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A new typology of small farms in Europe

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ABSTRACT

We propose a new typology of small farms in Europe using a multivariate analysis drawing from household surveys from 14 European countries. The variables to develop the types covered a range of characteristics from farmers' histories and motivations, to farm production, assets and labour, market linkages and access to support. The clustering analysis found five types of small farms, two with relatively weak commercial orientation (peasant and part-time farms) and three with relatively strong commercial orientation (diversified businesses, specialized businesses, and new enterprises). This typology provides a richer picture of the diversity and nature of small farming across Europe beyond assumptions about their role in subsistence and fragile household economies. We find evidence of entrepreneurship and strong market linkages as well as a range of motivations, including lifestyle options. Typologies such as the one presented here can help to better document and understand the role of small-scale farming in Europe, and provide an input for evidence-based policy making that can enhance their livelihoods and contribution.

1. Introduction

Small farms are typical of the rural landscape in the Global South, but small-scale farming continues to exist –and even thrive—in the Global North, including Europe (Davidova et al., 2012; FAO, 2014; Guiomar et al., 2018). Small farms are crucial for global food security, producing between 50% and 75% of food calories consumed globally (IFPRI, 2019; Ricciardi et al., 2018; Samberg et al., 2016). Small-scale farming also provides key opportunities for employment and livelihoods (Lowder et al., 2016), is a crucial part of rural communities and landscapes (Alexandri et al., 2015; Larson et al., 2016; Shucksmith and Rønningen, 2011), and play an important role in environmental sustainability and supporting agricultural biodiversity (D'souza, & Ikerd.,1996; Boyce, 2006; Altieri, 2009).

While they share some common characteristics, of which size is the most obvious, not all small farms are the same. There is considerable diversity across and within regions and countries with regard to their farmers' backgrounds, histories and environments (Lowder et al., 2016). Farms have different assets, needs and objectives (Davidova et al., 2012). Furthermore, biophysical, institutional, social and economic drivers also differ between contexts, resulting in different responses from farmers and their communities (Alvarez et al., 2014; FAO, 2014; Pinto-Correia et al., this issue).

Some small farmers are successful commercial entrepreneurs, while for others farming is a household coping strategy to reduce the risk and the extent of rural poverty (e.g., Mellor and Malik, 2017). The conceptualization of small farms in theory and policy has typically used this dichotomy between market orientation and subsistence (CSM, 2018), but reality is richer. Many small farms which have a high degree of self-provisioning do so not out of poverty but as a lifestyle choice (Davidova and Bailey, 2014; van der Ploeg, 2010).

Typologies are a way of capturing and understanding the variability of small farms. (Alvarez et al., 2014; Chaplin et al., 2007; Daskalopoulou and Petrou, 2002; Davidova et al., 2012; Hoppe and MacDonald, 2013), as well as a means to develop interventions and guide appropriate policy approaches (Alvarez et al., 2014). The European Commission uses a common EU-wide farm typology, established in 1985 and revised in 2008, which classifies farms according to their main source of income (whether crop of livestock) and the degree to which their income is specialized or diversified, as well as their economic size. Another typological framework distinguishes between peasant, entrepreneurial and capitalist farms (van der Ploeg, 2010).

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Peasantry is considered a more traditional farming strategy, based on an agrarian lifestyle, small size and less dependence on the market both for commercialization and for inputs. Meanwhile, entrepreneurial farming is driven by policy, particularly by the European Common Agricultural Policy (CAP), and features higher market dependency, larger size, more risk-taking and profit maximization (Niska et al., 2012). Other typological exercises go beyond this purely economic classification, recognizing that farms are multifunctional and multidimensional, and that classification is enriched by a broader understanding of farmers' trajectories and preferences (van der Ploeg et al., 2009) or environmental management practices (Andersen et al., 2007).

In this paper we propose a typology of small farms in Europe using a different approach. Instead of assuming the axes of variation *a priori*, we use a multivariate analysis to let the data speak for itself. This means that, while the choice of the variables included in our analysis is informed by the conceptual debates outlined above, a statistical procedure organizes the data in a way that captures similarities and differences across a wide range of characteristics, including farmer's histories and motivations, farm production, assets and labour, market linkages and access to support. With this approach we aim to capture and illustrate the diversity of small-scale farming in Europe beyond the current typological frameworks. In doing so we want to convey a fuller and more detailed picture of European small-scale farming beyond assumptions and stereotypes, providing inputs for evidence-based policy.

2. Methods

2.1. Data collection

The data to construct the typologies comes from a survey of 734 farm households, which was conducted in 24 regions of 14 European countries during May to August 2017 (see Table 1). The selection of the countries and regions was based on the results of Guiomar et al. (2018), which present a classification of European regions at NUTS-3 level, based on the structural and economic farm sizes and the relative importance of agriculture of each region. The final selection of the regions was done by an expert panel with the aim to select an equal share of regions from each of the classes defined in Guiomar et al. (2018) distributed in different geographical locations. The interviews were meant to provide an illustration of the diversity of histories, strategies, resources, activities and challenges for small farm households in each region. The sample size varied between 5 and 60 depending on the region. We aimed for at least 30 households per region, but in some cases the sample was smaller due to practical resource constraints (see sample sizes in Table 1). Sampling was purposive: the field teams identified farms of 5 ha or less in size, or below 8 Economic Size Units, the thresholds used for statistical and policy purposes within the European Union (EC, 2011), and then snowballed as other suitable farms were identified. To capture the broadest possible diversity, the sample included farms that had different degrees of market integration and self-provisioning, and that covered a wide range of geographical locations within the region. This sampling method was not meant to be statistically representative, but rather to capture a diverse set of small farms in the selected regions.

Surveys were conducted face-to-face. The survey questionnaire included questions about the farmers' background, farms' crops produced, economic functioning, labour, market linkages, and access to inputs and support. The variables used to construct the typologies were selected according to three criteria: number of valid responses; the interpretability of each variable and the distribution/frequency to guarantee variability. The statistical analyses were performed using the following continuous and categorical variables: annual turnover (€; using a Purchasing Power Parity conversion factor), income of household from farming activities (%), land owned (%), share of production kept in the household (%), membership in a cooperative (Y/N), use of certification schemes (Y/N), distance to the nearest urban centre (5 categories), age (5 categories), and reason to start farming (5 categories).

2.2. Data analysis

All the statistical analysis was made using R software version 3.4.3. (R Development Core Team 2017). Model-based clustering using Gower's distance as dissimilarity coefficient was applied to the selected variables to find typologies among the small farms sampled in our study. Gower's distance (Gower, 1971) was chosen to derive the dissimilarity matrix for the model-based clustering (Bouveyron et al., 2019), which is appropriate with mixed data types (continuous, categorical and ordinal; e.g., Podani and Schmera, 2006; Pavoine et al., 2009). The Gower's dissimilarity matrix was computed using the StatMatch package for R (D'Orazio, 2016) and a distance plot (provided in the Appendix) between all the registers was made using R package corrplot (Wei et al., 2017). . The dissimilarity matrix was used as input in the model-based clustering through the mclust package for R (Fraley et al., 2012). The number of clusters was selected through the distribution of the Pearson Γ (or normalized Γ as in Halkidi et al., 2001) and the Bayesian Information Criterion (BIC; Banfield and Raftery, 1993), considering that larger values in both measures indicate strong evidence for the best solution (Hennig and Liao, 2013; Kassambara, 2017). We used the R package fpc (Hennig, 2020) to determine the Pearson Γ and the above mentioned mclust package to compute the BIC (Fraley et al., 2012). The model parameters were fitted through maximum likelihood estimation using an expectation-maximization algorithm (Dempster et al., 1977) and the best candidate models were assessed using the BIC statistic. Geometric features of each cluster were determined by the covariance matrix. The R package factoextra (Kassambara and Mundt, 2017) was used to produce the cluster plot.

3. Results and discussion

3.1. The types

The model selected with our data was 5-cluster VEI, which means that the clusters have variable volume (V), the same shape (E) and orientation equal to coordinate axes (I) (Fig. 1). In the Appendix we provide additional outputs resulting from the cluster analysis as the Gower's distance matrix which was the input to the model-based clustering procedure (Fig. A1), a plot with the distribution of the Pearson Γ and BIC which supported the selection of the number of clusters (Fig. A2) and also a plot showing the distribution of BIC statistics associated with each *n*-clusters model (Fig. A3). Our approach was centered on a model-based cluster analysis applied to a dataset with mixed-type data (categorical and continuous). The use of categorical or ordinal data in cluster analysis requires dimension reduction (van de Velden et al., 2017) and Gower's distance was suggested by Podani and Schmera (2006) for distance-based clustering of mixed-type data. Kuczynski et al. (2010) also highlighted the performance of Gower's distance to detect clusters. van de Velden et al. (2019) compared different methods for distance-based cluster analysis of mixed-type data and, despite the good results achieved using the Gower's dissimilarity followed by Partitioning Around Medoids, concluded that for this type of data it is difficult to choose between distinct solutions.

In our study, this approach yielded a clear identification of five clusters, corresponding to five types of small farms: peasant farms, part-time farms, diversified businesses, specialized businesses, and new enterprises. The five types fall into two broad groups (Fig. 2). The first broad group is of farms with weaker or more informal market orientation, characterized by having relatively low annual turnover and income, low or no use of production contracts, low use of hired labour, the lack of membership in cooperatives and the lack of use of certification schemes. Small farms in this group also keep a larger proportion of their products for self-consumption and under this group we find both young and older farmers. The second broad group has farms with

Table 1
Key socio-economic characteristics and sample sizes of the regions included in this study. (Source: EUROSTAT).

Country	Region	Region size (km^2)	Population (thousands, 2016)	Population density (people/km^2)	Regional GDP per capita (EUR, 2016)	Sample size
Eastern Europe						
Bulgaria	Montana	3634	136	37	3991	5
Croatia	Varazdinska	1262	171	140	9339	6
Czech Rep.	Jihocecky Kraj	10,058	637	63	13,738	5
Latvia	Latgale	14,550	276	19	6422	36
	Pieriga	10,135	366	36	10,409	30
Poland	Rzeszowski	3552	621	178	9912	39
	Nowosadecki	3524	530	152	6876	52
	Nowotarski	2632	334	130	6505	57
Lithuania	Vilniaus Apskritis	9731	805	83	19,660	10
Romania	Bistrita-Nasaud	5355	283	62	6436	60
	Giurgiu	3526	274	81	3858	26
Southern Europe						
France	Vaucluse	3575	559	152	30,390	10
Greece	Imathia	1686	141	84	10,830	39
	Larisa	5369	284	53	14,345	38
	Ileia	2583	157	61	10,920	42
Italy	Lucca	1773	391	222	27,255	32
	Pisa	2444	421	172	30,324	24
Portugal	Alentejo Central	7393	158	21	15,670	38
	Oeste	2220	359	161	14,690	36
Spain	Castellón	6662	571	89	24,945	27
	Córdoba	13,771	792	58	17,061	40
Northern Europe						
Norway	Hedmark	26,100	195	7	42,675	31
France	Ille-et-Vilaine	6774	1052	155	33,489	10
Scotland	East Scotland	7450	2072	33	35,712	15
	West Scotland	14,196	100	7	31,464	31

stronger and more formal market orientation: they have relatively higher incomes and turnovers, more widespread use of contract farming, they are relatively more dependent on hired labour, and a higher proportion either uses certification or is affiliated with co-operatives for marketing. They do not keep large shares of their product for self-consumption and market both through conventional and alternative markets. Further differentiations within both these groups correspond to the five types identified.

The five types are described in greater detail below, and a summary of their key characteristics is presented in Table 2. Within the group of weaker market orientation, we recognize two types: Peasant farms (Type 1) and Part-time farms (Type 5). **Peasant farms** account for 23% of our sample. This is the poorest type in terms of income and turnover, even though they sell most of their production. These farmers are the oldest in the sample, have deep roots in farming and in their regions, and the lowest share of university education. Our evidence suggests they are strongly path-dependent and may continue on farming partly because they do not have any alternative to secure their livelihoods. This type of farm was found more commonly in the Polish and Romanian regions. **Part-time farms** (14% of our sample) are also quite poor in terms of income and turnover, but they keep a substantial amount of what they produce for family self-provisioning and are less dependent on farming for household income. These farmers are relatively young, and may be motivated by lifestyle options, but they have roots in farming and in their region. Most of this type of farms in our sample we found in Poland, Bistrita (Romania) and Pierīga (Latvia).

Within the group of stronger market orientation, we recognize three types: diversified businesses (type 2), specialized businesses (type 3), and new enterprises (type 4). **Diversified businesses** (27% of the sample) are commercially oriented farms with a diverse portfolio of buyers, including cooperatives and wholesalers. All farms in this type are members of cooperatives, but do not sell only through the co-operative. They have relatively high incomes and turnover, and the highest proportion of farmers using contracts. The farmers are relatively young, but with roots in farming and their region. This type is common in the export-producing regions of the Mediterranean, producing citrus, other fruits, olives, and wine. **Specialized Businesses** (22% of sample) are also commercially oriented, but they are more dependent on cooperatives for marketing and seem to be more locked into a specific value chain. This is the richest type in terms of income and turnover, and they can invest in hired labour, irrigation, and on-farm processing. They are all members of cooperatives and all use some certification scheme. Furthermore, they have the best access to subsidies, finance and training, the last two probably a function of their membership of a cooperative. These farmers are relatively old and traditional, but well educated. This type is also common in the agro-export regions of the Mediterranean, as well as in Hedmark (Norway). Finally, **New Enterprises** (14% of the sample) are driven by relatively young, well-educated farmers who are often new entrants to farming: more than 80% of the farmers in this type have been farming for less

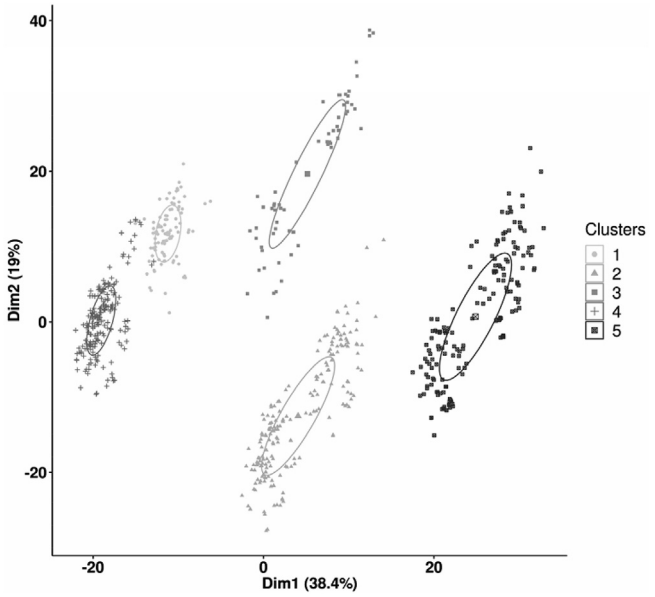

Fig. 1. Cluster plot with final classification of small farm typologies. (Selected model: VEI with 5 components; BIC = 1098431; Cluster 1 (Peasant farms) n = 92; Cluster 2 (Diversified businesses) n = 195; Cluster 3 (Specialized businesses) n = 62; Cluster 4 (New Enterprises) n = 220; Cluster 5 (Part-time farms) n = 165).

than 20 years, and only a third of them are older than 50. Only 58% entered farming due to family tradition (the lowest percentage among types), and 17% of them did so seeking a lifestyle change (the highest percentage among types) They can invest in different forms of innovation, searching for new markets, and adding value to their product for example through certification. This type is wealthy in terms of income and turnover, and has a diverse set of buyers, including processors. Only a third of the farms in this type are members of cooperatives, but all of them use some certification scheme. This type was found mostly in some regions of Poland and Romania, as well as Alentejo (Portugal) and Pierīga (Latvia).

3.2. Profile of the farmers

The farms in our sample cover a wide range of socio-economic and cultural backgrounds. Most of the farmers surveyed are relatively old (older than 40), in line with the general trend in EU, where nearly 70% of farmers are over 40 (EUROSTAT, 2017). However, the types differ in terms of the ratio between young and older farmers. Farmers in peasant farms and specialized businesses are the oldest, having more than 70 farmers older than 50 for every farmer younger than 30. Diversified businesses, new enterprises and part-time farms have a less lopsided distribution, having respectively 12, 2 and 7 farmers older than 50 for every farmer younger than 30. The sample is unbalanced in gender terms, with males being the majority across all types. This imbalance may reflect the overall dominance of male farmers in Europe (EUROSTAT, 2018), but females are much better represented in our sample than in average in the European farmers.

About half of the farmers in our sample only have secondary education, with specialized business and new enterprises having a much higher proportion of farmers with post-secondary education that is consistent with the greater commercial and entrepreneurial character of their farms.

Most farmers in our sample are originally from the region in which they currently live, and have many years of experience in farming. This is characteristic to all types, except for type 4 (new enterprises), whose farmers are on average newer to the region and have less experience in farming. Moreover, most of the farmers in our sample started farming as a continuation of a family tradition or through marriage – again with the exception of farmers in new enterprises, many of which said they were motivated by lifestyle change or a new business opportunity. At the other side of the spectrum are farmers in peasant farms, which have the deepest roots in the region, in farming, and in tradition. This is coherent with the path-dependency of low income farmers, which is well described in the literature (Davidova et al., 2012; Labarthe and Laurent, 2013; Lee et al., 2012).

3.3. Land assets

The farms in this sample cover a very wide range of farm sizes, from less than 1 ha to several dozen hectares, reflecting differences in geographical contexts, intensity of the production system, levels of wealth, access to land (Table 3) (Jepsen et al., 2015). The average farm size in our sample was 8 ha, with new enterprises (type 4) being the largest, and peasant farms the smallest. The same relative differences apply to the Utilized Agriculture Area (UAA), which is a more accurate descriptor of functioning farm size (Davidova et al., 2012) The plot size data patterns across types similarly to average farm size and UAA. The larger plots are found in new enterprises (type 4) with an average of 3.3 ha, suggesting that these farms have relatively more capacity for mechanized work and for rationalization of field routines. Land ownership appears to be related to the degree to which farms are rooted in

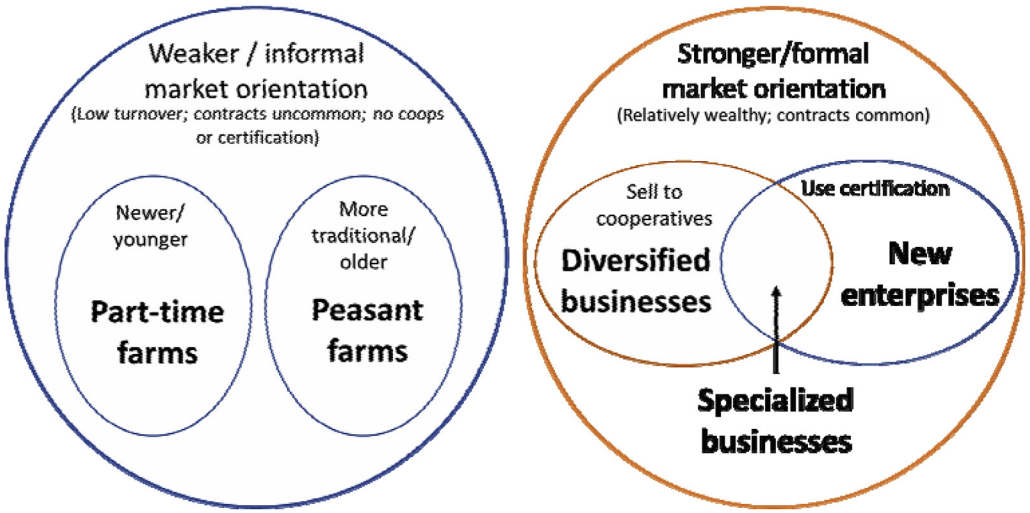

Fig. 2. Summary of the main characteristics and grouping of the five European small farm types.

Table 2
Summary of key characteristics of farm type.

	Peasant farms	Diversified businesses	Specialized businesses	New Enterprises	Part-time farms
Farmer profile	Oldest group. Longest time in region and in farming, highest % driven by tradition. Lowest % with university degree. Half of farmers exclusively dedicated to farming. Highest % of women.	Relatively young. Long time in region and in farming, high % driven by tradition. Low % with university degree. High exclusive dedication to farming. Low % of women.	Relatively old. Long time in region and farming, less driven by tradition. Relatively high % with university degree. Highest exclusive dedication to farming. Lowest % of women.	Youngest group. Shortest time living in region and farming. Least driven by tradition. Highest % with university degree. Half of farmers exclusively dedicated to farming. High % of women.	Relatively young. Long time in region and farming, high % driven by tradition. Relatively low % with university degree. Lowest % exclusively dedicated to farming. Relatively high % of women
Land assets	Smallest farm size; highest number of plots. Some use of irrigation. Highest % of land owned.	Medium farm size; some use of irrigation. High % of land owned.	Medium farm size; highest use of irrigation. High % of land owned.	Largest farm size; very low use of irrigation. Lowest % of land owned	Relatively small farm size; lowest % of irrigation. 2nd lowest % of land owned
Income & turnover	2nd lowest average and median annual turnover and income.; half of HH income comes from farm.	3rd highest average and median turnover and income. About half of HH income comes from farm	Highest average and median turnover and income; highest % of farming in HH income	2nd highest average and median turnover and income. About half HH income comes from farming	Lowest average and median turnover and income. Lowest % of HH income from farming.
Labour	Lowest reliance on permanent hired labour, but highest reliance on occasional hired labour	Relatively high reliance on both permanent and occasional hired labour	Highest reliance on both permanent and occasional hired labour	Relatively high reliance on permanent hired labour, but lowest reliance on occasional hired labour	Low reliance on both permanent and occasional hired labour
Market linkages	Lowest % using contracts; low % of production stays in HH, most products sold to farmer's markets and wholesalers. High food self-sufficiency. Lowest % doing processing. No use of certification.	Highest % using contracts; low % of production stays in HH, most products sold to wholesalers and cooperatives. High food self-sufficiency. Relatively low % doing processing. No use of certification.	High % using contracts; lowest % of production stays in household, most products sold to cooperatives Lowest food self-sufficiency. Relatively low % doing processing. All farms use certification	High % using contracts; low % of production stays in HH, products sold to diverse buyers, including processors. Highest food self-sufficiency. Highest % doing processing. All farms use certification.	Low % using contracts; highest % of production stays in HH, rest of food sold to farmer's markets and wholesalers. High food elf-sufficiency. Relatively high % doing processing. No use of certification.
Subsidies & support	High % with access to subsidies. Relatively low % with access to finance and training, and low % with support from relatives	High % with access to subsidies. Relatively low % with access to finance and training, and lowest % with support from relatives	Highest % with access to subsidies. Highest % with access to finance and training, and low % with support from relatives	Relatively low % with access to subsidies. High % with access to finance and training, and high % with support from relatives	Lowest % with access to subsidies. Low % with access to finance and training, and high % with support from relatives

tradition: the proportion of land owned was higher in peasant, diversified and specialized farms, whose farmers are on average older and have been farming for longer, than in new enterprises and part-time farms, whose farmers are younger and newer to farming. This is consistent with findings in Eastern Europe (Chaplin et al., 2007), where tenure is a challenge for small part-time farmers moving into full-time farming, and also recently for Scotland, concerning part-time farmers who prefer to stay as part-time (Sutherland et al., 2019). As for the largest new enterprises, the high proportion of rented land can be interpreted as part of a growth strategy.

Access to irrigation provides an important insight into how this land asset is used. Whereas the lack of irrigation may simply mean that irrigation is not needed (due to crop types and/or climatic context, in particular the rain regime), the presence of irrigation does signal access to considerable resources. We found that most of the farms in the sample do not use irrigation. The most extensive use of irrigation is found in diversified businesses, which has the highest share of farms using irrigation, and specialized businesses, which has the highest share of area under irrigation. This is consistent with these types being common in the drier, fruit exporting regions of the Mediterranean where irrigation is absolutely needed to secure regularity of production (Ortiz-Miranda et al., 2013).

3.4. Income and turnover

Turnover and income display considerable variability among the farms sampled, both within and between different types (Table 3). The three more commercially oriented farms (diversified, specialized and new enterprises) have the highest turnover and income, while peasant and part-time farms have the lowest. The low turnover combined with high share of production which stays in the household – 60% on average — for part time farms strongly underlines our suggestion that these are primarily hobby farmers with little marketable surplus. At the same time, the relatively low share of production kept −14%- by peasant farm households confirms low returns even within a stronger market orientation. Peasant farms are typically in a fragile economic situation, with farmers and family members facing barriers to diversify activities in the farm or sources of income outside the farm (Chaplin et al., 2007; Davidova et al., 2012).

Farming is an important component of household income in the farms in our sample, but not the only one. Across all the types, farm-related activities (both agricultural and non-agricultural) account on average for about a half of the household income. The data also reveals some differences between the types: part-time farms are the least dependant on farming for income, and specialized business farms are the most dependent ones. Moreover, the majority of farms in our sample derive most of their farm income from agriculture, as opposed to other non-agricultural activities like catering or tourism. Our results suggest evidence of diversification and multifunctionality in small farms in regions of Europe dominated by large scale intensive farming, where small farms tend to be lifestyle farms (Sutherland et al., 2019). In European regions where small farms represent larger share of the active farms, they continue being mostly dedicated to agriculture.

This data on sources of income can be helpfully read together with the evidence on part vs. full time farming. Most of the farmers in our sample are exclusively dedicated to farming, or they spend more than half of their time farming, i.e. most are professional farmers with a high level of time commitment. This is consistent with the relative importance of farming in their income generation. Exclusive dedication to farming is highest in specialized businesses (67% of farms), diversified businesses (61%) and new enterprises (53%), which are also the types with strongest orientation to commercialization and the highest turnovers. Accordingly, only about a third of part-time are exclusively dedicated to farming. The evidence suggests considerable differences in what part-time farming can be (Jehlička et al., 2018; Sutherland and Darnhofer, 2012): in some cases an important contribution to

Table 3
Summary of characteristics of European small farms, by type.

	1	2	3	4	5
	Peasant farms	Diversified businesses	Specialized businesses	New enterprises	Part-time farms
Socio-economic characteristics of farmers					
Ratio of old (> 50) to young (< 30)	76	12	73	2	7
% Women	36	27	24	34	31
% with university degree	16	20	30	33	21
% originally from the region	91	84	84	76	84
% living in region > 20 years	94	91	90	84	94
% farming > 20 years	71	69	73	47	74
% farming due to tradition or marriage	85	78	67	60	77
Land assets					
Mean farm size (ha)	5.9	8.0	8.6	12.4	7.5
Mean number of plots	7.6	5.9	7.1	6.1	6.2
Mean land owned (%)	90	82	82	61	63
Land irrigated (%)	30	30	47	23	18
% farms with no irrigation	56	49	60	96	96
Household income and dedication to farming					
Average annual farm turnover (EUR, PPP)	11,259	20,626	28,554	23,925	6886
Average annual farm income (EUR, PPP)	4400	6439	11,208	7705	2541
Household income from farm (%)	50	52	58	51	43
Farm income from agriculture (%)	82	89	88	82	77
% exclusively dedicated to farming	50	61	67	53	36
Labour force used					
Permanent unpaid family labour (%)	88	74	73	58	84
Permanent paid non-family labour (%)	1	9	11	15	5
Occasional unpaid family labour (%)	24	46	43	49	37
Occasional paid non-family labour (%)	31	37	56	30	20
Permanent unpaid family labour (FTE)	1.5	1.3	1	1	1.7
Permanent paid non-family labour (FTE)	0	0.1	0.2	0.2	0
Occasional unpaid family labour (FTE)	0.3	0.7	0.6	0.6	0.6
Occasional paid non-family labour (FTE)	0.5	0.6	0.5	0.3	0.4
Permanent non-family paid as % of family non-paid	1.9	10	18	16.9	3
Occasional non-family paid as % of family non-paid	186	82	85	52	73
Average % of production going through different channels					
Sold to farmers' markets	34	17	17	18	16
Sold to wholesalers	32	21	18	17	12
Sold to processors	11	8	5	14	7
Sold to small retailers	2	7	4	10	3
Sold to cooperatives	6	30	44	9	1
Kept in household	14	17	8	25	60
Use and importance of on-farm processing					
% that do on-farm post-harvest processing	46	52	50	67	55
% for which processing is an important source of revenue	46	48	51	59	37
Subsidies and support received					
Subsidies (%)	82	82	87	75	71
Access to credit or finance (%)	52	58	80	76	58
Access to marketing training (%)	71	74	86	79	65
Support from neighbours or relatives (%)	49	47	55	71	62

household food provision and income which helps preventing poverty; in other cases a lifestyle option for families that develop farming alongside other activities, link to the market with diversified and quality production, and receive an extra income for the household –including pensions; and for others, especially young farmers who are beginning to farm, part-time farming can be a first step in a trajectory towards expanded production as obstacles are overcome (Chaplin et al., 2007; Pinto-Correia et al., 2017).

3.5. Labour

Small-scale farming is conventionally equated to family farming, and the assumption is that most, if not all, labour is family-based and unpaid (Wiggins et al., 2010). The data presented here largely support this assumption, but with important distinctions across the different types regarding the nature, quantity and permanence of the labour. Most farms across types use a combination of paid and unpaid labour, relying on both family and non-family members. Table 3 shows the percentage of farmers who say they use a particular type of labour. Family labour is dominant across all farm types, including those which are more commercially oriented. Permanent hired labour was mentioned by a relatively small proportion of farmers across types, and as expected was slightly higher in the more commercially oriented diversified, specialized, and new enterprises, which can presumably invest more on additional labour. All farm types use occasional family and hired labour, but its importance varies among farm types. Farmers in peasant and part-time farms mentioned unpaid occasional family labour less frequently than those in the wealthier types. Paid occasional labour is far less frequent than unpaid one, the former being particularly important in specialized businesses, underlining this type's difference in commercial orientation and the types of products that require extra labour during specific periods, for example at harvest.

Using Annual Work Units (AWUs), the equivalent of a person working full time, provides an additional level of insight on labour (Table 3). Across our sample the highest average number of AWUs was on unpaid, family labour, as suggested by previous studies (Davidova et al., 2012; Shucksmith and Ronningen, 2011). Consistent with the data discussed above, peasant and part-time farms have the highest averages while diversified, specialized and new enterprises have the lowest. The ratio of non-family paid labour to family unpaid labour shows two interesting patterns. First, for permanent labour, this ratio is highest in the wealthier types (2, 3 and 4), and lowest in the less wealthy ones (1 and 5). This is in line with the expectation that the wealthier, commercially oriented farms have a higher reliance on permanent hired labour relative to family labour. Second, for occasional labour, the magnitude of the ratio is much higher for peasant farms than for any other group, suggesting that poorer farms have a clear and much more pronounced reliance on hired labour relative to family labour during the critical activities (e.g., planting or harvesting) that are time-sensitive. This may also speak to the scarcity of labour faced by some of the smallest and less well-off farms.

3.6. Commercialization strategies and market linkages

All farms in the sample combine production for the market and production for self-consumption. The balance between these two is one of the key distinguishing features of the different types (Table 3). Except for part-time farms, which keep on average 60% of their production, all other types sell more than they keep. Their pathways to commercialization underline small farms' different strategies, possibilities and constraints (Abebe et al., 2013). Cooperatives are the key commercialization channel for diversified and specialized businesses, which come from the typically export-oriented Mediterranean regions. Farmer's markets are an important commercialization channel across all types, and particularly for peasant farms, suggesting that many of the small farms in our sample are connected with their local food systems and directly to consumers. Wholesalers are also important across types, with processors and small retailers being less common across the sample. The evidence on the relationship between small farms and small retailers in Europe is scant, but our results suggest that retailers of all sizes may prefer the lower cost and predictability of larger suppliers. The link between small farms and small businesses appears to be far from straightforward (Hernández, 2020).

The use of production contracts provides an additional level of insight into the differences in the market linkages described above. Contracts signal a formal arrangement between producers and buyers. While they can provide greater certainty for producers about prices and timing, they also demand compliance with strict quality and quantity standards. Contracts therefore can both drive better practices and involve higher costs for farmers (Tang et al., 2016). The use of production contracts is starkly segmented in our sample: on the one hand only a small proportion of peasant and part-time farms use contract farming (10 and 11%, respectively), suggesting a more informal connection to market chains; on the other hand a considerable proportion of diversified, specialized and new enterprises uses production contracts (35, 28 and 27%, respectively), suggesting greater vertical integration.

The use of certification allows farms to increase the value added of their products and, in some cases, to access public payments. Certification, as a service provided by a third party, is relatively costly; it is therefore most commonly used by farms that are strongly commercially oriented, as it is often mediated by contracts and other formal commercial arrangements (Abebe et al., 2013). All specialized business farms and most new enterprises use certification. The most common types of certification are organic and integrated production, each of which is used by about a third of the farms.

On-farm processing – from sorting and packaging to more complex forms like wine-making and milling – is another strategy used by small farms to add value to their crops. Processing is done by nearly half of the small farms in our sample across all types. Processing is highest (67%) in new enterprises, reflecting the prevalent good produced by this type, such as olives for olive oil or grapes for wine. About half of the farmers in the sample see processing as an important source of revenue. Processing seems to be slightly more important for diversified and specialized farms, and particularly for new enterprises, suggesting that the more commercially oriented farms also tend to add more value through processing than peasant or part-time farms.

3.7. Subsidies and support

Small farms may struggle to access subsidies and other forms of financial support due to their size – they may be under an eligibility threshold or unable to pay for certification, for example — or due to their lack of assets (Labarthe and Laurent, 2013). In the European Union, small farms over 0.5 ha in size are typically eligible for support under the CAP. Most farms in our sample have some access to government subsidies. Specialized businesses have the highest proportion of farms receiving subsidies (87%) while part-time farms have the lowest (71%). Notably, a high proportion (82%) of peasant farms also receive subsidies, suggesting that these play a key role in maintaining these farms afloat (Chaplin et al., 2007). Access to financial services and training reflects clearly the division between the wealthier, more commercially oriented types (2, 3 and 4), and the poorer counterparts (1 and 5). More strongly commercially oriented farms have better business connections, and can better assume credit risks. Notably, two thirds of the part-time farms tap into family and neighbour networks, presumably to compensate for greater formal support. This practice is also common in commercially-oriented farms, especially new enterprises.

4. Conclusions

While there is extensive knowledge on small farms around the developing world (Graeub et al., 2016; Lowder et al., 2016; Ricciardi et al., 2018), the universe of small farms has not been a priority for European research and policy in recent years (Ingram, 2018; Vanloqueren and Baret, 2009). Research on European small-scale farming has centered on semi-subsistence farming and path-dependency (Davidova et al., 2012), or with part-time self-provisioning (Jehlička et al., 2018; Wilbur, 2013), often related to weak integration in the market (Lee et al., 2012). Our study provides a new picture of the surprising diversity of small farms that can be found in Europe today.

Our results provide a complementary view to that of other typologies. The variables used to determine the clusters provide a rich, multidimensional classification of the farm/household unit. By going beyond classifications that use a smaller number of key dimensions, we can appreciate new – and somewhat unexpected – points of commonality and difference between small farms. For example, our types are broadly consistent with the peasant and entrepreneurial types identified by van der Ploeg (2010), but provide further differentiation and detail about what lies in between. Moreover, our typology was constructed objectively – letting the data “guide” the types rather than building a typology from a preconceived decision about the meaningful variables.

Our data suggests that small farms are not reduced to self-provisioning and fragile household economies, but that they exist along a wide spectrum from weak to strong formal market integration and specialization of production. Certainly, many small farms appear to be locked into a situation of economic vulnerability, but many others show strong market orientation, wealthy business models, specialization, innovation and diversification of family income, as well as a lifestyle motivation. In the same way, there are new entrants to farming, coming from other sectors, and strongly business oriented farmers, showing small farmers are not only those who lack other opportunities and are prone to disappear with time. Moreover, the different types are not concentrated in a specific region; instead, all regions show a diversity of

small farms.

The evidence presented here raises important questions about the future of small farms in Europe. Even the best performing farm types in our sample have an income of only around 2000 EUR per month per household. We have also shown in section 3.5 that farming accounts for most of the household income across types. Combined with the data on labour presented here, these figures suggest a relatively low ratio of economic output per worker (i.e. income per AWU), raising questions about the long-term viability of these businesses, and their ability to cope with unexpected shocks. At the same time, we found evidence suggesting potential for "upgrading" or movement from one type to the other. For example, the part-time farms in our sample are on average poor, but many are also young and relatively well educated; it is plausible that, with the right support, some of these farmers might transition into new enterprises.

We found some evidence to support the notion that small-scale farming can contribute to a transition to sustainable agriculture (see e.g. Velten et al., 2015), but more precise measurements –outside the scope of this study—would be necessary to assess this properly. For example, our data shows that even specialized farms produce a range of products for self-consumption, suggesting a higher degree of agro-biodiversity than large-scale monoculture farms. This diversity of production is further explored in another paper of this special issue (Pinto-Correia et al., this issue). We have also shown that self-provisioning and sale to local markets is common in all types (see also Rivera et al., 2020), suggesting that small farms are important in local food networks with a relatively small transportation environmental footprint. Finally, we have shown that the prevalence of irrigation is low across farm types, suggesting that small farms do not make a significant contribution to water depletion.

Finally, our typology also points to some of the challenges faced by small farms in Europe. We found relatively few new entrants into farming, pointing to the well-known problem of succession in European small farming (see Żmija et al. this special issue). Small farms are disappearing at a faster rate than other farms in Europe (EUROSTAT, 2018), and yet we have shown that their economic status, market linkages and trajectories are very variable, and that they can complement other farm sizes in their regions, reinforcing local and regional food networks and diversity of connections. Our results also show there is a capacity of small farming to attract new entrants to farming, as lifestyle farmers and also as business-oriented farmers. Starting as new in a small farm, in terms of investment, is surely easier than in a large farm. It remains to be seen, if with strategic and targeted support, this ease of entry could be improved and contribute to minimizing the problem of ageing farmers in Europe. Small farms make an important contribution to sustainable food systems in Europe, but their potential might not be optimally used. Typologies such as the one presented here can help to better document and understand their roles, and inform a better targeted public support that can enhance their livelihoods and contribution.

Declaration of competing interest

We declare no conflict of interest.

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Appendix A. Supplementary data

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References

Abebe, G., Bijman, J., Kemp, R., Omta, O., Tsegaye, A., 2013. Contract configuration: smallholders'preferences for contrcat design attributes. Food Pol. 40, 14–24.
Alexandri, C., Luca, L., Kevorchian, C., 2015. Subsistence economy and food security – the case of rural households from Romania. Procedia Econ. Finance 22, 672–680.
Altieri, M.A., 2009. Agroecology, small farms, and food sovereignty. Mon. Rev. 61 (3), 102–113.
Alvarez, S., Paas, W., Descheemaeker, K., Tittonell, P., Groot, J., 2014. Typology Construction, a Way of Dealing with Farm Diversity. Humidtropics, CGIAR Research Program Led by IITA. (Wageningen, The Netherlands).
Andersen, E., Elbersen, B., Godeschalk, F., Verhoog, D., 2007. Farm management indicators and farm typologies as a basis for assessments in a changing policy environment. J. Environ. Manag. 82 (3), 353–362.
EC, 2011. What Is a Small Farm? EU Agricultural Economics Brief, vol. 2 European Commission Agriculture and Rural Development, Brussels.
C.S.M., 2018. Connecting Smallholders to Markets. International Food Security & Nutrition Civil Society Mechanism.
Banfield, J.D., Raftery, A.E., 1993. Model-based Gaussian and non-Gaussian clustering. Biometrics 49, 803–821.
Bouveyron, C., Celeux, G., Murphy, T.B., Raftery, A.E., 2019. Model-based Clustering and Classification for Data Science with Applications in R. Cambridge University Press, Cambridge.
Boyce, J.K., 2006. A Future for Small Farms? Biodiversity and Sustainable Agriculture. Human Development in the Era of Globalization: Essays in Honor of Keith B. Griffin. pp. 83–104.
Chaplin, H., Gorton, M., Davidova, S., 2007. "Impediments to the diversification of rural economies in central and eastern Europe : evidence from small-scale farms in Poland. Reg. Stud. 41 (3), 361–376.
D'souza, G., Ikerd, J., 1996. Small farms and sustainable development: is small more sustainable? J. Agric. Appl. Econ. 28 (1), 73–83.
Daskalopoulou, I., Petrou, A., 2002. Utilising a farm typology to identify potential adopters of alternative farming activities in Greek agriculture. J. Rural Stud. 18 (1), 95–103.
Davidova, S., Bailey, A., 2014. Roles of Small and Semi- subsistence Farms in the EU. EuroChoices 13 (1), 10–14.
Davidova, S., Fredriksson, L., Gorton, M., Mishev, P., Petrovici, D., 2012. Subsistence farming , incomes , and agricultural livelihoods in the new member states of the European Union. Environ. Plann. C Govern. Pol. 30, 209–227.
Dempster, A., Laird, N., Rubin, D., 1977. Maximum likelihood from incomplete data via the EM algorithm. J. Roy. Stat. Soc. B 39 (1), 1–38.
D'Orazio, M., 2016. StatMatch: Statistical Matching. R Package Version 1.2.4.
EUROSTAT, 2017. Farmers in the EU - statistics. Available at. https://ec.europa.eu/eurostat/statistics-explained/index.php/Farmers_in_the_EU_-_statistics.
EUROSTAT, 2018. Farms and farmland in the European Union – statistics. Available at. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics#The_evolution_of_farms_and_farmland_from_2005_to_2016.
FAO, 2014. The state of food and agriculture: Innovation in family farming. Food and Agriculture Organization of the United Nations, Rome.
Fraley, C., Raftery, A.E., Murphy, T.B., Scrucca, L., 2012. Mclust version 4 for R: normal mixture modeling for model-based clustering, classification, and density estimation. Technical Report, vol. 597 Department of Statistics, University of Washington.
Gower, J.C., 1971. A general coefficient of similarity and some of its properties. Biometrics 27, 857–874.
Graeub, Benjamin E., Jahi Chappell, M., Wittman, Hannah, 2016. The state of family farms in the world. World Dev. 87, 1–15.
Guiomar, N., Godinho, S., Pinto-Correia, T., Almeida, M., Bartolini, F., Bezák, P., et al., 2018. Typology and distribution of small farms in Europe: towards a better picture. Land Use Pol. 75, 784–798.
Halkidi, M., Batistakis, Y., Vazirgiannis, M., 2001. On clustering validation techniques. J. Intell. Inf. Syst. 17, 107–145.
Hennig, C., 2020. Fpc: Flexible Procedures for Clustering Version 2.2-5. URL. https://www.unibo.it/sitoweb/christian.hennig/en/.
Hennig, C., Liao, T.F., 2013. How to find an appropriate clustering for mixed-type variables with application to socio-economic stratification. Appl. Stat. 62 (3), 309–369.
Hernández, P., et al., 2020. Do small food businesses enable small farms to connect to regional food systems? Evidence from 9 European regions. Global Food Secur In this issue.
Hoppe, R.A., MacDonald, J.M., 2013. Updating the ERS Farm Typology, EIB-110. U.S. Department of Agriculture, Economic Research Service.
IFPRI, 2019. Global food policy report. International Food Policy Research Institute, Washington, DC.
Ingram, J, 2018. Agricultural transition: niche and regime knowledge systems boundary dynamics. Environ. Innovat. Soc. Transit 26, 117–135.
Jehlička, Petr, Daněk, Petr, Jan, Vávra, 2018. Rethinking resilience: home gardening, food sharing and everyday resistance. Can. J. Dev. Stud. 1–17 0(0).
Jepsen, R.J., Kuemmerle, T., Müller, D., Erb, K., et al., 2015. Transitions in European land-management regimes between 1800 and 2010. Land Use Pol. 49, 53–64. https://

doi.org/10.1016/j.landusepol.2015.07.003.
Kassambara, A., 2017. Practical Guide to Cluster Analysis in R: Unsupervised Machine Learning. STHDA, Marseille.
Kassambara, A., Mundt, F., 2017. Factoextra: Extract and Visualize the Results of Multivariate Data Analyses. R package version 1.0.5.
Kuczynski, J., Liu, Z., Lozupone, C., McDonald, D., Fierer, N., Knight, R., 2010. Microbial community resemblance methods differ in their ability to detect biologically relevant patterns. Nat. Methods 7 (10), 813.
Labarthe, P., Laurent, C., 2013. "Privatization of agricultural extension services in the EU: towards a lack of adequate knowledge for small-scale Farms ? Food Pol. 38 (240–252).
Larson, D.F., Muraoka, R., Otsuka, K., 2016. Why African rural development strategies must depend on small farms. Global Food Secur. 10, 39–51.
Lee, J., Gereffi, G., Beauvais, J., 2012. Global value chains and agrifood standards: challenges and possibilities for smallholders in developping countries. Proc. Natl. Acad. Sci. Unit. States Am. 109.
Lowder, Sarah K., Skoet, Jakob, Raney, Terri, 2016. The number , size , and distribution of farms , smallholder farms , and family farms worldwide Q. World Dev. 87, 16–29.
Mellor, J.W., Malik, S.J., 2017. The impact of growth in small commercial farm productivity on rural poverty reduction. World Dev. 91, 1–10.
Niska, M., Vesala, H.T., Vesala, K.M., 2012. Peasantry and entrepreneurship as frames for farming: reflections on farmers' values and agricultural policy discourses. Sociol. Rural. 52 (4), 453–469.
Ortiz-Miranda, D., Moragues-Faus, A., Arnalte-Alegra, E., 2013. Agriculture in Mediterranean Europe. Between Old and New Paardigms, first ed. Emerald.
Pavoine, S., Vallet, J., Dufour, A.B., Gachet, S., Daniel, H., 2009. On the challenge of treating various types of variables: application for improving the measurement of functional diversity. Oikos 118, 391–402.
Pinto-Correia, T., Rivera, M., Guarin, A., Grīviņš, M., Tisenkopfs, T. (this issue). Unseen food: the importance of extra-market small farm's production for rural households in Europe. Global Food Secur.
Pinto-Correia, T., Almeida, M., Gonzalez, C., 2017. Transition from production to lifestyle farming: new management arrangements in Portuguese small farms. Int. J. Biodivers. Sci., Ecosyst. Serv. Manag. 13 (2), 136–146.
Podani, J., Schmera, D., 2006. On dendrogram-based measures of functional diversity. Oikos 115, 179–185.
R Core Team, 2017. R: A Language and Environment for Statistical Computing. Vienna, Austria. https://www.Rproject.org/.
Ricciardi, Vincent, Ramankutty, Navin, Mehrabi, Zia, Jarvis, Larissa, 2018. "How much of the world food do smallholders Produce ? Global Food Secur. 17, 64–72.
Rivera, M., Guarín, A., Pinto-Correia, T., Godinho, S., Almaas, H., Arnalte-Mur, L., Burns, V., Czekaj, M., Ellis, R., Galli, F., Grivinis, M., Hernández, P., Karanikolas, P., Prosperi, P., Sánchez Zamora, P, 2020. Assessing the role of small farms in regional food systems in Europe: evidence from a comparative study. Global Food Secur In this issue.
Samberg, L.H., Gerber, J.S., Ramankutty, N., Herrero, M., West, P.C., 2016. Subnational distribution of average farm size and smallholder contributions to global food production. Environ. Res. Lett. 11, 124010. https://doi.org/10.1088/1748-9326/11/12/124010.
Shucksmith, M., Rønningen, K., 2011. The Uplands after neoliberalism? The role of the small farm in rural sustainability. J. Rural Stud. 27, 275–287.
Sutherland, Lee-ann, Darnhofer, Ika, 2012. "Of organic farmers and ' good farmers ' : changing habitus in rural england. J. Rural Stud. 28 (3), 232–240.
Sutherland, Lee-Ann, Barlagne, Carla, Barnes, Andrew, 2019. "Beyond ' hobby farming ': towards a typology of non-commercial farming. Agric. Hum. Val. 36 (3), 475–493.
Tang, C.S., Sodhi, M.S., Formentini, M., 2016. An analysis of partially-guaranteed-price contracts between farmers and agri-food companies. Eur. J. Oper. Res. 254 (3), 1063–1073. https://doi.org/10.1016/j.ejor.2016.04.038.
van de Velden, M., D'Enza, A.I., Palumbo, F., 2017. Cluster correspondence analysis. Psychometrika 82 (1), 158–185.
van de Velden, M., d'Enza, A.I., Markos, A., 2019. Distance-based clustering of mixed data. WIREs: Comput. Stat. 11 (3), e1456.
van der Ploeg, J.D., 2010. The peasantries of the twenty-first century: the commoditisation debate revisited. J. Peasant Stud. 37 (1), 1–30.
van der Ploeg, J.D., Laurent, C., Blondeau, F., Bonnafous, P., 2009. Farm diversity, classification schemes and multifunctionality. J. Environ. Manag. 90, S124–S131.
Vanloqueren, G., Baret, P.V., 2009. How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. Res. Pol. 38, 971–983.
Velten, S., Leventon, J., Jager, N., Newig, J., 2015. What is sustainable agriculture? A systematic review. Sustainability 7 (6), 7833–7865.
Wei, T., Simko, V., Levy, M., Xie, Y., Jin, Y., Zemla, J., 2017. Package 'corrplot': visualization of a correlation matrix Version 0.84. Available online. https://github.com/taiyun/corrplot.
Wiggins, S., Kirsten, J., Llambí, L., 2010. World Dev. 38 (10), 1341–1348. https://doi.org/10.1016/j.worlddev.2009.06.013.
Wilbur, Andrew, 2013. Growing a radical ruralism: back-to-the-land as practice and ideal. Geogr. Compass 7 (2), 149–160.
Zmija, K., Fortes, A., Sumane, S., Ayambila, S., Zmija, D., Satula, L. and Sutherland, L. (this issue). Small farming and generational renewal in the context of food security challenges. *Global Food Secur.*