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DIVERSITY AS A KEY TO ANALYZE FRENCH ORGANIC FARMS: METHODOLOGICAL ELEMENTS

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Abstract: Many typologies of organic farms exist but they fail to take into account diversity, *i.e.* the combination of productions, which is a core principle in agroecology.

Our aims were multifold: i) increase the knowledge of the organic farms (OF) ii) better characterize organic systems in terms of diversity, iii) analyze the territorial distribution of diversity types, and iv) compare diversity between conventional farms (CF) and OF.

The French Observatory of Organic Agriculture (ONAB) database from Agence Bio was used. It collects data from all French organic farms and provides detail on surfaces and livestock (about 200 species).

We explored complementary methods to build a classification able to reflect the type and level of diversity within the farms' systems, and to take into account their localization. Nevertheless it was challenging and further work is needed to improve methods to better characterize organic systems with this focus on diversity.

Introduction: We consider that the principles of organic farming are closely linked to those of agroecology, in particular diversity that leads to increase interactions between farm components and farm sustainability. Even if classical typology of farms are usually based on farm specialization, taking into account this specificity of OF, we chose type and level of diversity as key determinant of a typology of OF farms in France. However, we assumed that localization is conditioning diversity types, in relation with pedoclimatic conditions, value chains, etc. Thus, we wanted to classify the existing French OF based on their diversity and localization.

Material and methods: The ONAB database registers all French certified OF, their localization and the detail of their production classified following 203 production codes that we organized into 28 main production categories. The indicators are the area and the number of animals. In 2017, there were 36000 farms among which 29000 fully converted to OF on which we focused, calling our sample ONAB2017.

We combined different methodologies to reveal the combinations of productions.

1) The existing OTE (Technico-Economic Orientation) methodology groups farms by major production *ie* their specialization according to the Standard Gross Production (SGP) of their different productions, without subsidies (Farm Structure Survey, French SSP, Service de la Statistique et de la Prospective).
The reference data allocate SGP per type of crop (per Ha) or type of animal, with possible differences according regions. In the absence of SGP coefficients specific to organic, we used the conventional ones, assuming that the lower organic yields are compensated by the higher price.
We mobilized the French FADN - Farm Accountancy Data Network- references (RICA2017) to have a comparison with conventional, but FADN only concerns « professional » farms *ie* with SGP above 25000 €. Others are considered as "small" ones.

2) For a given production, we wanted to investigate the farms production combinations and the diversity level. Therefore, we have made categories (i) according to the weight of the principal production into 4 quartiles of the share of production SGP in the total SGP (not on a biological approach), and (ii) we used the Simpson Diversity Index (S) (Simpson, 1949) which measures both the number of productions present on a farm and the homogeneity in their dimensions (in SGP). It ranges from 0 (minimum diversity) to 1 (maximum diversity) and is defined as follows:
$S = 1 - S^{n}_{i=1} p_i$
Where p_i is the SGP share of production i in total SGP among the 28 main types of production.
Thus this index value the fact that several homogenous productions sizes (in SGP) have a more diversified character than a large production with others much more marginal.

3) We also used ClustOfVar R package (Chavent et al., 2017). It permits a reduction of variables (203 productions) to synthetic variables (SV). This involves classifying the original variables according to their level of correlation. Each SV synthesizes a cluster of variables. SVs are the subject of a trade-off between a small number of SVs (summarizing the information) and a number that guarantees a sufficient explained variance.
We wanted also a spatial representation of the clusters. The introduction of geographical distances via the ClustGeo R package (Chavent et al, 2018) makes it possible to further refine the classification: this method is based on two distance matrix, one structural and one geographical. Euclidean distances on the GPS coordinates have to be calculated (headquarters of the farms commune). The importance accorded to geographical distances in the classification is determined by an applied coefficient α between 0 and 1.

Results: 1) The OTE approach provides information to establish a profile of the size of OF farms and to compare to all French farms (sectors under or over-represented in organic) (Fig.1), but also to locate these OTE geographically and to study their diversity (Fig. 2).
It should be noted that small farms (which are excluded from FADN) represent a significant proportion of French OF (37 %), but this share of small farms is about the same as that of all 2017 RICA farms.
We could verify the very smallest arable crops share in the total organic area compared to the conventional one. The French "organic farm" is much more a vegetable, fruit and wine farm (more than 40 % of the surface) than the general French farm (20 %).

2) Our second approach focuses on production sector one by one and analyzes the combinations with the other productions according to their degree of economic preponderance in the farms. (Fig. 3, for the pigs sector).
We could reveal that in average 50 % of a production are outside the main OTE (except for vineyards, which are much more specialized farms).
The next step consisted to allow a visualization of the profile of the concerned production sector for the Q1 to the Q4 in terms of medium size (herd, area or total SGP) and the link with diversity (Fig.4).
The medium sizes of the farms are not correlated with the S index. S Index is often the highest for the Q3, and the lowest for the Q4, which is expected in the more specialized farms, but we have to underline that S is sensitive to the way we divided the categories.

3) Our third approach gave us some interpretation difficulties, because the method was not enough discriminating: one of the cluster represented 63% of all sample, which did not allow further classification. For the geographical representation, the challenge lied in the choice of a value α which allows the geographical criterion to be taken into account without unduly deteriorating the information provided by the variables of interest. This work is in progress.

Discussion: OTE typology method offers an advantage in the comparison with conventional, but fails to account for the diversity within the farm systems because of the focus on farms specialization.
Our second approach is focused on the combination of activities, but it does not enable a proper classification of the farms insofar as a same farm can enter into the analysis of several production sectors. Another point is that the used Simpson index misses to measure “distances” in the levels of diversity, for instance between pigs and vegetables or between dairy cattle and meat sheep, or inside vegetables. As diversity depends above all on the way it is measured, it is therefore difficult to establish a relationship between farm size and diversification.

Considering the type of database used, this statistical approach could not give us information on the level of interrelations between farm productions. We could not investigate further on to see how this classification into quartiles could help us to test the links between diversity and health, because we don’t have national databases on plants’ or animals’ health which could be crossover with ONAB.

For our third approach, we believe that both the choice of the clusters and the geographical distances need to be redesigned. Too much weight is given for geographical distance for farms that can be similar: distances constraining or the use of contiguity between farms are part of the future investigation.

Our work is original in that this typology is based on the diversity of productions, and ambitious in that it covers all OF at the scale of a country. Our exploratory work has confronted us to methodological questions in the quantification of diversity at farms’ scale, but also in the organization of a national typology taking into account the huge heterogeneity of French territories.

Another perspective is to study diversity levels between newly converted and previously converted farms to OF as the ONAB has collected data yearly from 2010 to 2019. We would especially like to explore the hypothesis of the “conventionalization” of OF.

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References: Chavent, Marie, Vanessa Kuentz-Simonet, Amaury Labenne, et Jérôme Saracco. 2018. « ClustGeo: An R Package for Hierarchical Clustering with Spatial Constraints ». Computational Statistics 33 (4): 1799-1822., R package version 2.0 :https://CRAN.R-project.org/package=ClustGeo

Chavent M., Kuentz-Simonet V., Liquet B., Saracco J. 2017. « ClustOfVar: Clustering of Variables », R package version 1.1 : https://CRAN.R-project.org/package=ClustOfVar

SSP - Production brute standard et classification des exploitations http://agreste.agriculture.gouv.fr/IMG/pdf_pbs.pdf

Simpson E. H. 1949, Measurement of Diversity, Nature 163 (4148): 688-688. https://doi.org/10.1038/163688a0.

Image:

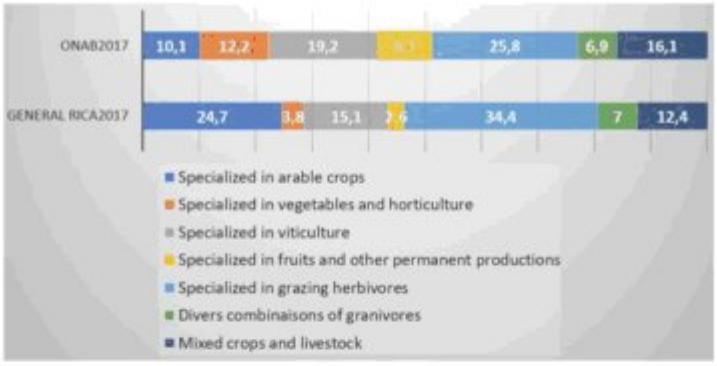

Fig 1 – Comparison of the share of farms belonging to different OTE in ONAB2017 and RICA2017

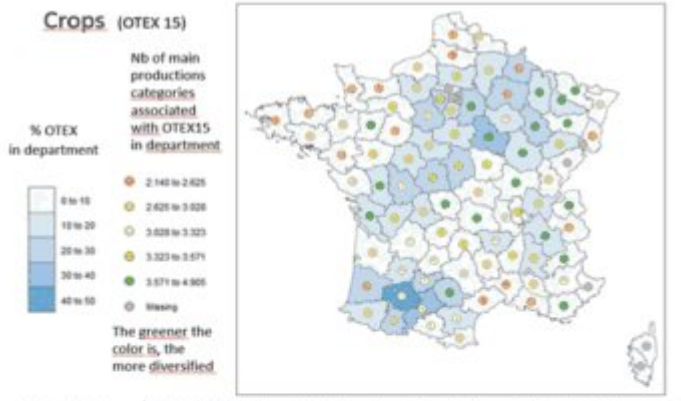

Fig. 2 – Share of the OTEX 15 (cereals, oilseeds and protein crops) in the total organic farms (from ONAB 2017) by department and number of main productions categories associated with OTEX 15 farms in the department.

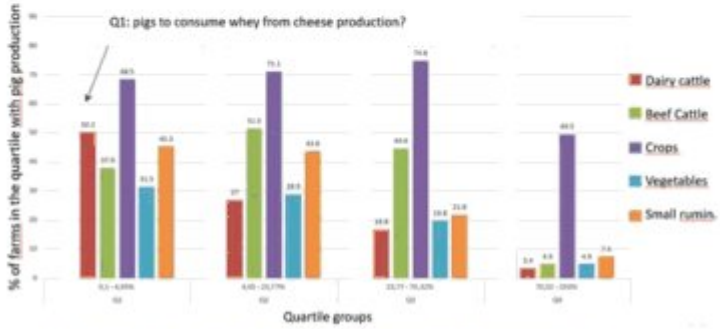

Fig. 3 – For the 4 pig SPG share quartiles, frequency of the combinations with 5 major productions

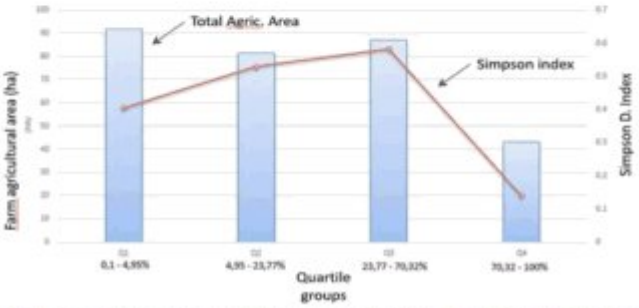

Fig. 4 – Farm agricultural area and Simpson Diversity Index for the 4 quartiles (pig production)

Disclosure of Interest: None Declared

Keywords: diversified production, diversity, ecological farming, Farm characterization, typology