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A typology of European organic multi-species livestock farms

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A typology of European organic multi-species livestock farms

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Abstract

Keeping two or more livestock species or categories on the same farm simultaneously is a diversification option that has received little attention to date. We surveyed 95 organic multi-species livestock farms across six European countries to build a farm typology and characterise their diversity in structure, management, and performances. Farms combined cattle (meat, milk), small ruminants (meat, milk) and/or monogastrics. Survey data on the structure, management, and performances allowed for the creation of indicators (including farmer's satisfaction) used to run a principal component analysis and an agglomerative hierarchical clustering to build the farm typology. The following variables structured the first four factors of the PCA: F1: Farm size and crop-pasture balance; F2: Intensification - Feed self-sufficiency; F3: Work productivity - Diversification activities and marketing; F4: Dairy cattle and permanent pasture. Four groups of farms emerged from the clustering: G1: Large area with a high share of crops, low feed autonomy, dairy cattle with beef cattle or pigs, on-farm processing, short sale channels and agritourism; G2: Prevalence of poultry with beef cattle, leading to high labour productivity and low feed autonomy, although ruminant diets highly rely (90%) on fodder; G3: Beef cattle associated with meat sheep, high feed autonomy, frequent short sale channels; G4: Italian farms with predominantly dairy ewes and dairy or meat cattle, rangelands, on-farm processing and short sale channels. Our next objective is to study the relationships between agricultural practices, work organisation, sales management and farm performances.

Introduction

Implementing agrobiodiversity is a core principle of agroecology in livestock farming systems (Dumont et al. 2013), especially in organic production. It is often studied through the lens of crop-livestock integration. Keeping two or more livestock species or categories on the same farm simultaneously is another diversification option that has received little attention to date, even though it is expected to increase the sustainability of livestock farms (Martin et al. 2020). The few studies dealing with this topic at the farm level had at best a regional coverage (Dumont et al. 2020) and, therefore limited possibilities for outscaling these multi-species livestock systems across Europe. We aimed to propose a pan-European typology of organic

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multi-species livestock farms according to animal species or productive orientation combinations, farm structure and management (land, livestock, human resources, sales).

Material and methods

We surveyed 95 farms combining cattle and small ruminants (meat or dairy production), cattle and monogastrics (pigs and/or poultry) and small ruminants and monogastrics in six European countries. Each survey was based on a half-day discussion with the farmers and consultation of accounting documents when available (only in France). Survey data covered (i) farm structure in terms of types and areas of cropping areas and grasslands, type and numbers of animals, (ii) management practices, (iii) marketing channels, i.e. type, amounts and prices of products sold and diversification activities (e.g. energy production) and (iv) work organisation via the status, role and satisfaction of farmers. This data allowed the calculation several indicators describing farm production, productivity (per worker, per total livestock unit (LU)), efficiency (e.g. ratio between outputs and inputs) as well as the ability of farmers to manage their farm resources for production (e.g. feeding autonomy), marketing management, farmer's satisfaction etc. Note that rangelands are not included in the Usable Agricultural Area (UAA). The detailed data collection and indicator calculation procedures can be found in Ulukan et al. (2021) (under review).To characterize the diversity of multi-species livestock farming systems, we first performed a principal component analysis (PCA) using four types of variables with a total of 43 variables (using XLSTAT v2020.3.1 software). An agglomerative hierarchical clustering (AHC) was then conducted to identify four groups of relatively homogeneous farms.

Results

The first four factors of the PCA explained 36.5% of the total variance in the farm sample and had the following essential characteristics:
i) Factor 1 (10.6% of the variance. *Farm size and crop–pasture balance*): contrast between large farms including crops, mainly used for feeding the animals on the one hand and mainly dairy sheep farms dependent on purchased feed on the other hand (Fig 1);
ii) Factor 2 (9.6% of the variance. *Intensification – Feed self-sufficiency*): contrast between farms with a low overall stocking rate, a high degree of feeding autonomy based on fodder use with usually the presence of beef cattle, and on the other hand farms with a high animal density and high amounts of purchased feed related to the presence of monogastrics (Fig 1);
iii) Factor 3 (8.9% of the variance. *Work productivity – Diversification activities & short channel*): contrast between farms with monogastrics displaying high labour productivity in terms of livestock unit per average worker unit (LU/AWU) and output (€) per AWU, and a high overall stocking rate, and on the other hand smaller farms with low labour productivity and crops used to produce animal feed, and other diversification of the farm activities;
iv) Factor 4 (7.5% of the variance. *Dairy cattle and permanent pasture*): dairy cattle farms based on permanent grasslands (and opposed to dairy sheep), with on-farm processing, and farmers converted to organic farming a long time ago and generally very satisfied with their system.

Figure 1 depicts the first two factors of the PCA and the ellipses representing the four groups of farms generated by the AHC with an explained 87.8% intra-class variance and a 12.2% inter-class variance. The classes are quite unequal in size, from 7 to 35 farms.

The six countries are well distributed in the groups, with the exception for Group 4, which includes only Italian farms. In addition, Groups 3 and 4 are distant from Group 1 but fairly close to each other.

Group 1 (C1; 35 farms; *large farms – crops – dairy cattle - agrotourism*) can be characterised by a large mean area with a high percentage of crops (1/3 of the UAA) and 78 livestock, lower than the average 87 livestock for the 95 farms sampled. Farms are mainly dairy cattle, associated with beef cattle or pigs. Up to 63% of farms process their products on-farm and 42% use short-sale channels. Agritourism is practised in 37% of farms (compared to the 27%

average). Labour productivity is low when expressed in LU/AWU (23.4) but relatively high when expressed in € of sales per AWU due to the added-value induced by on-farm processing and short-sale channels. Despite the presence of cereal production, feed autonomy of these farms is relatively low (68%) due to the presence of monogastrics. However, nitrogen efficiency (Ninput/Noutput) is the highest of the four groups. These farms also have the highest number of workers (n=6 AWUs on average) and the most experienced farm managers, with very early conversion to organic farming (1996 on average), despite the absence of agricultural roots in one third of these farms. These farmers were usually satisfied with their farming system.
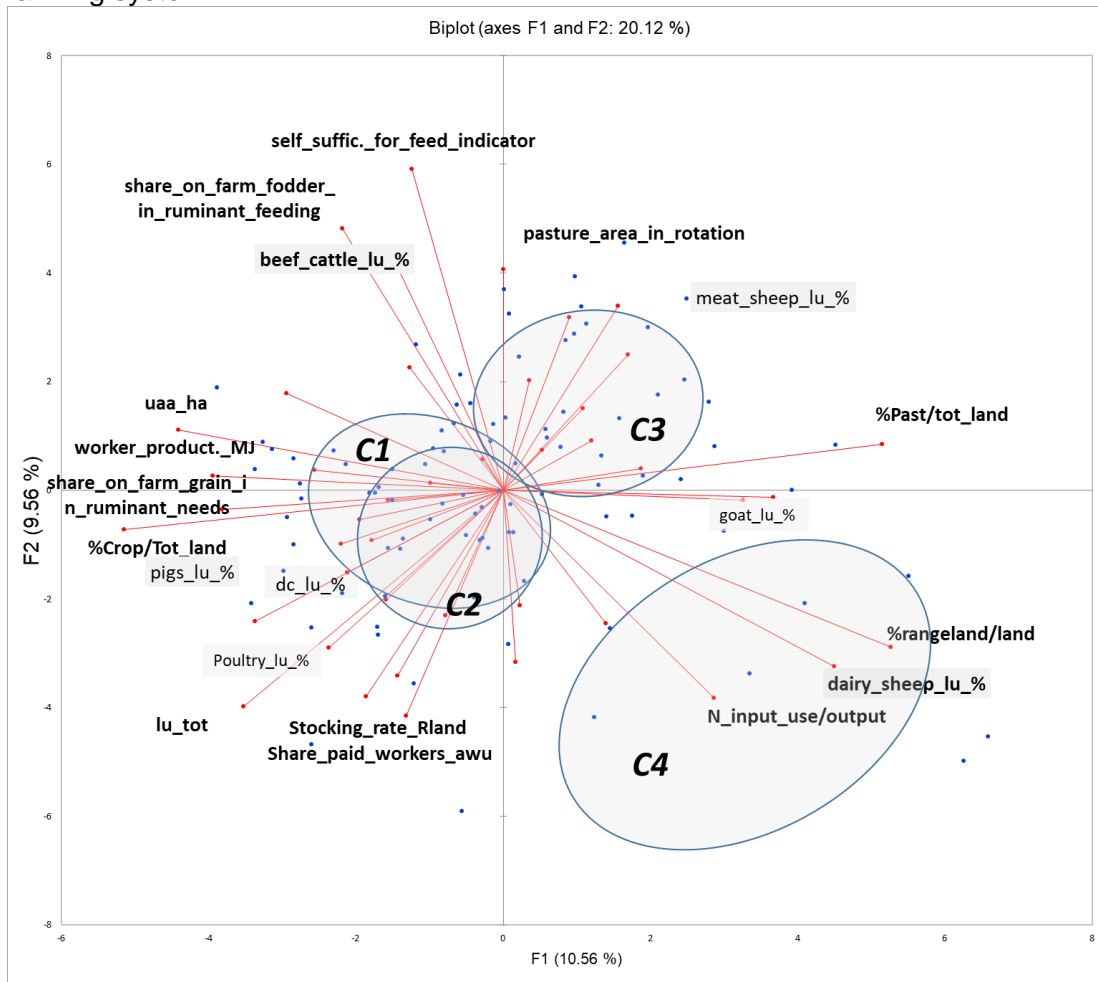
Figure 1. Projection of the main variables (representing more than 5% of factors 1 and 2) of the principal component analysis and the four groups of farms from the agglomerative hierarchical clustering (ellipsis plot with 40% confidence). Radiant lines: projection of the variables. Small dots: 95 farms. Bold labels: variables most contributing to factors 1 and 2. Labels on grey background: % LU for animal enterprises

Group 2 (C2; 17 farms; *Poultry and beef – permanent grassland – work productivity*) represents medium-sized farms with a significant proportion of permanent grassland in the UAA (58% on average). Their specificity is the prevalence of poultry (in LUs), usually associated with beef cattle, leading to high labour productivity expressed in LU/AWU. It is the highest of all four groups, even when expressed in sales per AWU, exceeding 110 000 €/AWU. There are only 2.6 AWUs on average. The percentage of fodder (roughage, pasture or cultivated) in ruminant diets is very high (90%) in relation to frequent beef cattle breeding. Nevertheless, feed autonomy at the farm level only reaches 61.5% on average due to poultry, which also explains the high mean N input/output ratio of 2.45. The farmers in this group are

the ones who most frequently attend training courses and they have the highest overall satisfaction, including the income generated.

Group 3 (C3; 36 farms; *Beef cattle & meat sheep – feed autonomy – short channel marketing*) has structural factors comparable to C2 (area used), although temporary grasslands are slightly more prevalent. Beef cattle is the main production and is generally associated with meat sheep. Farm feed autonomy is the highest among the four groups, at 87.9% on average. Short channel sales are present on 92% of the farms and represent 72.5% of the total value of sales. The stocking rate on the grassland area is the lowest, at 0.81 LU/ha (ruminants only). Compared to C2, this group has a comparable UAA but a three times lower stocking rate on the UAA (on average 0.80 vs 2.58 total LU/ha UAA) linked in particular to the absence of monogastrics. Labour productivity is half that of C2, both as LUtot/AWU, €/AWU and mega-joules (MJ) produced per AWU. This group has the least paid workers (13.9% on average) and the highest proportion of first-generation farmers (33%). Farmers in this group considered the complexity of their farming system to be low, and reported the highest human welfare scores and the lowest workload.

Group 4 (C4; 7 farms; *Dairy sheep – No monogastric – Italy - Processing & direct selling*) is a little specific because it includes farms with predominantly dairy ewes, associated with dairy or meat cattle, and sometimes goats. They are all located in Italy and have an important percentage of rangelands (three farms fully rely on rangelands). The other areas (included in UAA) are limited on average to 26.4 ha. With LUs reaching 125.2 (no monogastrics in this group), the stocking rate on the fodder area (including rangelands) is high (1.4 LU/ha on average). On-farm processing (dairy products) is present in five of the seven farms, and 82% of the sales are made in short channels. Note that paid workers carry out 46.2% of farm activities, and the overall workforce is high (5.4 AWUs). The overall satisfaction of the farmers in this group is the lowest compared to the three other groups.

The following key points are highlighted:

- The presence of monogastrics strongly limits feed autonomy, but it provides an important input of nutrients and most likely contributes to the maintenance of soil fertility in the area used by ruminants.
- The most autonomous systems raise ruminants for meat production. The Italian farms are unique, linked to the high frequency in this sub-sample of small ruminants (especially dairy sheep) associated with processing, large workforce and limited arable land.
- The percentage of sales via short channels ranges from 26% to 82% between groups. We can hypothesise that farmers' practices are influenced by this management of sales, e.g. through specific calendars of practices aiming at regular sales across the year. This may result in a part of the off-season production generating high production costs, because of higher use of concentrate feeds. Nevertheless, the added-value generated could compensate for the extra costs. Moreover, this type of sale can increase social satisfaction.
- The pool of workers appears to vary greatly between the four groups. Two out of the four groups have between 5 and 6 AWUs, which is very high and could be related to the high degree of farm diversification. This may also have positive effects on the technical management of farm enterprises in terms of resilience, if the versatility of the workers between enterprises is important.

Discussion

It is important to be aware that the study of very diversified farms across agronomic, environmental and social dimensions taking into account farm structures and management results in highly complex surveying. Thus, based on an initial sample of 146 farms, only 95 were kept for all the analyses of indicators. Different interviewers carried out the surveys with different skills in diverse dimensions and situations surveyed. This may have had a small divergent effect on data acquisition, particularly on social evaluations.

Therefore, our objective is to refine the analysis of the potential relationships that exist between sales management (including the diversity of products sold) and management practices on the one hand and farm productivity and efficiency on the other hand. We also aim to focus on the link between enterprise integration and farm performances, particularly in terms of resource use efficiency. This will require questioning and renewing some traditional indicators that are not adapted to such diversified farming situations and diverse contexts to innovate in terms of appropriate indicators and methods.

Suggestions for research and support policies to develop further organic animal husbandry

We highlighted the impact of the type of animal species combination on feed autonomy. In particular, the presence of monogastrics leads to a high amount of feed purchased. This raises the question of the feed origins and the possibility of promoting collaborations between specialised livestock and crop farms from the same area.

Half of the farms had a large workforce, which seems to facilitate the implementation and success of these highly diversified system usually builds on short-sale channels. To support this type of farming system, which generates employment and social dynamics in rural areas, the CAP should account for the workforce present on the farms; and the cross compliance of subsidies payment (subsidy threshold) per person rather than per hectare.

Acknowledgements

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