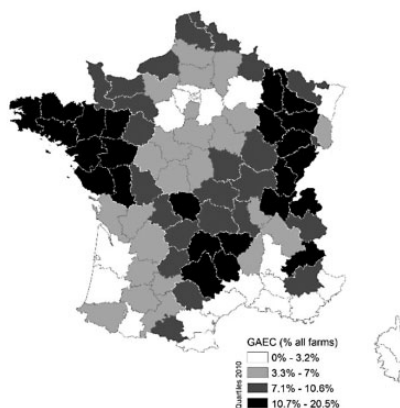


Figure 2. GAECs as a percentage of all farms in 2010.

especially conducive to cooperation, such as the local economy, ecology, demography, culture or a mix of these and other factors? An analysis of these factors is of interest both in itself and to help us understand which underlying factors are more conducive to the formation of group farms. This understanding could also provide lessons for the potential adaptability of such models beyond France.

The questions we pose have been little researched, especially the factors underlying the regional clustering of group farms. Our paper thus breaks fresh ground. It will also contribute to ongoing academic and policy debates on economically viable agriculture, by its focus on farming models based on cooperation. The paper is divided into six sections. The next section provides a background to GAEC and EARL formation and an overview of existing studies, following which there is a discussion of the broad characteristics of GAECs and EARLs based on agricultural censuses from 1988 to 2010. We then present our model and hypotheses regarding the factors that could explain the greater incidence of group farms in certain regions over others in 2010. The penultimate section presents our regression results, followed by concluding reflections and policy pointers in the closing section.

Background and existing studies

Legally, GAECs were catalysed in France by a law passed in 1962, which became fully effective in 1965 (Raup, 1975). The law specified a legal minimum of 2 partners/associates and a maximum of 10, with the requirement that all partners work full-time on the farm. The law also incorporated a ‘transparency principle’ (Article L323-13 of the French Rural Code) under which the state, for its agricultural support programmes, would treat each GAEC partner as an individual entity, while recognizing too a GAEC’s collective identity. This principle enabled GAEC partners to benefit from public incentives on the same basis as individual farmers, including when the Common Agricultural Policy (CAP) of the European Union (EU) introduced direct income support ‘decoupled’ from price support in 1992.⁸ Also in 2013, the EU officially recognized the transparency principle for GAECs.⁹

Socially, however, GAECs were propelled especially by the *Jeunesse Agricole Catholique* (JAC),¹⁰ an association of young Catholic farmers, ‘guided by the conviction that a “third road” was needed between what was regarded as the abuses of capitalism and the excesses of Marxian collectivism’ (Raup, 1975: 3; see also Boussard, 1991). The farmers, supported by some intellectuals and high-level civil servants, are said to have convinced the French government that an enabling law was needed. Their efforts fell on fertile ground, since the government, led by key figures such as Edgard Pisani (Minister of Agriculture, 1961–1966),¹¹ was seeking to modernize family-based agriculture, and the GAEC was seen as an institutional innovation close in structure to a family farm, in contrast to a corporate farm dependent largely on hired employees.

Forming a GAEC was expected to help individual family farms improve their managerial efficiency, productivity, and work conditions (GAEC & Sociétés, 2010a).¹² For instance, by pooling their resources, even farmers with limited means could modernize their farming techniques and organization; experiment with new technologies that needed too much capital for an individual farmer to afford; take advantage of scale economies; and free children or spouses from agricultural work to seek higher education or non-farm jobs. Moreover, in recognizing sons and fathers as equal partners, GAECs enhanced the status of sons within the family, and thus their incentive to work harder and increase productivity. Farmers’ wives, however, remained unequal, both economically and socially (Darque, 2008). Under the law, married couples could not become associates without the presence of a third associate, until a change in law in 2010 allowed spouses to constitute couple GAECs.

In 1985, another type of group farm – the EARL – was legally instituted, basically as a limited-liability society, subject to different laws and procedures than GAECs.¹³ For example, unlike GAECs, which required at least two associates, EARLs could also be formed by one person as well as by married couples. Moreover, in EARLs only shareholders who individually or as a group hold the majority capital are required to work on the farm, while minority shareholders need not. GAEC associates, in contrast, cannot take up any significant income-earning activity outside the GAEC.¹⁴ Notwithstanding these differences, it is important to study EARLs, since those with 2 or more associates (the maximum can be 10) constitute a type of group farm, requiring the associates to make capital investments and cooperate. In fact, sometimes EARLs change into GAECs or vice versa (GAEC & Sociétés, 2010a). Today, many GAECs have sustained for long years (one with six associates is over 50 years old: Copex, 2012), and have moved on to another generation of associates.

These farming models, based on close cooperation among associates (especially in GAECs), are of considerable contemporary interest for France and other countries. Apart from the potential advantages of group farming already listed, there are others, such as the ability of group farms to provide viable livelihoods to those (especially the young) who lack adequate land or capital to farm alone, or who like a rural life and are willing to cooperate on a daily basis for the less strenuous work life possible in a GAEC compared with individual farming. In a GAEC, for example, associates can substitute for each other in labour-intensive or monotonous tasks and take holiday breaks. Resource pooling can also allow associates to invest in larger capital-intensive machines, expand farm size, diversify farm activities or specialize in labour-intensive work such as animal breeding, and enlarge the range of skills and knowledge beyond those found in one farmer or one family. The small number of associates who know each other well can also help overcome the classic problems of free-riding and work shirking through peer-vigilance and mechanisms for enforcing accountability, such as weekly meetings and management committees.

Notwithstanding their relevance, long duration and numerical strength, however, there is rather little systematic and rigorous research on GAECs. On the quantitative side, although the French agricultural census provides periodic data on the numbers, locations, composition and characteristics of GAECs, these data (which are comprehensive from 1988) appear to have been little-used analytically, beyond the Ministry of Agriculture's own descriptive briefs (see various issues of *Agreste Primeur* and also *Agreste*, 2014). The studies that do use the census – such as those investigating farm size inequality across departments (Piet et al., 2012), or those preparing a typology of farm size and type of labour used (Bignebat et al., 2015) – fail to separate individual and group farms, thus conflating a crucial characteristic of French farms. In fact, most existing research on GAECs is qualitative, and even this is limited in scope. Between 1965 and 1988, for example, the archives of GAEC & Sociétés list 29 master's theses on the subject, but most are sociological studies of single GAECs or writings on GAEC law. In this period, there was in fact a fascination with the history of GAEC formation. For instance, a doctoral dissertation by an American anthropologist who researched 42 GAECs (not selected systematically) spread across France in the mid-1970s provides historical insights on how GAECs emerged and functioned (Murphy, 1977). There are also occasional research papers on the administrative, legal and incentive provisions that encouraged GAEC creation (Raup, 1975), or on how family farms evolved into GAECs (Bazile and Viallon, 1985; Madec, 1983; Reboul, 1977), as well as some specialized monographs, such as on the involvement of GAEC associates in the social movements of the 1970s (Alland and Alland, 2002). In fact, this preoccupation with the legal, philosophic, historical or social aspects of GAECs continues, with empirical exploration being limited to

a few GAECs, as evidenced by more recent journal articles (e.g. Barthez, 2007; Chandellier et al., 2012; Foyer et al., 2012), as well as two special issues of *Revue de Droit Rural* (2012).

These writings are insightful, but they leave many questions unanswered, not only about the characteristics of France's group farms and changes in them over time, but particularly about the geographic variations in their incidence across France. Explaining this variation through a rigorous empirical analysis, in order to better understand the conditions that would be conducive to cooperation in production, is the central concern of this paper, and one which has not been addressed so far in the existing literature.

Characteristics of farm structures and changes over time

To map the range of French farming enterprises over time, we use department-wise data from the French agricultural censuses of 2010, 2000 and 1988 (Ministry of Agriculture, 2014).¹⁵ We complement this with data from other sources, to quantify the explanatory variables outlined in the next section. Our analysis is confined to 92 of the 96 departments of metropolitan France: the four excluded departments (Paris, Hauts-de-Seine, Seine-Saint-Denis and Val-de-Marne) are highly urbanized and have few farms. In this section, we describe the broad characteristics of France's group farms and their evolution, before examining their regional variation in the following sections.

Farm types and shifts over time

In 2010, individual farms, GAECs and EARLs respectively constituted 69.4%, 7.6% and 16.0% of all farms (Table 1). Notably though, almost half of the EARLs had only one associate, making them effectively similar to individual farms except for their legal status. Since our interest is in understanding farmer cooperation, we will concentrate on GAECs, with some comparison with EARLs that have two or more associates (herein called EARL ≥ 2).

In the 22 years between 1988 and 2010, the number of all farm enterprises fell by more than 50%, mainly due to the dramatic decline in individual farms (Table 1). In contrast, between 1988 and 2000, GAECs and EARLs increased notably, in both numbers and proportions, after which EARLs continued to increase numerically, but GAECs showed a slight decline. Since 2010, however, even GAEC numbers have been rising. According to GAEC & Sociétés, 2296 new GAECs were registered in 2014 alone, many of them being couple GAECs which were by then legally permitted.¹⁶

Table 1. Farms by legal status in 1988, 2000, 2010

Type of farm	1988		2000		2010	
	No.	%	No.	%	No.	%
Individual	945,801	93.0	537,444	81.0	339,836	69.4
GAEC	37,708	3.7	41,474	6.3	37,204	7.6
EARL	1523	0.2	55,913	8.4	78,594	16.0
Other	31,393	3.1	28,785	4.3	34,252	7.0
All farms	1,016,425	100.0	663,616	100.0	489,886	100.0

GAEC, *Groupement Agricole d'Exploitation en Commun*; EARL, *Exploitation Agricole à Responsabilité Limitée*.

In this and subsequent tables, all farms (small as well as professional) are included.

Source: Calculated from the 1988, 2000 and 2010 agricultural censuses (Ministry of Agriculture, 2014).

In proportional terms, the numbers of both GAECs and EARLs rose between 1988 and 2010, with GAECs doubling from 3.7 to 7.6 as a percentage of all farm enterprises. According to GAEC & Sociétés (2010a: 10), there is a strong correlation between the increase in GAEC numbers and government incentives to encourage young people to settle in agriculture (DJA or *Dotation Jeunes Agriculteurs*).¹⁷ But other factors, which cannot be explored here, may also underlie these shifts.

Social composition of group farms

Although the majority of GAECs continue to be constituted only of family members (84% in 2010), proportionally family GAECs have been declining and non-family or mixed GAECs have been increasing (Table 2). Among family GAECs, those constituted by father and son fell from 59% in 1988 to 28% in 2010, while same-generation GAECs – typically of brothers or cousins – doubled. This suggests that GAECs are moving towards equality among associates (since father–son GAECs contain an implicit social hierarchy, notwithstanding their equal legal status as associates).

EARLs, by contrast, were predominantly single-member units (54%) in 2010, 29% being couple EARLs and only 8% being father–son units, with the rest being variously constituted (Table 2 and *Agreste*, 2014: 17). Together, GAECs and EARL ≥ 2 comprised 14.9% of all farms in 2010.

Group farms are also becoming important in terms of annual work units (AWUs) in agriculture, with 1 AWU being equivalent to one adult working full-time for a year on the farm (termed '*Unité de Travail Annuel*' or UTA in France).¹⁸ In 2010 (the year of the last French agricultural census), GAECs accounted for 15% of AWUs and EARL ≥ 2 for 12.7% of AWUs, together providing 27.7% of total AWUs (Table 3). This is a marked rise from 8% in 1988, while the figures for individual farms fell from 82.6% to 44.1% during

Table 2. GAEC and EARL by social composition in 1988, 2000 and 2010

Type of GAEC and EARL	1988		2000		2010	
	No.	%	No.	%	No.	%
GAEC						
1. GAEC mixed	460	1.3	1,596	4.1	2,654	7.4
2. GAEC non-family	1152	3.3	2,655	6.9	3,100	8.7
3. GAEC family	32,891	95.3	34,489	89.0	29,951	83.9
– GAEC father and son	(19,283)	(58.6)	(11,286)	(32.7)	(8285)	(27.7)
– GAEC same generation	(7598)	(23.1)	(15,368)	(44.6)	(14,799)	(49.4)
– GAEC several generations	(5965)	(18.1)	(7602)	(22.0)	(6434)	(21.5)
– GAEC couple ^a	(45)	(0.1)	(233)	(0.7)	(433)	(1.4)
All GAEC with information ^b	34,503	100.0	38,740	100.0	35,705	100.0
EARL						
1. EARL single person	789	56.0	31,729	56.7	42,747	54.4
2. EARL ≥ 2 associates	619	44.0	24,184	43.3	35,847	45.6
All EARLs with information ^c	1408	100.0	55,913	100.0	78,594	100.0

Note: Figures in brackets relate to subcategories of 'GAEC family'.

^aCouple GAECs were not legally permitted till 2010. These numbers could thus reflect either misreporting or farms in transition which earlier had >2 associates.

^bExcludes cases with missing information on GAEC type

^cExcludes cases with missing information on associate numbers

Source: Calculated from the 1988, 2000 and 2010 agricultural censuses (Ministry of Agriculture, 2014).

Table 3. Annual work units (AWUs) and average SAU area by farm type in 2010

Type of farm	Farms		AWUs		AWUs per farm	SAU (ha) ^a per AWU	SAU (ha) per farm
	No	%	No	%	No	No	No
Individual farm	339,836	69.4	331,179	44.1	0.98	34.8	34.0
Other farms	34,252	7.0	128,381	17.1	3.75	19.0	71.1
GAEC	37,204	7.6	112,963	15.0	3.04	48.5	147.6
EARL	78,594	16.0	178,359	23.8	2.27	42.0	95.2
– EARL ≥ 2	(35,847)	(7.3)	(95,295)	(12.7)	(2.66)	(43.3)	(98.4)
All farms	489,886	100.0	750,883	100.0	1.53	35.8	55.0

Note: Figures in brackets are a subcategory of EARL.

^aFarm land (SAU) includes both crop land (under seasonal or perennial crops) and permanent pastures.

Source: calculated from the 2010 agricultural censuses (Ministry of Agriculture, 2014).

this period. In 2010, the per-farm AWU (including salaried and seasonal workers) was 3.04 for GAECs, 2.27 for EARLs and 0.98 for individual farms. GAECs (and group farms more generally) thus provide adult employment which is proportionately greater than their numeric presence. Also, in 2010, 1 AWU on average managed 48.5 ha in a GAEC, against 42 ha in an EARL and 35 ha in an individual farm (Table 3).

Moreover, if we take average land area, measured here in terms of ‘*Surface Agricole Utile*’ (SAU) or utilized agricultural area,¹⁹ GAECs are substantially larger in area than other types of farms and grew faster than them between 1988 and 2010. In 2010, GAECs managed 147.6 ha on average, relative to 95.2 ha managed by EARLs and only 34.0 by individual farms (Table 3).²⁰ Notably too, we found that multi-generational family GAECs and GAECs of both family and non-family associates tended to be the largest, going up to 180 ha on average. A larger number of associates enables farms to diversify their activities and expand in area, while also making such expansion necessary for an adequate income per associate.

Activity specialization

Most important for our discussion, group and individual farms differ notably in their product specialization. In 2010, almost one-quarter of all farms specialized in seasonal crops (mostly cereals and oilseeds), 42% in animals, and 21% in horticulture or gardens, plantations and vineyards, with the rest doing mixed farming (Table 4). However, these proportions varied significantly by farm type. Over 65% of GAECs were involved in animal rearing (with 51% breeding meat and/or milk cattle), and only 10% were producing seasonal crops. EARL ≥ 2 came in between these, with the main activity again being animal farming, practised by 47%, followed by crops (22%).²¹

This activity pattern suggests a link between GAEC formation and farm specialization. Rearing animals tends to be much more labour-intensive than growing crops, since animals need daily care (feeding, milking, etc.) even with some mechanization. Moreover, this intensity continues throughout the year and, unlike crops, is not limited to seasonal peaks. Hence we would expect farmers who want to rear animals to veer towards group farming. Also, we might surmise that one of the factors underlying the concentration of GAECs in some regions over others could be ecology, which favours a particular type of

Table 4. Product specialization by farm type in 2010

Farm specialization (OTEX)	All Farms		GAEC		EARL \geq 2 associates		Individual farms	
	No.	%	No.	%	No.	%	No.	%
Field crops	118,748	24.3	3740	10.1	7846	22.3	82,035	24.3
Cattle	120,526	24.7	18,791	51.0	11,113	31.6	77,806	23.0
– Meat	(59,519)	(49.4)	(4150)	(22.1)	(2374)	(21.4)	(48,404)	(62.2)
– Milk	(50,219)	(41.7)	(11,653)	(62.0)	(7594)	(68.3)	(24,056)	(30.9)
– Mixed	(10,788)	(9.0)	(2988)	(15.9)	(1145)	(10.3)	(5346)	(6.9)
Sheep and/or goats	56,216	11.5	2549	6.9	1699	4.8	47,974	14.2
Pigs, cattle (stall-fed) and/or chicken	29,881	6.1	2721	7.4	3723	10.6	15,931	4.7
Mixed farms	59,579	12.2	6782	18.4	5185	14.8	39,837	11.8
Horticulture or plantation	32,865	6.7	862	2.3	1432	4.1	23,934	7.1
Viticulture	69,872	14.3	1424	3.9	4122	11.7	50,347	14.9
All farms with OTEX information	487,687	100.0	36,869	100.0	35,120	100.0	337,864	100.0
Unlabelled farms	1,770	–	0	–	0	–	1536	–
No information on OTEX	429	–	335	–	727	–	436	–
All farms	489,886		37,204		35,847		339,836	

Percentages exclude farms which were unlabelled or had missing information on specialization.

Figures in brackets are subcategories of cattle breeding.

Source: calculated from the 2010 agricultural census (Ministry of Agriculture, 2014).

specialization. For instance, animal farming is often the best option in many mountainous or semi-mountainous areas (as, say, in parts of central-eastern France), where crop cultivation tends to be less profitable. Here, difficult work conditions could also encourage cooperation.²²

Similarly, regions with more permanent pastures would provide fertile ground for forming GAECs, although, technically, intensive livestock breeding is also possible through stall-feeding. Consider, for instance, Figures 3 and 4. Figure 3, which gives the regional spread of all farms specializing in animal breeding,²³ reveals an interesting overlap between animal farming regions and the GAEC concentrations noted from Figures 1 and 2: both show concentrations in western and eastern France. In turn, we would expect animal breeding to be linked to permanent pastures. Figure 4 gives us permanent pasture land as a percentage of SAU. Here, the overlap with GAEC incidence and animal farming is broadly consistent in the eastern parts but not in the western. In western France, as in Bretagne, there is little pasture land, and here the animals are largely stall-fed, although many still grow fodder for feed.

We also explored and found an interesting relationship between the regional concentration of pastures and regional *changes* in GAEC numbers over time. In Table 1, we had noted that in absolute numbers GAECs increased considerably between 1988 and 2000, and then decreased between 2000 and 2010, returning broadly to the 1988 figure by 2010. To see if this held across departments, we disaggregated these changes further, mapping departments where GAECs had increased in both periods; decreased in both periods; or had moved in divergent directions between the two periods. Figure 5 shows a notable similarity to

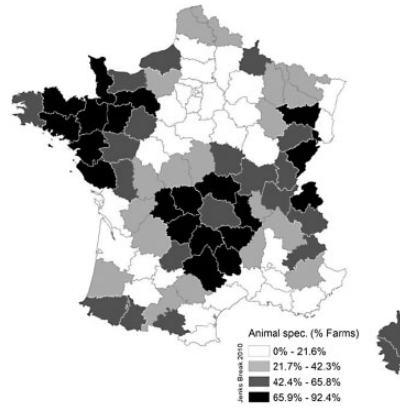


Figure 3. Farms specializing in animal breeding as a percentage of all farms in 2010.

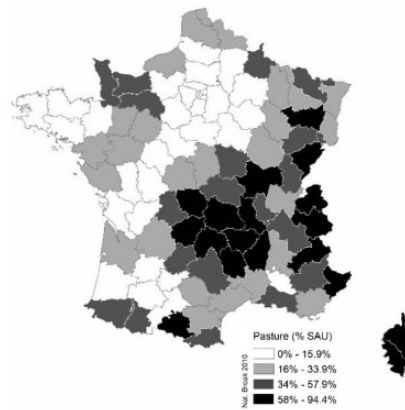


Figure 4. Permanent pastures as a percentage of SAU land in 2010.

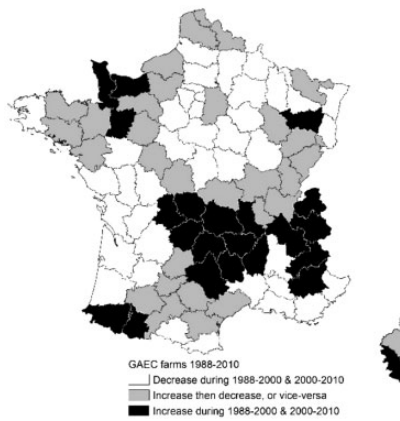


Figure 5. Changes in absolute numbers of GAECs: 1988–2010.

Figure 4: the departments where GAECs have increased in absolute numbers consistently since 1988 overlap in fair extent with departments that have high proportions of permanent pastures, and vice versa.

In addition, Appendix Table 1 shows that the GAECs specializing in animal breeding are the ones that have increased in absolute numbers between both periods (with the exception of stall-fed breeding), while the GAECs specializing in crops and horticulture/plantations have decreased in numbers in both periods, suggesting a particular link between GAEC formation and pasture-dependent animal farming. This relationship between the regional incidence of GAECs and the regional concentration of permanent pastures (and hence animal farming) is further borne out by our regression results.

One additional point needs to be mentioned here, which is difficult to capture statistically but is likely to have a bearing on changes in GAEC incidence over time, namely a snowballing effect. We would expect that in regions where GAECs have been historically successful, a demonstration effect would lead more farmers to see GAECs as alternatives to individual farms and form one themselves. Also, over time, such regions would stimulate investment in support services such as for refrigeration, milk processing and storage, animal slaughter and marketing, which newcomers forming GAECs could take advantage of. Similarly, farmers who have been exposed directly to GAECs formed by their parents or relatives or neighbours are more likely to form or join GAECs themselves than are those totally unexposed to such enterprises. All these factors could intensify a regional clustering of GAECs over time. We get some support for this phenomenon in the observed strengthening over time of regional clusters around animal breeding, for which the support services mentioned above are likely to prove much more important than for crop cultivation. In other words, a snowballing effect could vary across activities. This could be one among other factors underlying the changes in group farm numbers between 1988 and 2010, but exploring these factors further is beyond the scope of this paper.

Explaining regional variability: hypotheses

We draw on our conceptual and historical understanding of French farming to identify potential explanatory factors for the observed regional variability of GAECs and $\text{EARL} \geq 2$ in 2010. Some factors could be economic, others ecological, social/cultural or demographic. We use an ordinary least squares (OLS) regression model (specified below) to test for the significance of the identified factors. The dependent variable Y is the percentage of GAECs (or $\text{EARL} \geq 2$) to total farm enterprises in a department:

$$Y_d = \beta_0 + \sum_i \beta_i X_{i,d} + \sum_j \lambda_j R\text{dummy}_j + \varepsilon_d$$

where d represents departments (there are 92), X_i denotes the explanatory variables (detailed below and in Appendix Table 2), $\{\beta_0, \beta_i\}$ are the parameters to be estimated, and R represents the 13 regions we have controlled for.

The explanatory variables are the following:

- *economic* (percentage of farms with SAU <20 ha, 20–49 ha and ≥ 50 ha respectively in 1970; and income Gini index in 2010);
- *ecological* (percentage SAU under permanent pasture in 2010, and percentage SAU irrigable in 2007);
- *social* (number of active priests *c.*2010–2014); and

- *demographic* (percentage of students specialized in agriculture in 2010; and percentage of women among farm workers in 2010).

Below we outline our hypotheses relating to these variables, first for GAECs and then briefly for EARL ≥ 2 .

Economic factors

We examine two economic variables to explain the regional (departmental) incidence of GAECs: (1) farm size categories dominant in the department in 1970 (that is, fairly soon after the GAEC law became effective); and (2) income inequality as measured by the Gini index.²⁴

In relation to pre-existing farm size categories in a department, normally we would expect the presence of a large number of small farms to encourage group farming, since resource pooling would help non-viable farms to create a viable economic unit. This trajectory may not play out for GAECs, however, since GAEC associates are legally required not only to pool their resources (each has to bring a share of capital or land), but also to work full-time on the farm without seeking outside employment, or running individual farms on the side. This means that the GAEC must provide associates with at least a basic income. Moreover, the idea that all farms (not just GAECs) should be large enough to yield a minimum income for the family was embedded in the French government's 1975 decree, under its Rural Code (article 188), which specified the minimum surface area (*Surface Minimum d'Installation* (SMI)) for settling in agriculture.²⁵ These factors are likely to reduce the chances of very small farms combining to form GAECs. Rather, we would expect departments with a high percentage of small farms in 1970 (the earliest year for which there are data after the GAEC law became effective) to be *less likely* to have formed GAECs.

Departments with a high percentage of very large farms in 1970 would also be less likely to form GAECs, since they would not need to do so to tap economies of scale, although they may form one for other reasons, such as engaging in multiple economic activities. In short, departments with a high percentage of farms in the very small and very large categories in the early period of GAEC formation may be expected to have lower proportions of GAECs today. It also means that the relationship between farm size categories and GAEC incidence is likely to be non-linear. In this context, Raup's (1975: 21) observations for the 1970s are especially notable: he observed that GAECs tended to be concentrated in areas dominated by medium-sized farms, and were rarer in areas dominated by either very large or very small farms. He did not, however, statistically test this observation, as we will be doing.

To test the effect of a pre-existing farm size distribution on GAEC formation, we used data from the 1970 agricultural census. Although it does not give the size of each farm, it gives us the proportion of farms in different farm size categories (in SAU units) in the department. Our hypothesis is that the higher the proportion of farms in a department in 1970, in either the <20 ha category or the ≥ 50 ha category, the lower is likely to be the proportion of GAECs to total farms in 2010 in that department. In contrast, the higher the proportion of farms in the 20–49 ha category in 1970, the higher is likely to be the proportion of GAECs to total farms in 2010.

With regard to our second economic variable, we would expect GAECs to thrive more in regions of relative economic equality, since GAEC formation is likely to need the prevalence of a spirit of cooperation. Indeed, equality among associates is an important principle in GAEC formation and functioning. Also, group homogeneity is often noted to be more conducive to cooperation than heterogeneity (Baland and Platteau, 1996). Hence regions

with high inequality could adversely affect GAEC formation. We measure inequality by using the Gini index (Gini coefficient \times 100) of the department's per household taxable income.

Ecological factors

We would expect local ecology to play an important intermediary role in GAEC formation. As noted earlier, some regions of France are less suited to crops, such as ecological zones with poor land quality, marginal pasture areas and mountain terrain characterized by low crop yields, leaving animal breeding on pastures as the main livelihood option. In addition, the CAP has regulations restricting the conversion of permanent pastures to crop land.²⁶ For example, the CAP reform of 2003 linked the maintenance/use of permanent pastures to subsidies, which would be reduced if the pastures were converted to cropland (see e.g. Beaufoy et al., 2011). Moreover, the reform specified that land under permanent pasture in a given reference year be maintained. In France, the reference year was 2003 and the regulation was enforced from 2005 (Desjeux et al., 2007: 19).²⁷ In many regions, therefore, ecological and related conditions encourage milk or meat farming over crops or other activity. Livestock breeding, in turn, needs high labour inputs throughout the year, which would encourage GAEC formation, since GAECs can induct more adults to share the work. There would therefore be a greater likelihood of GAEC formation in regions with more permanent pastures (and hence greater potential for livestock farming). We use the percentage of SAU land under permanent meadows and pastures in a department as an explanatory variable, expecting it to be related positively to the incidence of GAECs in the department.

A region's irrigation potential can also affect activity choices. Crop cultivation is more dependent on irrigation than other farm activities, and one crop – maize – alone accounts for half of all surface area irrigated in France (Barraqué et al., 2010). Farmers in regions with a higher percentage of irrigable land are thus more likely to cultivate crops, and hence less likely to form GAECs. We use irrigable area as a percentage of total SAU to test this effect. Notably, only 9.8% of SAU land in France was irrigable in 2007 and only 5.8% was actually irrigated around that time.²⁸

Social factors

The importance of social norms and relations of trust and reciprocity in laying ground conditions conducive to cooperation is now widely recognized in collective action theory. In the early years of GAEC formation, catholic priests and religious associations, especially the JAC, played an important role in establishing social norms that emphasized community, cooperation and benefit sharing (Murphy, 1977). René Colson, a French farmer, became the general secretary of JAC in the early 1940s and mooted the idea of small farmers pooling resources to invest in machinery, and practice modern agriculture through cooperation.²⁹ In 1951, he founded an organization with his colleagues, which evolved into GAEC & Sociétés 40 years later (GAEC & Sociétés, 2012: 5).

Catholic priests worked with JAC to encourage young farmers to form GAECs (Murphy, 1977; Raup, 1975). To capture these social effects on GAEC formation, we used the number of active (non-retired) Catholic priests in a department in the early 2010s as a proxy measure to explain the regional incidence of GAECs. In today's France, of course, religion is a less cohesive force, and other types of institutions – political bodies, farmers' unions, and similar associations – can generate social capital, cohesion and support. But we lack data to

empirically measure the impact of these diverse institutions, which may also pull in different directions.

Demographic factors

We would expect at least two demographic factors to affect the geographic incidence of GAECs: availability of educated youths specialized in agriculture and the gender composition of the agricultural workforce. The first is likely to matter especially due to the link between having an agricultural degree and getting state support. For instance, formal training in agriculture at the secondary level or above has been essential (at least since the early 1990s: Rogers, 1991: 150) for getting the young farmer subsidy (DJA) that is offered by the French government and the EU (see also endnote 17). Although the DJA is not linked to any type of farm (group or individual), a young farmer could use it more effectively by becoming a partner in a GAEC than by setting up an individual farm on his/her own, since this could require additional investments. The importance of formal training is strengthened further by the necessity (barring exceptional circumstances) for farming establishments to have professional agricultural skills in order to receive national and European incentives.³⁰ A degree can also help farmers acquire the skills to manage bigger farms, which need more complex accounting procedures. Moreover, without an agricultural qualification, farmers face greater restrictions on buying or renting farm land.³¹ Overcoming such restrictions matters more to GAECs, since they have a greater need than individual farms to expand farm size in order to provide for all the associates. Overall, therefore, in regions where a larger percentage of students are specializing in agriculture, the potential for constituting GAECs is likely to be greater.

The gender composition of the agricultural workforce is also likely to matter, given the noted legal restriction until 2010 on wives becoming GAEC associates with husbands, unless there was a third associate. This restriction was much debated over the years. Some argued (unsuccessfully) that excluding spouses was neither pragmatic nor conducive to the efficient organization of a farm (e.g. Foyer et al., 2012). Others felt that the restriction would free wives from hard agricultural labour and allow family holidays, which would prove difficult if both spouses worked on the same farm. In 2010, this restriction was legally removed (GAEC & Sociétés, 2010b), but since we are using 2010 data it is too early to catch the impact of this change. For our analysis, we expect that the larger the percentage of female farm workers in a department, the lower would be the proportion of GAECs.

What about EARL ≥ 2 ? We may expect the effects to be similar to GAECs on some counts but different on others. In terms of divergence, first, since not all EARL associates work on the farm, EARLs are less likely to be affected by the labour intensity of an activity (in particular cattle versus crop farming), and therefore by whether a department is dominated by permanent pasture or crop land. In fact, EARLs may even favour crops since they need less labour than animal upkeep (in other words, the relationship could even be negative). Second, related to crops, we would expect the availability of irrigable land to be positively related to the incidence of EARLs. Third, since EARL ≥ 2 could be formed by couples even before 2010, and given that associate wives are not required to work in an EARL, we do not expect the percentage of women working in agriculture to notably affect the incidence of EARL ≥ 2 .

Regression results

In our regressions, we examine the impact of the above-mentioned explanatory variables on the two dependent variables at the department level: (1) the percentage of GAECs out of total farm enterprises; and (2) the percentage of EARL ≥ 2 farms out of total farm

enterprises. The analysis is based on 2010 data, unless another year is mentioned. Exact definitions of the explanatory variables are given in Appendix Table 2. All equations are adjusted for regional fixed effects based on the administrative classification of France into 13 regions in the early 2010s. The regression results are presented in Table 5 and the summary statistics in Appendix Table 3.

First consider the results for GAECs (Table 5, equation 1). Of the two economic variables, the outcomes for farm size are particularly interesting. We find that the higher the proportion of 20–49 ha farms and the lower the proportion of ≥ 50 ha farms in 1970, the greater the share of GAECs to all farms in 2010. Departments with a 1 percentage point higher proportion of 20–40 ha farms (relative to < 20 ha farms) in 1970 have a 0.15 percentage point higher share of GAECs in 2010. In contrast, departments with a 1 percentage point higher proportion of ≥ 50 ha farms (relative to < 20 ha farms) in 1970 have a 0.11 percentage point *lower* share of GAEC farms in 2010. In other words, the regional incidence of GAECs in 2010 rises with an increase in the proportion of 20–49 ha farms but falls with an increase in the proportion of ≥ 50 farms in 1970, while departments dominated by < 20 ha farms come in between. In short, it is in departments with a predominance of farms which were neither too small nor too big in 1970 that we find the highest proportions of GAECs four decades later (as was observed for an earlier period by Raup, 1975); and the relationship between farm size and GAEC formation is non-linear.³²

Our second economic variable, the Gini index of household taxable income, is again consistently and negatively significant, as hypothesized. Departments with higher levels of income inequality have a significantly lower proportion of GAECs relative to all farms. On average, departments with a one point higher Gini index have a 0.4 percentage point lower proportion of GAECs.

Table 5. Geographic variations in the incidence of GAECs and EARLs: regression results

Explanatory variables	Dependent variables: percentage of total farms in 2010	
	GAECs equation 1	EARL ≥ 2 equation 2
Percentage of farms with SAU 20–49 ha, 1970	0.154*** (0.000)	0.054* (0.063)
Percentage of farms with SAU ≥ 50 ha, 1970	–0.106*** (0.001)	0.058* (0.069)
Income Gini index, 2010 (from 0 to 100)	–0.398** (0.042)	–0.074 (0.637)
Percentage SAU under permanent pastures, 2010	0.077*** (0.000)	–0.030*** (0.009)
Percentage SAU 2010 that was irrigable in 2007	–0.047 (0.119)	0.041*** (0.028)
No. active priests, c.2010–2014	0.008* (0.055)	0.003 (0.291)
Percentage of students specialized in agriculture, 2010	0.346*** (0.023)	0.116 (0.234)
Percentage of women among farm workers, 2010	–0.916*** (0.000)	0.061 (0.483)
Controlled for 13 regions	Yes	Yes
Constant	43.747***	6.87
N	92	92
Adjusted R ²	0.82	0.81

SAU, *Surface Agricole Utile* (utilized agricultural area).

All regression equations are with robust standard errors and adjusted for regional fixed effects.

Figures in parentheses are *p* values. Significance: *** at 1%; ** at 5%; * at 10%

Of the two ecological variables, however, although the signs of the coefficients for both variables are in the directions hypothesized, only the pasture variable is significant: the higher the percentage of permanent pasture to total farm land in the department, the greater the proportion of GAECs to other farms, while irrigable area is negative but insignificant. Our regression results for pastures thus support and supplement the observations in the previous section.

The social variable is again significant. The greater the number of active priests in a department, the greater the percentage of GAECs to other farms, although the coefficient is small. The demographic variables have an important impact, however. Departments with a higher proportion of students specializing in agriculture have a significantly higher percentage of GAECs, and those with proportionately more female farm workers have a significantly lower percentage of GAECs. A 1 percentage point rise in the proportion of students in agriculture raises the share of GAEC farms by 0.35 percentage points, while a 1 percentage point rise in the proportion of women among farm workers lowers the share of GAEC farms by almost 1 percentage point (equation 1). Overall, our model explains 82% of the regional variations in GAEC proportions.

Now consider the $EARL \geq 2$ results (Table 5, equation 2). Here we see interesting differences with GAECs. To begin with, the effect of farm size distribution in 1970 on the incidence of $EARL \geq 2$ in 2010 is (as with GAECs) positively significant for the 20–49 ha category, but unlike GAECs it remains positively significant even for the ≥ 50 ha category. Departments with a 1 percentage point higher proportion of 20–49 ha or ≥ 50 ha farms in 1970 (relative to < 20 ha farms) have a 0.05 percentage point higher share of $EARL \geq 2$ in 2010. The difference between the coefficients of the 20–49 ha size group and the ≥ 50 size group is also significant. In other words, it is departments dominated earlier by medium to large-sized farms that have the higher shares of $EARL \geq 2$ in 2010, while a dominance of < 20 ha farms in a department in 1970 was a deterrent to $EARL \geq 2$ formation.³³ It is likely that the differences between $EARL \geq 2$ and GAECs in the farm size results arise because EARLs from the start could be managed as large corporate entities with a few associates, whereas with GAECs large farms required several associates, especially with labour-intensive animal production, and this could make coordination more difficult. In recent years, however, mechanization has moved apace even in milk farming, with the introduction of robots for milking, and GAECs engaged in animal breeding too can grow to quite large sizes.

The results for GAECs and $EARL \geq 2$ also differ on other counts. For instance, for $EARL \geq 2$ although the Gini index is negative, it is not statistically significant, nor is the number of active priests. The percentage of SAU under pasture is negatively significant for $EARL \geq 2$ (while for GAECs it was positively significant), and the percentage of SAU irrigated is positively significant for $EARL \geq 2$, whereas it was negative and insignificant for GAECs. These results are in keeping with our earlier observations that $EARL \geq 2$ farms are more likely to undertake crop cultivation than GAECs, while animal farming (linked with pastures), with its high labour intensity, is less likely to be favoured by $EARL \geq 2$ farms, understandably since (unlike GAECs) they cannot depend on the guaranteed labour of associates.

In addition, for $EARL \geq 2$ (in contrast to GAECs), the impact is insignificant for both proportion of students in agriculture and proportion of females among farm workers. That gender is not significant is not surprising, since unlike GAECs (as noted earlier) married couples could form EARLs even before 2010. Across all the variables, the coefficients of the explanatory variables for the $EARL \geq 2$ equations are also much smaller than for the GAEC equations. However, our model explains 81% of the regional variations for $EARL \geq 2$.

Overall, therefore, the departments that tend to have a larger percentage of GAECs are those that were dominated by middle-sized farms historically (rather than very small or large

farms); whose ecological conditions are more favourable to animal farming (especially the percentage of land under permanent pastures); whose economic and social conditions are conducive to cooperation (less economic inequality and a greater presence of institutions that promote community cooperation); and which have particular demographic characteristics (a greater presence of students in agriculture and a lower presence of women among farm workers). For $EARL \geq 2$, economic inequality matters less, and although farm size distribution is important, the effect is different from GAECs at the higher ranges. Also, while the ecological variables are significant, it is in the direction opposite to that for GAECs, and the demographic variables are insignificant. On gender, given the change in GAEC laws, the difference between GAECs and $EARL \geq 2$ farms is likely to disappear in time.

Concluding reflections and policy pointers

What lessons can we draw from this analysis for France, and for regions beyond France? For France, our analysis suggests, first, that group farming will tend to find more fertile ground in regions that have less overall economic inequality, a larger percentage of farms historically in the lower to middle size range (rather than very small or very big) and more social institutions that promote community cohesion/cooperation.

Second, cooperative ventures are more likely to be sought for those agricultural activities that require intensive labour inputs *on an everyday basis*, such as cattle breeding (for milk or meat). Hence group farms are more likely to emerge (or take root more easily if promoted) in ecological zones that have a high incidence of permanent pastures, or where other types of farming are less profitable or less possible, as in harsher mountain areas and in zones with poor-quality land. The reverse is likely in regions that have favourable conditions for crop cultivation due to, say, soil type or access to irrigation. Since crops require less intensive labour inputs on a regular basis than animal breeding, they can also be managed effectively by individual families (or associations like EARLs, which have few working associates), with peak requirements being covered by hired labour and machines. Here there would be less incentive to undertake group farming.

Third, demographic factors matter, such as the incidence of agricultural graduates or of women farm workers in a region, but these factors can also be subject to legal conditions (as in France), such as whether an agricultural degree is needed to access farm subsidies, or whether spouses alone can form an association.

The incidence of farm enterprises needing lower levels of cooperation than a GAEC, such as $EARL \geq 2$, are likely to be affected by somewhat different factors. Economic inequality and social and demographic factors appear not to matter in the same way, but ecological variables such as pastures and irrigation do matter, depending on the choice of farm specialization and hence intensive labour needs.

These observations stem from our results based on existing models of group farming. Variations on these models may emerge, however, if some of the legal requirements for forming GAECs were relaxed. For instance, GAEC associates need to work full-time on the farm and pool all their productive resources. This requirement implicitly dictates a certain minimum farm size. If associates were allowed to undertake supplementary income-earning activities at an individual level, such as managing their own farms in addition to the group farm, or allowed to seek part-time non-farm work, then even small farms could pool their resources and farm collectively, while also pursuing other earning opportunities. Of course, in such models it would be especially important to set in place mechanisms for monitoring

each associate's work contribution, in order to ensure that the work is equitably shared and the likelihood of free-riding is minimized.

Beyond France, say for other parts of the EU, the factors found significant in our study – especially economic and ecological – are general enough to be relevant. Also, EU laws (such as those pertaining to permanent pastures or subsidies for young farmers) which have played an enabling role for group farming in France would be applicable to other countries in the Union.

For developing countries, however, it is more difficult to extrapolate directly from our results, since their laws governing land use and tenancy and the structure of subsidies tends to be quite different. Even so, it could be argued that efforts to promote group farming are more likely to be received favourably in regions of lower economic inequality, and where the local ecology and economy favour labour-intensive farm activity, such as animal breeding. Many of the other advantages of group farming mentioned earlier, such as labour sharing, viable farm size, resource pooling for capital-intensive investments and skill diversification would apply as well. The GAEC model also points to a potential pathway for women farmers and junior family members in the Global South to move away from simply being unpaid workers on family farms, since it allows spouses, siblings and adult children to become equal business partners in a group farm. At the same time, models that allow a combination of group farming and individual activity (rather than those which only allow group activity) are likely to be more relevant for developing countries, where most farmers cultivate very small farms of a hectare or less, and therefore need to diversify their livelihood portfolios to earn a decent income.

Finally, looking ahead, group farming can provide an important third model of farming, beyond family farms and corporate agriculture, not only for farmers who are seeking better economic and ecological outcomes, but also for newcomers interested in community-based options, agroecological practices and building social and solidarity economies around food and farming systems. GAECs emerged in France as a result of young farmers seeking a third path, away from the negative features of both capitalist and socialist farming, and a government seeking to modernize agriculture within the ambit of families and communities. These motivations are as relevant today, and not just in one country or region but increasingly more globally.

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Notes

1. Land area is only one measure of farm size, but it is the most commonly used. In France, by the 2010 agricultural census, 24.5% of all farms were less than 5 ha in size.
2. See Sabates-Wheeler (2002) and Sabates-Wheeler and Childress (2004) for Romania and Kyrgyzstan respectively; Mathijs and Swinnen (2001) for East Germany; Ruben and Lerman (2005) for Nicaragua; and Agarwal (2010a) for additional examples.
3. See, especially, Robinson (1967) and Nove (1969) for the USSR; Lin (1990) and Putterman (1997) for China; and Goyal (1966) and Agarwal (2010a) for an overview of several countries.
4. See, especially, Agarwal (2010a) for a detailed discussion on both socialist collectivization and the 1950s/1960s experiments in cooperative farming in developing countries.
5. See, e.g., Deininger (1993), Mascarenhas (1988), Haris and Fulton (1999), and Fisher and Qaim (2014).
6. The globally expanding agroecology movement is a case in point (Wezel et al., 2009).
7. For example, there is a growing trend towards community-supported agriculture in Europe and the USA (see, e.g. Adam, 2006), including examples of community members farming jointly on small plots (personal observation in Brussels by Bina Agarwal in 2018). Enrolment in agricultural courses is also growing in the UK and elsewhere (*Guardian* 2016).
8. In 1992, the EU under the CAP began to reduce price support for particular products, while introducing 'direct payments' per farm (or per associate in the case of GAECs).
9. In terms of recognition, for direct subsidies see EU Regulation No. 1307/2013 of 17 December 2013, articles 8.4, 11.5, 41.8 and 52.7. For the European Agricultural Fund for Rural Development (EAFRD), see EU Regulation No. 1305/2013 of 17 December 2013, article 31.4. For debates around this in early 2013, see Saget (2014).
10. The JAC, created in 1929 by youths and priests, became the Rural Christian Youth Movement (MRJC) in 1963, and constituted a vibrant wing of the French Catholic Action.
11. In 1960, another key institution which impinged on farm structures and growth was introduced, namely *Sociétés d'Aménagement Foncier et d'Etablissement Rural* (SAFER). These non-profit private companies work under government supervision, with a pre-emptive oversight on all transactions in agricultural land (Boinon, 2003).
12. GAEC & Sociétés is the national association of GAECs founded by several organizations, including FNSEA, the main farmer's union in France. It publishes the journal *Agriculture de Groupe*.
13. Other French farm enterprises, such as civil companies (SCEA) or commercial companies (SARL), are few in number (*Agreste*, 2014: 3).
14. See <https://www.legifrance.gouv.fr/initRechCodeArticle.do> and therein "Code rural et de la pêche maritime" articles L323-1–L323-16 and R323-1–R323-54. (accessed 20 September 2018).
15. Some details (especially on the social composition of GAECs) are not available in censuses prior to 1988.
16. Personal communication, Eric Mastorchio (GAEC and Sociétés, Paris), March 2016. In the absence of census data after 2010, these figures are strongly indicative.

17. In France, subsidies were established in 1973 for young farmers under 35 years of age, initially for mountainous and less favoured areas, but extended in 1976 to all of France, the amounts varying by the farm's location (Boinon, 2003: 168). Subsequently, other types of aid were added (including start-up aid and business development grants), and the age limit raised to 40 (European Commission, 2013). In 2014, additional conditions were set (*Agreste*, 2014; GAEC & Sociétés, 2016).
18. See the National Institute of Statistics and Economic Studies, France: <https://www.insee.fr/fr/metadonnees/definition/c1039> (accessed 20 September 2018).
19. SAU includes arable land (that is land under crops, vegetables, fallows, temporary pastures, and perennial crops such as vines and orchards) and permanent pastures, but excludes woods and forests.
20. France distinguishes between 'small' farms and 'professional' farms (namely 'medium' and 'big' farms) based on their annual standard gross production or 'SGP' (www.insee.fr/en/metadonnees/definition/c1354, accessed 20 September 2018). We based our analysis, however, on all farms, in order to test which farm size categories were more likely to form GAECs. Also, for international comparability, we used agricultural area rather than SGP to define farm size.
21. See also *Agreste* (2014) for a discussion on activity specialization and farm type.
22. Within the broad category of 'mountain areas' there can of course be exceptions, but typically mountain areas tend to be less suitable for crops than flat areas or valleys, in terms of soil, climate, potential for irrigation, mechanization and market connectivity. The government also recognizes these disadvantages in the special incentives it gives for mountain areas.
23. Animal breeding includes farms breeding cattle for milk and/or meat (grazed or stall-fed), sheep, goats, pigs and poultry.
24. We also tried another economic variable, namely percentage population that was jobless in the department in 2008 or earlier, to see if unemployment in the past affects GAEC percentages in 2010, but the coefficients were not significant in most equations. Also, the data aggregate unemployment across the department and do not separate *rural* joblessness. It is also difficult to anticipate how much the time lag may be. Hence we have not included this variable in our results.
25. Fixed by ministerial decree (and periodically revised), the SMI varied by departments and zones within departments, according to land quality and activity. However, we could not find historical SMI data for all departments that we could use as the threshold level. SMI specifications were discontinued in 2014. See <http://www.terresdeurope.net/SMI.asp> (accessed on 20 September 2018).
26. Under French rules, permanent pastures are 'areas devoted to grass production or other herbageous fodder crops, in place for 5 years or more (except fallow lands). These permanent pastures are [so] named whether [they are] permanent grasslands, temporary grassland more than 5 years old, moorland, heath and rangelands' (Beaufoy et al., 2011: 31).
27. See also European Union (2009), wherein Regulation (EC) No. 1782/2003 recognized the environmental benefits of permanent pastures and sought to encourage their maintenance and prevent their mass conversion to cultivated land. This principle still stands (see Regulation No. 1307/2013 of the European Parliament and of the Council of 17 December 2013).
28. See the Ministry of Agriculture at <http://www.stats.environnement.developpement-durable.gouv.fr/Eider>, accessed 10 February 2015.
29. See also Flauraud (2006) on JAC and Hervieu and Purseigle (2008) on the influence of Christian youth movements on young farmers in France, historically.
30. <http://www.terresdeurope.net/en/acquiring-capacity-french-professional-agricultural-skill-qualifications.asp> (accessed on 20 September 2018).
31. See articles L331-1–L331-12 and R331-1–R331-12 of the French Rural Code.
32. We also tested the impact of average farm size and farm size square in 1970 on GAEC incidence in 2010: both were significant but with opposite signs (the former positive, the latter negative), again indicating a non-linear effect.
33. This is also supported by an additional regression we ran with only the <20 ha farm size category in equation 2. The coefficient was significant and negative (−0.056).

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Appendix Table I. GAECs by farm specialization, 1988–2010

Farm specialization	GAEC (numbers)			Annual rate of change over given period		
	1988	2000	2010	2000–1988	2010–2000	2010–1988
Cattle, sheep or goats	14,671	17,844	18,791	1.6%	0.5%	1.1%
Stall-fed animals	3694	3857	2721	0.4%	–3.4%	–1.4%
Field crops	5940	5097	3740	–1.3%	–3.0%	–2.1%
Horticulture or plantation	985	718	454	–2.6%	–4.5%	–3.5%
Viticulture	2098	2329	1424	0.9%	–4.8%	–1.7%
Mixed farms	7826	8446	6782	0.6%	–2.2%	–0.6%
Total farms with information on specialization	37,333	41,153	36,869	0.8%	–1.1%	–0.1%
All farms	37,708	41,474	37,204	0.8%	–1.1%	–0.1%

Appendix Table 2. Definitions and data sources for explanatory variables.

Variable	Definition
Surface Agricole Utile (SAU)	This is 'utilized agricultural area' which includes arable land, permanent grassland, permanent crops, other agricultural land such as kitchen gardens. It excludes unused agricultural land, woodland and land under buildings, farmyards, tracks, ponds, etc. ^a
Percentage SAU under permanent pasture, 2010	Percentage SAU under permanent pastures, census 2010 ^a
Percentage SAU 2010 that was irrigable in 2007	Percentage SAU in 2010 that is irrigable using the latest available 2007 data on irrigable area. For the 20 departments that had no data on irrigable area in 2007, the 2000 value was used. ^b
Average SAU per farm, 1970	Average SAU per farm (ha), 1970 ^c
Percentage farms with SAU <20 ha, 20–49 ha, and ≥50 ha in 1970	Percentage farms under 20 ha SAU, 20–49 ha SAU, and ≥50 ha SAU (as relevant) in 1970 ^c
Gini index, 2010	Gini index of taxable income per unit of household consumption in 2010 ^d
No. of active priests, c.2010–2014	Number of priests per department currently active (i.e. not yet retired), c.2010–2014. Data are only available by diocese. Adjustments were made when these did not overlap with administrative departments. ^e
Percentage of students specialized in agriculture, 2010	Percentage of students in secondary education (or doing short-term higher education degrees) who specialize in agriculture, September–October 2010 ^f
Percentage of women among farm workers, 2010	Percentage of agricultural workers (other than seasonal workers) who are female in 2010. These include farm heads, co-heads and agricultural salaried employees. ^a

Sources of data: ^aMinistry of Agriculture (2014); ^bMinistry of Agriculture (<http://www.stats.environnement.developpement-durable.gouv.fr/Eider>; accessed 10 February 2015); ^c'Données en ligne Agreste' (<http://agreste.agriculture.gouv.fr>; accessed 14 April 2016); ^dInstitut National de la Statistique et des Etudes Economiques (<http://www.insee.fr>; accessed 19 January 2015); ^eEglise Catholique de France (<http://www.eglise.catholique.fr>; accessed 20 January 2015); ^fMinistry of Agriculture (<http://www.chlorofil.fr>; accessed 19 January 2015) and Ministry of Education (<http://www.education.gouv.fr>; accessed 19 January 2015).

Appendix Table 3. Summary statistics.

	N	Mean	SD	Min.	Max.
GAEC	92	7.73	4.63	0.74	20.48
EARL ≥ 2	92	7.12	3.41	0.90	15.97
Percentage of farms with SAU <20 ha, 1970	92	65.70	16.92	31.07	98.08
Percentage of farms with SAU 20–49 ha, 1970	92	23.68	9.86	1.20	52.28
Percentage of farms with SAU ≥50 ha, 1970	92	10.61	10.83	0.44	43.85
Income Gini index, 2010	92	33.95	2.02	30.27	39.58
Percentage SAU under permanent pasture, 2010	92	32.83	24.23	1.40	94.44
Percentage SAU 2010 irrigable, 2007	92	10.81	12.27	0.03	54.01
No. active priests, c.2010–2014	92	98.50	67.50	24.00	358.00
Percentage of students specialized in agriculture, 2010	92	4.71	2.69	0.13	11.65
Percentage of women among farm workers, 2010	92	31.26	2.46	23.58	37.00

Note: N, number of observations; SD, standard deviation.