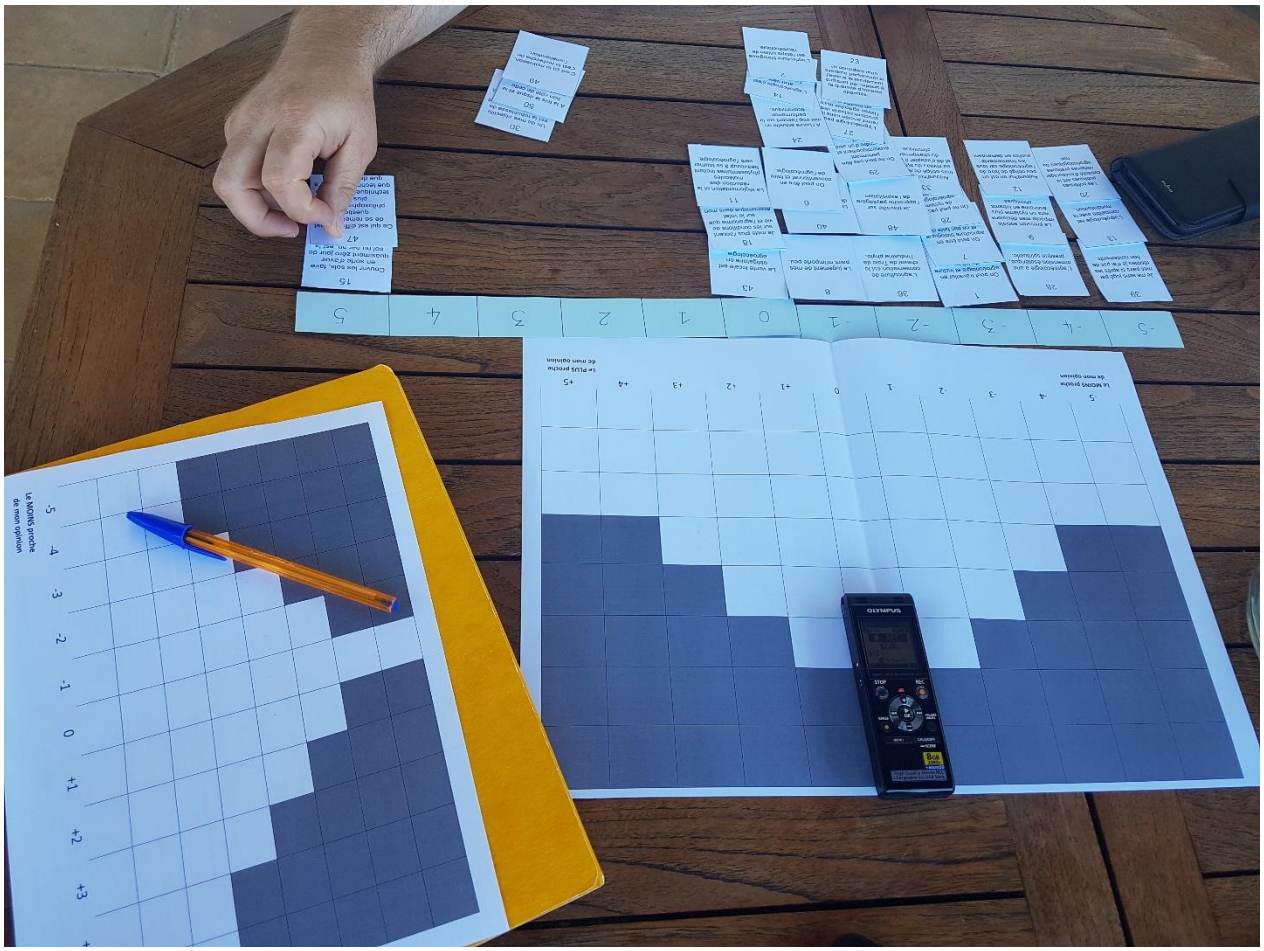
Perceptions of agroecological performance in arable crops:

a Q methodological approach



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Perceptions of Agroecological performance in arable crops: a Q methodological approach

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Abstract

Agroecology, *a minima*, refers to an alternative production system to conventional farming. Thus, it should not be assessed using conventional framework and tools to fully grasp its performance. Moreover, if no consensus on agroecology meaning can be found in literature, it does not prevent farmers from practicing and experiencing it on their farm. Hence, in this paper, we analyse how agroecology practitioners define it for themselves. To this end, we conducted a Q analysis looking at how farmers valuate their agroecological performances and in what way they consider it as a relevant concept for them. Based on data from 19 arable farms implementing agroecological practices in the Adour-Garonne area, this analysis identifies four discourses labelled the *Entrepreneur*, the *Organic Pragmatic*, the *Chemical Frugalist* and the *Welfare Farmer*'s viewpoints. We found that if they all share a common interest for agroecology and a sensibility for environment conservation, each discourse supports different strategies. Unveiling the meanings behind agroecological performance is instrumental in guiding policy-making towards the kind of performant agriculture we want for a sustainable future.

Keywords: *Agroecological performance, Agroecology, Q Methodology, Farmer's discourse.*

1. Introduction

Eighty percent of the water consumption in the Adour Garonne Basin is driven by agriculture. In this context of increasing water pressure, it appears essential to pay attention to water efficient and clean agricultural practices. Indeed, the Garonne 2050 report presents alarming prospective regarding climate change effects on water management quality and quantity in the Basin (Agence de l'Eau Adour-Garonne n.d.). Already, the area is facing a structural deficit of 250 million m^3 in regards to current water demand, as well as numerous conflicts on water use and pollution issues. In this context, the BAG'AGES project (*Bassin Adour-Garonne: quelles performances des pratiques agroécologiques?*) aims to evaluate the effects and impacts of agroecological practices on water resources in Adour-Garonne. To this end, the project selected four agroecological practices relatively widely adopted among arable farms, the latter being the most responsible for water pressure in the area, to analyse comprehensively. These practices include: (1)

extended crop rotation[1] (2) multi-service intermediate crops[2] (3) soil conservation[3] (no till) (4) agroforestry[4]. One objectives of Bag'Ages is to realise a transversal performance evaluation at farm level over three campaigns in order to confront with conventional farm performances. An expected outcome is to orientate decision-making regarding which agroecology practices to foster based on measured impacts.

In this quantitative-oriented and data-heavy framework, the present study offers to take a step back and approach the central topic of agroecology through social sciences lenses. Indeed, if Bag'Ages project identified a lack of scientific knowledge on agroecology's effects on water, one can also notice the absence of consensus on what agroecology is. The term endorses many definitions and related principles in the literature since its apparition in literature in the 1970s (see Wezel et al., 2009 for a condensed summary of the evolution of 'agroecology' meanings). The only consensus is that there is none. Thus, we see at least two reasons for taking this step back and investigate the concept of agroecology. First, agroecology is, *a minima*, an alternative production system to the conventional one and therefore it should not be assessed using conventional framework and tools to fully grasp its performance. Second, if no consensus on agroecology meaning can be found in literature, it does not prevent farmers from practicing and experiencing it on their farm. Hence, our objective lies in understanding how agroecology practitioners define it for themselves.

Q methodology has gained more and more attention in the field of rural sociology in an attempt to foster methodological pluralism (Previte, Pini, and Haslam-mckenzie 2007). According to its founders and followers, this method particularly qualifies for studying subjectivities (Brown 1980). Zagata (2010) asserts that Q methodology "*inherently acknowledges multiple versions of reality that are constructed by the engaged actors*" (p.281). For this reason, we conducted a Q analysis to understand how farmers valuate their agroecological performances and in what way they consider it as a relevant concept. To this end, we identified how these perspectives are translated into relevant indicators for evaluation and how they relate to existing sustainable agriculture paradigms. This study relied on the premise that several visions of agroecological performances coexist among farmers, even if they may implement similar practices. In addition, we acknowledge that performance is a normative and value-loaded concept, which is worth deconstructing and analysing to increase transparency of evaluation schemes. Finally, we hypothesized that farmers have ambivalent perceptions of agroecological performances that do not fully conform to existing paradigms in sustainable agriculture. They tend to have more nuanced positions than pre-existing categories. Q methodology allowed us to avoid using the latter and gave the way to the emergence of original discourses.

2. Materials and Methods

Q methodology is a mixed method designed to identify idealized forms of latent discourse, for instance, farmer's viewpoints on performance in agroecology (Van Exel and de Graaf 2005). Davies and

[1] Defined by project team as the lengthening of crop rotation compared to the pedoclimate standard rotation. A long rotation is more diversified, comprising at least 3 to 4 crops (besides intermediate crops). This definition includes crop succession (e.g. peas – rapeseed is different from rapeseed – peas).

[2] Crop that is sowed but not harvested for its grains. It includes crop residues and regrowth. The intermediate crop must be standing for at least 2 to 3 months (2 is legal minimum).

[3] The principle is the non-disturbance of soil horizons and labour intensity reduction. It excludes ploughing but also the chisel (which mix soil superficial horizons up to 20cm). The project team distinguishes no deep till (>15cm), no-superficial till (5-15cm), no very superficial till (<5cm) and direct sowing (no till).

[4] Inclusion of ligneous formations in and around the field.

Hodge (2007) emphasize that "*Q methodology assists in a structured analysis of what sets of attitudes, values and beliefs combine to form coherent perspectives or discourses on the topic*" of interest. The method confronts a set of statements, called the *Q sample*, expressing existing opinions on a given topic (Brown 1993; Stephenson and Stephenson 1994). Participants, called the *P sample*, are asked to rank-order the statements, in a forced quasi-normal distribution, according to, for example, their level of agreement or disagreement (Watts and Stenner 2005). Then, Q methodology enables a quantitative assessment of qualitative data by operating a rotation of factor analysis, looking at the set of opinions. The successive steps characteristics followed in Q methodologies are detailed in the next sub-sections.

Q methodology has gained increasing recognition in social sciences thanks to its claim of providing "*a foundation for the systematic study of subjectivity*" (Brown 1993, p.93), its advantage to combine qualitative and quantitative approaches' strengths (Akhtar-Danesh, Baumann, and Cordingley 2008), as well as its convenient trait not to require a large and random sample to operate (Danielson 2009). It is particularly interesting to use Q methodology as the basis of performance evaluation, as the latter is known to be embedded in a particular sustainability framework (Bockstaller, Feschet, and Angevin 2015). In this study, we attempted to gather farmers' discourses to construct this framework. Q methodology was particularly suited to this quest because, as Walter (1997) stated, "*farmers provide their own definitions and sort themselves into categories, rather than being assigned to categories by virtue of their answers to measures of externally derived constructs*". In this sense, the method does not relies on previously established scales and measures since the respondents are performing the assessment themselves rather than being evaluated (Hermans et al. 2012). The successive steps of Q methodology are described as follows: concourse design; construction of the Q sample; selection of the P sample ; and sorting.

2.1. Concourse and stakeholders interviews

Firstly, the Q sample is extracted from a wider *concourse*, which is an ensemble of possible statements on one topic. Dryzek and Berejikian (1993) assimilate a concourse to a "*population of statements about some topic*". Thus, the Q sample is the representative sample of statements from this population. In this study, we aimed at embracing all dimensions of performance and agroecology. The concourse was elaborated from a variety of sources: interviews with relevant stakeholders, project documents, and testimony videos of farmers (OSez l'Agro Écologie : Témoignages d'agriculteurs sur leurs pratiques agroécologiques n.d.).

Seven semi-structured interviews with the "Bag'Ages" project stakeholders were performed using an open and explorative interview guide. The selection of stakeholders was based on their assumed knowledge and well-formed opinion on the topic. Walder and Kantelhardt (2018) claim that including wider interest groups in the concourse elaboration than the actual population – here agroecological farmers - is an incentive for Q participants to position themselves on a wider range of statements, thus on a wider societal discourses. Therefore, we reached for interviewees from different institutions and backgrounds. Academics (INRA and IRSTEA researchers), farmers' association (GABB32) and project technicians (Agricultural Chambers, Solagro, AFAF) were interviewed. Farmers' statements were collected directly from testimonial videos where they detailed specificities of their systems, their reasons for a change in paradigm as well as their own definition of agroecology. We considered reaching concourse saturation at 206 statements as opinions expressed for each category below started becoming redundant.

2.2. Q sample: statements' selection

In order to ensure inclusivity and facilitate selection, the concourse was organised according to a categorical sampling matrix (Barry, Barry, and Proops 2016; Hermans et al. 2012; Walder and Kantelhardt 2018). The categories were first induced from interviews by coding recurring themes with Iramuteq software, then conceptualized by researchers. Selected categories were the following:

(1) Biodiversity and landscape;
(2) Climate change and adaptation;
(3) Commercialization and territory;
(4) Economic output;
(5) Farming profession;
(6) Public policies;
(7) Social aspects;
(8) Synthetic inputs;
(9) Tillage and soil.

The Q sample is a selection of statements allowing representativeness of the concourse while remaining cognitively manageable for Q participants to sort. As for representativeness, the Q sample should cover all concourse categories. Q statements should also be a verbatim, or very lightly edited, in an attempt to subtract researcher's subjectivity (Webler, Danielson, and Tuler 2009). They should be self-referential, that is sufficiently open to be interpreted in various ways from one respondent to another. Brown (1980) talks about the "*excess meaning*" of Q statements to indicate that statements should enable a whole range of interpretations. Regarding Q sample size, it is advised to use a 3:1 ratio with the number of participant (*P sample* size) (Webler, Danielson, and Tuler 2009). We selected 50 statements for 19 participants (i.e. 2.63:1 ratio). Each statement was printed on a randomly numbered set of cards (6x6 cm), which constituted the physical Q sample used by participants.

2.3. P sample: participants' selection

The *P sample* is the ensemble of participants to the Q study. Unlike for regular surveys, they are not randomly chosen among the target population. Indeed, the P sample should guarantee that no potential viewpoint held in the population is discarded (Walder and Kantelhardt 2018). Therefore, similarly with stakeholder interviews, we contacted participants according to their assumed well-formed opinion and potential to represent the breath of viewpoints (Webler, Danielson, and Tuler 2009). The criteria derived from farms' specificities highlighted in the Bag'Ages project:

(1) Different pedoclimates and thus, various farm locations in the Adour-Garonne watershed;
(2) Implementation and stabilization of one (or more) of the four agroecological practices targeted;
(3) Use vs. absence of irrigation;
(4) Organic certification (vs. none).

Nineteen out of twenty-six farmers contacted responded positively to our solicitation. We reached them via their technical advisors for Bag'Ages project. Five advisors provided us with farmers' contact details and facilitated fieldwork in some instances.

2.4. Q sorting

Q sorting refers to rank ordering the Q sample following a forced quasi-normal distribution, which results in an individual *Q sort*. It was conducted in the form of a face-to-face meeting with the farmer at

his[5] house. First, participants answered a short background survey to provide information on their farming system (e.g. production type, soil type, irrigation, certification, etc.). With this short survey, we aimed at launching the discussion and adapting the following questions to the participant's context. Secondly, participants were presented the cards and were asked to take some time to read the entire Q sample and pre-sort the cards into three piles: agree, neutral and disagree. During pre-sorting, they were encouraged to explicit their own understanding of each statement and the reasons driving their sorting. This talk-as-you-go form of interview makes the transcription process much easier for the researcher as information can be structured similarly to the Q sample, allowing links between an explanation and a particular statement card. Therefore, it was encouraged, but not compelled. Some participants chose to explicit their decisions after the sorting.

Participants were all constrained to use a response chart in a pyramidal shape to ensure quasi-normal distribution (**Figure 1**). This technique is deemed to force participant to prioritize and avoid weak positioning on the topic (Brown 1980), although it is debated among the Q community (Kampen and Tamás 2014). The sorting instruction were to sort statements according to the level of agreement, ranging from -5 (least like I think) to +5 (most like I think). Once the participant was satisfied with his sorting, he was encouraged to reflect on the statement ranked at both chart extremes and explain how these fit into his own discourse about agroecology. He was also asked whether he was willing to move the zero threshold to the right or the left according to where he positioned the frontier between agree and disagree. Complementary questions were asked to wrap up the process:

(1) "Do you think some related themes were missing in the Q sample?";

(2) "Do you claim to be part of a particular movement in agriculture?";

(3) "Are you satisfied with the performance of your system? If not, what do you wish to improve?".

An example of what a Q sorting looks like is provided in **Figure 2**.

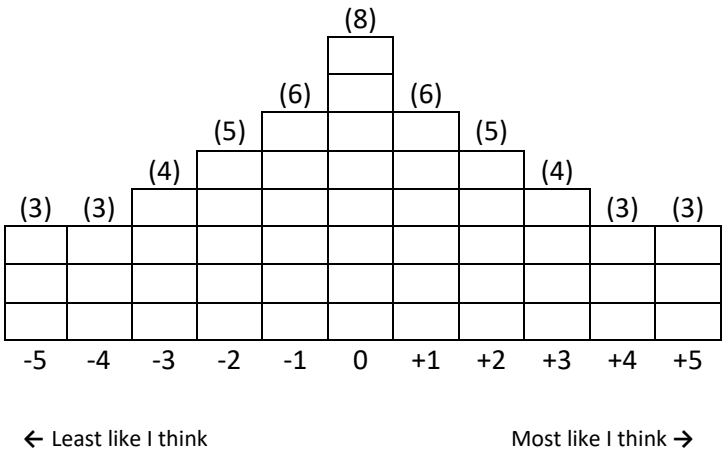

Figure 1. Q chart used in this study with a 50 statements Q sample.

Figure 2. Example of a Q sorting process.

[5] The use of masculine pronouns is justified by the fact that the entire P sample was male.

2.5. Correlation and factor extraction

In Q methodology, factor analysis and rotation are conducted to identify similarities and differences among individual Q sorts. The resulting idealized Q sorts, called *factors*, are the weighted average of similar individual Q sorts (Webler, Danielson, and Tuler 2009). Figuratively, if participants who ranked statements in a similar pattern would gather in a room and collectively rank and order the statements, it would result into a factor, in Q terminology. The researcher interprets the factor to translate it into a discourse. Previte, Pini, and Haslam-Mckenzie (2007) provides the clearest explanation, stating "*individuals who 'load' on the same factor have sorted the statement items similarly and consequently will be those who have a similar discursive position*".

In this study, we performed a Principal Component factor analysis and a Varimax Rotation of the factors on the nineteen collected Q sorts, using PQMethod software (Schmolck 2002). We decided upon the number of factors to extract according to four rules suggested in Webler, Danielson, and Tuler (2009):

(1) Simplicity, which states that fewer factors is better;
(2) Clarity, which avoids *non-loaders* (i.e. Q sort which does not load on any factor) and *confounders* (i.e. Q sort which loads on more than one factor);
(3) Distinctness, which encourages low correlation between factors;
(4) Stability, which maintains stable clusters of loaders.

In addition, a rule of thumb is to consider only factor presenting an eigenvalue>1, in this case up to the sixth factor. After testing this set of rules on 2 to 6 factors, it appeared that a four-factors analysis was the most satisfying result.

Manual *flagging* was conducted before performing the final Q analysis of the rotated factors. Flagging refers to notifying the software which sorts are considered to load significantly on each factor. The flagged sorts are called *defining sorts,* and are essential to the analysis because their weighted average constitutes the factor (Webler, Danielson, and Tuler 2009). Theoretically, the criterion to flag a sort is significant loading (at p<.01), that is: $2.58(1/\sqrt{n})$, where n is the Q sample size (i.e. 50), equals ±0.36 (Watts and Stenner 2005, p.87). However, it is not forbidden to use a more stringent level of significance and can be useful to limit confounders. Therefore, we applied a 0.45 significance level to manual flag Q sorts in this case.

The *discourses* are the factors' translation into common language that express a coherent viewpoint (Webler, Danielson, and Tuler 2009). The following combination of outputs underpinned factors' interpretation:

(1) Statements which received most extreme scores, both positively and negatively (i.e. -5; -4; +4; +5);
(2) Distinguishing statements of each factor;
(3) Categories structuring the Q sample;
(4) *Verbatim* of the participants to illustrate the meaning of a particular statement in the context of each factor.

3. Results

3.1. P sample description

Nineteen farmers performed Q sorting. All participants were male, regardless of any purposive sampling in this sense. We acknowledge that the inclusion of female participants could have influenced

the results presented below. **Table 1** shows a descriptive summary of the interviewed farmers' production systems. All the French departments covered in the Bag'Ages project were represented in our sample, with a majority of 32% farmers from Gers. The main production type was arable crops (i.e. 58%) and the latter were present in each system considered. Almost half of the sample was composed with organic farmers (i.e. 47%). Farm sizes varied between 23 and 350 ha, with a large majority of farms below 200 ha (i.e. 73%). Our sample was relatively balanced between irrigated, rainfed and a combination of both systems. As for agro-ecological practices, interviewed farmers had a relatively extensive rotation, from four up to eight years depending on the farm, and almost everyone in the P sample implemented soil cover crops, at least once a year. 32% of farmers performed ploughing, but not systematically for most of them. Only two farmers were implementing direct sowing. Finally, 26% of the sample had agroforestry plots, for which they received subsidies.

Four factors were selected for Q analysis. Seventeen out of the nineteen Q sorts were *defining* and hence used to elaborate these factors (n.b. factors are the weighted average of defining Q sorts). In other words, seventeen farmers helped to express the four discourses. Correlation rates presented in **Table 2** indicate how similar the farmer's Q sort was to factor - idealized sorts - A, B, C and D. Factor A gathered the largest number of farmers with eight defining sorts, as well as a *multi-loader* (Nicolas[6]), the only multi-loader of the sample. Since Nicolas' Q sort loaded significantly on two factors at the same time, it has not been considered in the factors' elaboration. Factor A also explained the largest part of the variance (i.e. up to 19%). However, because our sample was not randomized and relatively small, these data did not allow us to conclude that discourse A was dominant in our population. Factor B included four farmers as well as Nicolas, Factors C and D included respectively three and two farmers. Nelson was a *non-loader*, his Q sort did not significantly load on any factors (i.e. $r \leq 0.45$), and thus was not accounted for in their creation either. This does not mean that Nelson's opinion has little interest; only that it did not correlate to any other in our sample when considering four factors.

3.1. Farmers' shared values and beliefs

Despite their affinity for one of the four factors, this study highlighted significant points of consensus among the nineteen farmers interviewed. Out of fifty statements, fourteen obtained similar scores across all factors (i.e. 28% of the statements). Six of them were marked by a strong opinion, which is indicated by a Z-score superior to 1 (or inferior to -1) or a rank of ±3 (Van Exel and de Graaf 2005, p.22). Specifically, the study of these consensual statements highlighted that farmers appreciate exchanging with their peers on innovative practices and experiments (S38 - see **Table 4**). They are open-minded people who are in a perpetual learning process, which allows them to better respect their land (S44). In general, these agroecology pioneers are independent spirits, as they do not easily fall under the influence of others. Social pressure is not seen as a change driver towards low-input systems (S9). In addition, they do not suffer from peers' judgement after the harvest, even if they did not get good yields (S39). Moreover, they do not consider yields as a primary performance indicator (S40). Finally, farmers tend to oppose globalization with agro-ecology. However, reasons for this opposition differ between groups (see section 4.).

[6] The participant names have been modified to respect their anonymity.

Table 1. Descriptive summary of the 19 Q participants' farm characteristics, by factors and for the total P sample. Non and multi-loaders were excluded from the by factor summary but not from P sample column.

	Factor A n=8		*Factor B* n=4		*Factor C* n=3		*Factor D* n=2		*P sample* n=19	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Location										
Charente Maritime	3	38%	-	-	-	-	-	-	4	21%
Dordogne	1	13%	-	-	1	33%	-	-	2	11%
Gers	2	25%	3	75%	-	-	1	0,5	6	32%
Haute Garonne	-	-	1	25%	-	-	-	-	1	5%
Landes	-	-	-	-	2	67%	-	-	3	16%
Tarn	2	25%	-	-	-	-	1	0,5	3	16%
Production type										
Arable crops	4	50%	3	75%	2	67%	1	0,5	11	58%
Mixed farm	2	25%	-	-	1	33%	1	0,5	5	26%
Multiactive	1	13%	-	-	-	-	-	-	1	5%
Others (arable + other)	1	13%	1	25%	-	-	-	-	2	11%
Organic certification										
Yes	2	25%	4	100%	2	67%	1	0,5	9	47%
Farm size										
<100 ha	2	25%	3	75%	-	-	-	-	5	26%
<200 ha	4	50%	1	25%	-	-	2	1	9	47%
<300 ha	2	25%	-	-	2	67%	-	-	4	21%
+ de 300 ha	-	-	-	-	1	33%	-	-	1	5%
Soil type										
Clay-limestone	7	88%	4	100%	1	33%	1	0,5	13	68%
Groie	-	-	-	-	-	-	1	0,5	2	11%
Sandy	1	13%	-	-	2	67%	-	-	4	21%
Irrigation										
Rainfed	3	38%	2	50%	-	-	2	1	8	42%
Irrigated	2	25%	1	25%	2	67%	-	-	6	32%
Both	3	38%	1	25%	1	33%	-	-	5	26%
Rotation										
4 crops or -	1	13%	-	-	-	-	-	-	2	11%
5 crops	2	25%	2	50%	2	67%	-	-	7	37%
6 crops	3	38%	2	50%	1	33%	1	0,5	7	37%
7 crops and +	2	25%	-	-	-	-	1	0,5	3	16%
Soil cover								0		
Yes	8	100%	4	100%	2	67%	2	1	18	95%
Tillage										
Ploughing	2	25%	1	25%	2	67%	-	-	6	32%
Medium till <15 cm	2	25%	2	50%	1	33%	2	1	8	42%
Superficial till <5 cm	2	25%	1	25%	-	-	-	-	3	16%
Direct sowing	2	25%	-	-	-	-	-	-	2	11%
Agroforestery										
Yes	1	13%	3	75%	-	-	1	0,5	5	26%

Table 2. Factor matrix indicating the loading of each farmer's Q sort on the four factors. In bold are indicated defining sorts used to create the factor. Explained variance is indicated as a percentage.

	Factors			
	A	B	C	D
Farmers				
Arthur	**0.64**	0.41	-0.16	0.43
Cyprien	0.26	0.38	**0.60**	0.16
David	- 0.03	0.21	0.24	**0.83**
Charles	0.10	0.31	**0.57**	0.03
Armand	**0.46**	0.09	0.30	0.41
Alban	**0.65**	0.19	0.27	- 0.26
Nelson	0.30	- 0.19	0.35	- 0.14
Antoine	**0.69**	0.19	0.26	0.23
Archibald	**0.73**	- 0.12	0.03	0.28
Nicolas	0.47	0.47	0.15	- 0.04
Caspar	0.03	0.06	**0.73**	0.15
Dominique	0.31	- 0.04	- 0.01	**0.76**
Anatole	**0.48**	0.33	0.28	0.23
Benoît	0.43	**0.61**	- 0.13	0.24
Blaise	0.14	**0.55**	0.30	0.12
Benjamin	0.27	**0.68**	0.19	-0.03
Basile	- 0.20	**0.82**	0.06	0.01
Ange	**0.51**	- 0.23	0.40	0.37
Alain	**0.53**	0.20	0.06	0.07
Determining Q sorts	8	4	3	2
Explained variance in %	19	15	11	11

This consensus was reinforced by relatively high correlation rates between factors (**Table 3**). The latter indicates pairwise similarity rate. Discourses are relatively "close" to each other since four out of six correlation rates exceeded the significance threshold of this study, set at 0.36 for $p<.01$ (see Material and Methods section). However, Q methodology highlighted significant differences among farmers' discourses on several themes:

Discourse B remained the most specific, even if it was closer to discourses A (correl. 39%) and C (correl. 39%) than to D (correl. 22%). It differed from A on topics such as the role of conventional agriculture in agroecology, the use of agrochemicals, the importance of public policies and tillage. It differed from C regarding its landscape approach, public policies, marketing methods and climate change.

Discourses C and A were relatively close (correl. 43%). Particularly, they differed in their understanding of organic farming, the use agrochemicals, the landscape approach and the role of health in decision-making.

Discourses D and A were relatively close as well (correl. 0.42%). They differed specifically in their position as for the use of agrochemical, the prevalence of economic performance in decision-making, marketing and their approach to agroecology (i.e. pragmatic versus philosophical).

Table 3. Correlation rates between factors. The significance threshold (p<.01) for this study is 0.36 (see Materials and Methods).

Correlation	*Factor A*	*Factor B*	*Factor C*	*Factor D*
Factor A		0.39	0.43	0.42
Factor B			0.39	0.22
Factor C				0.32

3.2. Farmers' distinguishing understanding of agroecology

Twenty-seven out of fifty statements were instrumental in distinguishing the four factors. The latter were interpreted and translated into discourses potentially held by farmers who loaded on these factors. Each discourse reflected a certain approach to agroecology and established the relevant themes and indicators to assess its performance at farm level. Typical adherent to the discourses were named respectively: (A) *the Entrepreneur*, (B) *the Organic-Pragmatic*, (C) *the Chemical Frugalist*, (D) *the Welfare Farmer*. It is obvious that these designations are reductive and only take on their meaning in the details of discourse interpretation. Yet, to support these terms, we provide references to statements within brackets, indicating the number of the statement and its rank on the proposed scale from -5 (i.e. "Least like I think") to +5 (i.e. "Most like I think"). For example, (S1, -1) refers to statement number 1, which was ranked -1, indicating a slight disagreement. Extreme Z-scores and ranks revealed differences in opinions between the four factors. Z-scores are the standard scores of each statement for each factor. They indicate the distance between the considered statement's rank and zero, their unit being the standard deviation. The rank indicates the statement's position on the proposed scale from -5 to +5.

3.2.1. Factor A : agroecology as an innovative enterprise

Overall, the *Entrepreneur* displays a liberal vision of agroecology. It is a fluid and pragmatic form, with blurry contours, and is based on operators' own decisions. In this discourse, adaptation to climate change and markets is essential. In order to face these challenges, the *Entrepreneur* adopts a position of "entrepreneurship" (Antoine), who has a certain taste for risk through experimentation and enjoys reaching for improvement. Eight out of the nineteen farmers were assimilated to the *Entrepreneur's* profile and vision of agroecology.

Specifically, the *Entrepreneur* attaches great importance to ecosystem services, such as landscape structuring, erosion control, pollination, and water resource maintenance (S16, +5). The *Entrepreneur* particularly emphasizes the multitude of skills and continuous learning characteristic of agro-ecology, which, according to Arthur, "*gives meaning [to the] farming profession*". Several participants highlighted how the integration of agro-ecological practices has led to a shift of their working methods by encouraging observation and reflection, as opposed to a methodical, almost automatic, agriculture driven by manufacturers' recommendations for the use of their products. It is also in this sense that the search for improvement, often through experimentation, is the *Entrepreneur's* driving force (S49, +4). He is also attached to the profession of farmer that he wishes to pass on to his children after having made his farm flourish (S46, +5).

Table 4. List of statements, Z-scores and rank for each factor. *(P<0.05) and **(P<0.01) indicate that factors differed significantly from one another about the statement at stakes at respectively 5% and 1% of the confidence level. In italics are indicated consensus statements across all factors.

	Statements	*Factors scores*							
		A		**B**		**C**		**D**	
		Zscore	Rank	Zscore	Rank	Zscore	Rank	Zscore	Rank
S1	One can work agroecologically and practice ploughing.	-0.62	-1	**0.75**	**+2****	-0.54	-2	**-1.42**	**-4***
S2	Organic agriculture is the ultimate stage of agroecology.	**-1.76**	**-5****	1.10	+4	0.51	+1	-0.25	0
S3	Economic performance is essential for the acceptance and dissemination of an agroecological practice.	0.76	+2	**1.62**	**+4***	0.84	+2	**-0.84**	**-2****
S4	A practice that prides itself on being agroecological must necessarily be profitable.	0.75	+2	**-0.41**	**-1***	0.98	+3	**-1.34**	**-4***
S5	Profitability is a minimum rather than an objective to achieve.	**-0.74**	**-2***	-0.02	0	0.08	-1	0.42	+1
S6	One can be a conventional farmer and work agroecologically.	1.18	+3	-0.88	-2	0.93	+2	-0.50	-1
S7	One can be an organic farmer and not work agroecologically.	-0.04	0	0.39	0	-0.41	-1	0.76	+2
S8	My peers' judgement does not matter to me.	0.28	0	**-0.48**	**-1***	0.22	0	**1.93**	**+5****
S9	*Social pressure influences my decisions towards a lower agrochemical inputs system.*	-1.17	-3	-1.24	-3	-0.94	-2	-0.92	-2
S10	Nowadays, one must adopt agroecology principles.	-0.52	-1	**0.63**	**+1****	-0.38	-1	-0.67	-1
S11	Rules and regulations on agrochemical reduction encourage strongly shifting towards agroecology.	-0.67	-2	0.05	0	0.24	0	-1.01	-3
S12	Nowadays, one must do agroecology because all public subsidies ask for it.	-1.82	-5	**-0.39**	**-1***	-1.11	-3	-1.43	-5
S13	*Agroecology is compatible with globalization*.	-0.70	-2	-1.20	-3	-1.33	-3	-1.09	-3
S14	*Agroecology is moving towards the farm energy auto-sufficiency thanks to plants.*	-0.12	0	-0.26	-1	-0.62	-2	-0.34	-1
S15	Covering the soils, attempting permanent covering all year round, is the primary step towards sustainability.	1.19	+4	**-0.03**	**0****	1.07	+4	1.00	+3
S16	A system is interesting if it provides a number of services, such as landscape structuration, erosion limitation, pollination, and water retention.	1.81	+5	1.62	+5	**0.12**	**0***	1.00	+3
S17	*Diagnosis tools at farm level have an interest for the farmer.*	-0.22	-1	0.37	0	0.24	0	-0.34	-1
S18	I emphasize quality of life and agronomy rather than economy in my approach of sustainability.	-0.15	0	-0.64	-2	-1.22	-3	**0.67**	**+1***
S19	*To foster adoption of new agroecological practices, demonstration fields are the most effective strategy.*	0.56	+2	0.85	+3	0.34	0	0.75	+1
S20	Public policies have the capacity to foster agroecological pratices.	-0.84	-2	**1.83**	**+5****	-0.23	-1	-1.09	-3
S21	I am interested in agrochemical reduction because I believe there are too many cancers in my profession.	-0.01	0	-0.05	0	**1.49**	**+5****	-0.59	-1
S22	Climate change adaptation is not a key element in my system.	-1.31	-4	-1.76	-5	**0.50**	**+1****	-0.76	-2
S23	*I consider my system efficient if I estimate the yield sufficient in relation to the quantity of inputs provided.*	0.52	+1	0.69	+2	0.32	0	0.84	+2
S24	Nowadays, we over-emphasize economic performance.	-0.60	-1	-0.92	-2	-0.60	-2	**0.92**	**+2****

S25	*An agroecological system is first and foremost frugal in agrochemical.*	0.32	+1	0.95	+3	0.75	+2	0.17	0
S26	One cannot talk about agroecological systems, only about agroecological practices.	-0.55	-1	-0.60	-2	0.44	+1	1.01	+3
S27	Agroecology can remain embedded in the current structure of agricultural value chains but while modifying its inputs.	**0.17**	**0****	-1.25	-4	**1.05**	**+4****	-0.92	-2
S28	Agroecology has an esoteric, almost spiritual dimension.	-1.65	-4	-2.03	-5	-1.44	-4	**0.84**	**+2****
S29	One cannot be economically efficient while depending upon a single customer.	**-1.06**	**-3****	0.64	+1	0.59	+1	0.84	+2
S30	One of my objectives is the robustness of my system, in the broad sense of adaptability, plasticity, resistance to more or less important shocks.	**1.13**	**+2***	**1.91**	**+5****	**0.44**	**+1***	**-0.50**	**-1***
S31	*One of my objectives is to have my system embedded in the territory and to have a real connection with locality.*	0.40	+1	0.43	+1	-0.31	-1	0	0
S32	I feel responsible for the impact of my activities on the environment and society.	0.29	+1	0.72	+2	1.35	+5	0.08	0
S33	*Today, we are all forced to think about the system and adapt because of climate change.*	0.49	+1	0.69	+2	0.15	0	-0.17	0
S34	*Our role as farmers is to maintain fertility of the soil, after that, the rest is regulated by chemistry or mechanics.*	-0.70	-2	-0.54	-2	-0.47	-1	-0.50	-1
S35	Applying a little glyphosate is the price to pay for putting everything else in place.	**0.96**	**+2****	-1.73	-4	-1.41	-4	-1.42	-4
S36	Conservation agriculture is the Trojan horse of the agrochemical industry.	**-1.81**	**-5***	**-0.12**	**0***	**1.01**	**+3****	**-1.01**	**-3***
S37	Organic agriculture is destructive of soils.	**-0.52**	**-1***	-1.91	-5	-2.19	-5	-1.25	-3
S38	*I like sharing with other farmers who have tried practices in order to learn.*	1.18	+3	1.03	+3	0.98	+3	1.09	+4
S39	*I feel judged by my peers if after the harvest I don't have good yields.*	-1.24	-3	-1.01	-3	-1.50	-4	-1.43	-5
S40	*The first performance indicator is yields.*	-0.92	-3	-1.44	-4	-1.34	-3	-1.59	-5
S41	I am committed to preserving the environment around my farm, beyond the plots.	1.17	+3	0.74	+2	0.52	+1	0.17	0
S42	For me, producing quality food is essential.	1.41	+4	1.15	+4	0.78	+2	2.09	+5
S43	Local sale is mandatory in agroecology.	**-1.35**	**-4***	-0.33	-1	**-2.16**	**-5***	0.42	+1
S44	*I learn every day, which allows me to respect this soil, this land.*	1.18	+3	0.53	+1	1.13	+4	0.59	+1
S45	Health, family and money, that's my winning tiercé.	**0.45**	**+1****	**-0.98**	**-3****	1.81	+5	2.09	+5
S46	We are putting in place a system that we will transmit to our children, and that is our salary.	1.51	+5	**-0.05**	**0****	**-0.99**	**-2****	1.17	+4
S47	What is difficult is to question oneself, philosophically more than technically, because technically there are only solutions.	0.24	0	-0.37	-1	0.21	0	1.00	+3
S48	I work on the landscape approach of my exploitation.	0.20	0	**1.01**	**+3***	**-1.77**	**-5****	0	0
S49	That's the motivation, that's the search for improvement.	1.35	+4	0.47	+1	1.00	+3	1.09	+4
S50	At the same time the risk and the good side of this adventure is that we multiply our skills, we have to learn, get informed. It's very rewarding.	**1.61**	**+5***	0.45	+1	0.86	+2	0.42	+1

The *Entrepreneur's* discourse distinguishes for its positioning regarding agrochemicals use in agroecology. He is most likely to consent to a small amount of glyphosate application in order to ensure his crops' success (S35, +2). According to him, glyphosate is a tool like any other which must remain available in case of necessity. While some farmers see the product as a valuable help until they manage without, Alban believes that "*it's not a price to pay, it's part of the solution*". Unlike other groups, the *Entrepreneur* does not tend to demonize the agrochemical industry (S36, -5). He is also the least convinced that organic agriculture is the ultimate stage in agroecology (S2, -5). Only 25% of farmers who loaded on the *Entrepreneur's* discourse are certified organic, compared to 47% in the total sample (see **Table 1**). Several reasons are mentioned, among them the strong reliance on ploughing, relatively despised by the *Entrepreneur* (S1, -1), and the label regulation which can sometimes contradict agro-ecological principles. In the reverse, this discourse gives way to a view of agro-ecology compatible with conventional farming (S6, +3). This includes a soil cover as permanent as possible (S15, +4). However, farmers specify technical barriers they are facing regarding soil covers: "*There are the great theories and practice*" (Alban). Antoine denounces regulations on this matter, which he considers unsuitable to the local specificities and technical capacities of farmers: "*it is imposing something on us [the implementation of plant cover] that is not necessarily within farmers' abilities*".

The *Entrepreneur* is quite distrustful of public policies. He is not convinced that the latter have the capacity to foster agro-ecological practices (S20, -2), in the sense that legislators lack adequate knowledge. Similarly, the *Entrepreneur* does not see regulation as a driver of chemical inputs reduction (S11, -2), nor financial incentives as a driver of agro-ecological transition (S12, -5). Alternatively, he is very attached to his freedom, which is reflected in farmers' reluctance to the word "*obligation*". Alban asserts that "*agro-ecology is something that must come from the bottom up, not be imposed from above*".

Finally, the *Entrepreneur* is the most inclined to consider profitability as an objective to be achieved, and not a minimum (S5, -2). For him, margin is a better indicator of economic performance than yields (S40, -3). However, the *Entrepreneur* differs most from other profiles in his marketing approach. Indeed, he considers that having a single outlet, via cooperative, does not jeopardize economic performance (S29, -3). In addition, local sale is not the *Entrepreneur's* concern (S43, -4).

3.2.2. Factor B : agroecology as pragmatic organic farming

The *Organic Pragmatic* is convinced of organic agriculture's potential to operate the agro-ecological transition. Above all, he calls for discernment and agronomic skills to make decisions based on facts and agronomic principles, rather than dogmatism. As a result, he is open to other approaches. He has a systemic vision of agriculture and does not limit his analysis to organic standards. Four farmers out of nineteen correspond to this profile and adhere to a pragmatic vision of organic farming as an agro-ecologic ideal. Moreover, all those farmers are certified in organic farming.

The *Organic Pragmatic* is particularly attentive to the robustness of his system (S30, +5), its adaptability to change, particularly climate change (S22, -5), which is at the heart of his strategic choices. He also stands out from other groups due to his relative confidence in public policies' ability to foster the agro-ecological transition (S20, +5), through financial incentives rather than regulation (S11, 0). Nevertheless, farmers pointed out that organic conversion subsidies did not play a decisive role in setting up their production system, either because they started as organic farmers directly (three out of four farmers) or because they wanted autonomy and caution (one farmer).

Economic performance is of great importance in the *Organic Pragmatic* discourse (S3, +4; S18, -2; S24, -2). Benoît is alarmed by the very difficult economic conditions of some farms that are unable to generate a minimum wage despite a colossal amount of work. "*It's normal to focus on economic performance, we have the right to live off our work, it seems important to me*" (Benoît). However, according to the *Organic Pragmatic*, economic performance is not limited to yield (S40, -4) or economic margin. On the one hand, Benoît believes that economic performance should be assessed in long term: "*I would agree more [with statement S40] if there were a notion in time, because here I can do practices to increase yield for a few years but then it will break my neck*. ». On the other hand, Blaise stated that "*if we were ever integrating the real costs of conventional agriculture for the environment, we would realize that it is not at all profitable*".

For the *Organic Pragmatic*, agro-ecological farming aims at promoting ecosystemic services as much as possible (S16; +5). He also tends to pay more attention to the farm landscape than other groups (S48, +3; S41, +2). Farmers (three out of four) mentioned the importance of the farm's environmental aesthetics. This reflects an ongoing systemic vision of agriculture throughout the *Organic Pragmatic* discourse. Blaise said that "*agroecology is still a systemic approach, that's for sure*".

The *Organic Pragmatic* considers organic farming as the ultimate stage of agroecology (S2, +4). He considers that the latter and conventional agriculture are not compatible (S4, -2). Blaise specified that "*we can be a conventional farmer with an agro-ecological approach, but with the will to convert*". However, all participants mentioned examples of organic farming that they considered non-agro-ecological, particularly in terms of energy consumption. Concerning his agronomic practices, the *Organic Pragmatic* stands out for his lack of aversion towards ploughing in agroecology (S1, +2). He will tend to avoid ploughing - two of the farmers had been practicing non-tillage for nearly 20 years - but Blaise believes that "*it is necessary to be perceptive; some may need it [to plough]. Theoretically it is not incompatible [ploughing and agro-ecology] but it is far from being necessary*". Similarly, as for soil cover (S15, 0), the *Organic Pragmatic* favours a reasoning approach: "*Overall it is true that covering the soil is important to me, but there are small exceptions in it*" (Benoît), for example a short intercrop-period to allow sufficient biomass creation. Farmers also disapproved the agronomic relevance of existing regulations, which they consider inadapted to the variety of soil and climate conditions. In addition, some farmers warned against dogmatism and emphasized the technical dimension of agroecology, which lead them to favour a pragmatic, rather than a spiritual approach (S28, -5).

The *Organic Pragmatic* tends to oppose agro-ecology with globalization (S13, -3) in the current context of liberal and capital-intensive economic exchanges, particularly in relation to the high environmental cost of these exchanges. "*If globalization is a wild economy of the most violent that imposes itself on others, it is obviously incompatible [with agro-ecology]"* (Blaise). However, the *Organic Pragmatic* is not opposed to world cereal trade, nor does he put local sales in the forefront (S43, -1). He tends to favour the local when possible, but remains limited in his choices by the cereal system in place.

3.2.3. Factor C : agroecology as a low-agrochemical farming

The *Chemical Frugalist* defines agroecology as low-chemicals inputs agriculture, with a real concern for the health of their relatives and the environment. Unlike organic farming, which is structured by a set of rules, agroecology can take various forms depending on the system and constraints of each individual. This variability is reflected in the relatively high standard error (i.e. 0.28 versus 0.25 on average) of the

associated factor, which means a larger gap between participants gathered in this discourse. Three farmers are related to the *Chemical Frugalist* discourse.

Above all, the *Chemical Frugalist* is concerned with his health and that of his entourage. He places health and family at the top of his "winning tiercé" (S45, +5). This is the discourse most likely to correlate health with use reduction of agroechemicals (S21, +5). He considers that an agro-ecological system must be frugal in terms of chemical inputs (S25, +2). This theme permeates throughout the *Chemical Frugalist* discourse. He reckons that the implementation of agro-ecological practices, for example beneficial to soil life, does not justify the use of glyphosate (S35, -4). In addition, he is most likely to say that the agrochemical industry uses conservation agriculture to continue selling its products in a context where they are increasingly condemned (S36, +3). He differs from other groups by emphasizing the need to modify inputs used in agroecology, specifically their quantities and conditions of application, while remaining within existing agricultural chains (S27, +4). In addition, the *Chemical Frugalist* is the least likely to seek alternative value chains, including through local sales (S43, -5). Finally, the latter acknowledges the accountability of his agricultural activities to the society and the environment (S32, +5).

If he wishes to reduce or even eliminate his dependence on agrochemical products for multiple reasons - health, economic, independence - the *Chemical Frugalist* is not a great organic farming steward. On the one hand, farmers regretted the organic law's lack of consideration about several aspects of agro-ecology, such as the social aspect or soil life. On the other hand, Caspar sees organic farming merely as a market, which can reach saturation. This explains why he does not want to convert all his land to organic, whereas he reckons satisfying performances.

The soil theme is also dear to the *Chemical Frugalist*, who aims at permanent soil cover (S15, +4). However, Charles, being challenged with technical constraints, sees it as a possible contradiction with the reduction of agrochemical:"*[conservation agriculture] is the system in which we started, but well, it is the RoundUp system*". The *Chemical Frugalist* is reluctant to ploughing (S1, -2), although farmers expose different opinions on the matter according to their respective experiences. A contrario, the *Chemical Frugalist* does not consider that organic farming is destructive for soils (S37, -5), without erecting it as the ultimate step in agroecology either (S2, +1).

As for landscape approach, the *Chemical Frugalist* is the least likely to pay attention to it (S48, -5). He is also the least likely to prioritize adaptation to climate change (S22, +1).

Social pressure and peers judgement have little influence on the *Chemical Frugalist* (S39, -4; S9, -2), which shows a certain independence. In addition, public policies are not a determining factor in his decision-making (S11, 0; S12, -3; S20, -1). The economic aspect is more likely to orientate his choices. The *Chemical Frugalist* tends to emphasize economics over quality of life and agronomy in his approach to sustainability (S18, -3): "*If there is no economy, there is no sustainability*" (Cyprien). He believes that an agro-ecological practice must be profitable and that economic performance is necessary for its dissemination (S4, +3; S3, +2).

3.2.4. Factor D : agroecology as a « living well » philosophy

The *Welfare Farmer* practices agroecology as a way of life, a philosophy that guides his actions to achieve a certain quality of life for himself and his family through his practice. Money is a means rather than an end and sustainability is thought over several generations. Two farmers out of nineteen agreed with this discourse.

Family has a paramount importance in the *Welfare Farmer* approach, who improves his farm and make it flourish in order to transmit it to his children (S46, +5). Thus, money is relegated to the background, as a means to achieve primary objectives such as health, family (S45, +5) and quality of his production (S42, +5). Indeed, the *Welfare Farmer* tends to think that profitability is a minimum condition rather than an objective to be achieved (S5, +1). He is the most likely to say that economic performance is overemphasized in agriculture (S24, +2) and that it is not the main driver for agroecology dissemination (S3, -2). He advocates for a broader vision of economic performance, which would not be limited to short-term profitability. For example, he does not consider profitability as a necessary condition to implement an agro-ecological practice (S4, -4).

According to the *Welfare Farmer*, agro-ecology stems from a certain philosophy. Therefore, the transition lock-ins are rather philosophical than technical (S47, +3). Among the four discourses, this one is the most impregnated with a spiritual dimension (S24, +2). Consequently, the Welfare Farmer is more easily detached from other people's eyes (S8, +5). Dominique confirmed: "*They tease me a little because they compare me to my cousin, but well, the guy works days and nights, I have another philosophy. Enjoyment*". Compared to other profiles, the *Welfare Farmer* will more easily favour his quality of life over economics (S18, +1), although he acknowledges a link between the two. Moreover, the *Welfare Farmer* is not influenced by public policies in his decisions (S11, -3; S20, -3) either: "*No, I don't care about regulation, that's not what motivates me*" (Dominique).

As far as his production techniques are concerned, the *Welfare Farmer* is the most opposed to ploughing in agro-ecology (S1, -4). Nor is he inclined to apply glyphosate to promote his crops success (S35, -4). However, he does not accuse the agrochemical industry of making conservation agriculture its Trojan horse (S36, -3).

Finally, the *Welfare Farmer* tends to oppose agroecology and globalization (S13, -3). In addition, he believes agro-ecology does not belong to existing agricultural value chains (S27, -2). However, even if they were more in favour of local sales (S43, +1), farmers mentioned many challenges for them to embrace this commercialization path.

4. Discussion & conclusion

Our central question on how farmers understand and define agroecological performance received different answers in the form of four discourses, labelled as: the *Entrepreneur*, the *Organic Pragmatic*, the *Chemical Frugalist* and the *Welfare Farmer*. These results enable us discussing firstly their similarities and singularities with previously identified discourses in literature. Secondly, we evaluate the implication of the cohabition of these discourses for performance evaluation schemes. Finally, we reflect on the points of improvements of this study in order to conclude on future directions for research in that field.

4.1. Farmers' discourses in literature

These discourses did bear some similarities with other studies on farmer's attitudes, goals and values towards the environment in literature (Brodt, Klonsky, and Tourte 2006; Fairweather and Keating 1994; Pereira et al. 2016; Zagata 2010) (**Table 5**)**.** For instance, Brodt et al. (2006), in a study of almonds and grapes growers' goals and management styles in California, identified three major profiles that are not without reminding our four discourses: the *Environmental Steward*, the *Production Maximizer* and the *Networking Entrepreneur*.

Table 5. Distinct farmers' discourses found in Q literature.

Fairweather and Keating (1994)	Brodt et al. (2006)	Zagata (2010)	Pereira et al. (2016)	Present study
Environmentalist	*Environmental Steward*	*Organic as a way of life*	*Professional Farmer*	*Entrepreneur*
Dedicated Producer	*Production Maximiser*	*Organic as an occupation*	*Committed Environmentalist*	*Organic Pragmatic*
Flexible Strategist	*Networking Entrepreneur*	*Organic as an alternative*	*Profit Maximiser*	*Chemical Frugalist*
-	-	-	*Aspirant Top Farmer*	*Welfare Farmer*

Likewise, Fairweather and Keating (1994), distinguished three farming styles amongst pastoralists of New Zealand: the *Dedicated Producer*, the *Flexible Strategist* and the *Environmentalist*. Pereira et al. (2016), investigating the diversity of goals and values among Brazilian beef farmers, identified four perspectives: the *Professional Farmer*, the *Committed Environmentalist*, the *Profit Maximiser* and the *Aspirant Top Farmer*. A considerable difference between these studies and ours however is their broader P sample, since all our participants shared a common interest and practice in agroecology. Therefore, it is interesting to also look at Zagata (2010)'s findings, who attempted to understand Czech organic farmers' perspective regarding their own practices. He acknowledged three different farming styles: organic farming as *a way of life*, as *an occupation*, or as *an alternative food production* (compared to conventional).

In the light of these findings, one can notice the similar views shared by our *Entrepreneur* with Fairweather and Keating (1994)'s *Dedicated Producer*, Brodt et al. (2006)'s *Production Maximiser* and Pereira et al (2016)'s *Professional Farmer.* They align in their emphasis on finances and business management style. They are also the most likely to accept the environmental consequences of farming, in the form of agrochemical application for instance, in order to ensure production. Another major similarity lies in their attachment to the farming profession, which Pereira et al. (2016) formulated as they "*value farming intrinsically*". However, our *Entrepreneur* resembles in some aspects to Brodt et al. (2006)'s *Networking Entrepreneur,* particularly in his risk-taking attitude and interest in networking with like-minded peers. Nevertheless, the *Networking Entrepreneur's* off-farm activities contradict slightly with our *Entrepreneur's* consideration of farming as a full-time business and profession. Only one out of eight farmers labelled as *Entrepreneur* in our study was multi-active.

Our *Organic Pragmatic* farmer can be associated with Zagata (2010)'s perspective of organic farming *as an occupation*. Indeed, a central trait of this group is its pragmatism toward organic farming, not only regarding economics but first and foremost agronomy. These farmers also acknowledge their role in maintaining landscape and they adopt a positive attitude towards public financial support in return for their beneficial actions for the whole society. An interesting point however, is that in Zagata's study, all representatives of this group undertook a conversion from conventional towards organic whereas in our study, three out of four were organic from the start, which demonstrates a deep conviction.

The *Chemical Frugalist* might be the uncanny profile of our study, as his discourse is not represented in existing literature. Indeed, he presents a similar management style to the *Entrepreneur's,* but his reluctance to both agrochemicals and organic farming challenges common categories. On the one hand, as two out of three farmers identified as *Chemical Frugalist* were in organic conversion, one could hypothesis that this discourse is converging towards the "*organic as an occupation*" perspective (Zagata 2010), with an emphasis on the economic aspects. On the other hand, the *Chemical Frugalist* may remain

a more nuanced category of his own. In the end, Q methodology rejects a priori assumptions and refuses to classify participants into pre-determined categories (Previte, Pini, and Haslam-Mckenzie 2007, p. 141)

As for our *Welfare Farmer*, he certainly fits into Zagata (2010)'s perspective of *organic as a way of life* and can be compared to Pareira et al. (2016)'s *Committed Environmentalist* in some ways. The generational approach to farming, the holistic view and personal engagement are common to these farmers. The *Committed Environmentalist* shares with the *Welfare Farmer* his *"joy in outdoor life*" (Pereira et al. 2016, p.5) and his emphasis on family goals. They both approach performance from an unconventional angle, focusing on the improvement of the system rather than its expansion.

However, our four discourses show little similarity with Fairweather and Keating (1994)'s *Flexible Strategist* and Pereira et al. (2016)'s *Aspirant Top Farmer*. They both share strong interest in networking and off-farm activities. They emphasize marketing and external orientation and perceive farming as a self-fulfilment activity, a personal challenge, where they can thrive to be an example for others. If these characteristics are not completely alien to our discourses, they do not constitute distinguishing traits in our findings. Indeed, since our focus lied rather in agroecological performance at farm level than in farmers' personal goals and values *per se* - although they are related - our Q sample was not designed to identify such attitudes. Another noteworthy missing perspective in our findings is Zagata (2010)'s organic farming conception as an *alternative production of food*. The latter has a strong connexion with locality and replace organic farming in its landscape and local farming culture. Some participants to our study did mention that the social and cultural aspects of agroecology were relatively missing themes in our Q sample. This was a notable shortcoming of the concourse elaboration, probably due to the limited investigation of sources directly provided by farmers – our population of interest. However, an alternative argument is that arable crops are commodities, mostly exchanged on international markets; hence, questions of locality are hardly debated in the interviews.

4.2. Implications for agroecological performance evaluation

These different understanding of what agroecology should be and how to manage a successful agroecological farm provide insights on how to evaluate their performance. They highlights the diversity of agroecology interpretation, which can in turn unveil some drivers of management choices at farm level. For *Entrepreneur*-minded farmers, gross margin, adaptability to markets, diversified outlets, robustness and adaptability to climate change, risk taking, efficiency and transmissibility (to next generations) will be amongst most relevant performance indicators. *Organic Pragmatics* would also pay attention to robustness and adaptability to climate change, but for them gross margin would be restrictive to evaluate their economic performance; it should be considered over a whole rotation for instance and enhanced with other economic indicators such as efficiency, autonomy and sobriety. They would include indicators of ecosystems benefits, such as erosion limitation, increase of organic matter, landscape maintenance and pollination. *Chemical Frugalists* would hold more important health indicators and pollution indicators than other groups. As for *Welfare Farmers*, social and quality of life indicators would override economic indicators. A further step in this study would be to test different combination of indicators according to each discourse framework and assess whether farmers perform better in the indicators they value most. That will be the objective of following research.

These specificities are relevant highlighting when constructing a conceptual framework for performance evaluation. Indeed, in our case, this performance evaluation will be directed towards the

Adour-Garonne Water Agency, a public institution in charge with public policies and support programmes to reduce water pollution and ensure water resources conservation. The choice of indicators is instrumental in which story will be told regarding how agroecological farms perform compared to conventional ones. Walder and Kantelhardt (2018), who studied farmers' attitudes and behaviour towards multifunctional agriculture, insist on the importance for public policies to take into account this diversity when trying to influence farmers' behaviour. They warn against "*blanket approach*" which have a lesser, if not a counter-productive impact. For instance, according to our findings, *Organic Pragmatics* are receptive to financial incentives towards agroecological practices whereas *Welfare Farmers* distrust these programmes and are less likely to get involved. Moreover, interviewed farmers criticized "*one size fits all*" approaches in several occasions, notably regarding soil cover regulations. These findings coincide with Davies and Hodge (2007)'s who concluded from their Q analysis of UK arable farmers' environmental perspectives, that external financial incentives could be useful to foster the adoption of environmental-friendly practices by strongly production-oriented farmers but not instrumental in convincing nature-oriented farmers.

4.3. Leads for improvement and further research

At this stage, it is important to understand that Q methodology only allowed us to identify existing discourses among agroecology practitioners. In this sense, it was a necessary first step in mapping the above-mentioned diversity. However, Q is not suitable to determine the relative distribution of these discourses across the whole population of interest (Davies and Hodge 2007, p.331). Indeed, the purposive sampling and small sample size, characteristics of Q studies, prevent researchers from extrapolating the level of support for these discourses (i.e. factor loadings) across population (Zabala, Sandbrook, and Mukherjee 2018). Zagata (2010) reminds that "*the purpose of the sampling is not to construct a population that would enable one to generalize proportionally, but rather to explore the individual subjectivities of like-minded, and differently-minded, actors in the setting*". Thus, advocacy for a larger sample is not at stakes here. Previte, Pini, and Haslam-Mckenzie (2007) even assert that a large sample may be counterproductive since it tends to overlook complexities and fine distinctions –mostly found in post-sorting interviews - which can only be managed and reflected upon with few participants.

Nevertheless, relative distribution of the four discourses in Adour-Garonne could be of interest to guide policymaking (Davies and Hodge 2007; Walder and Kantelhardt 2018). Identifying which discourse receives broadest support can help determining the regulatory approach, although it should not overshadow minorities. In this sense, further research could consider to couple this Q study with a classic survey –called R study in Q jargon. An additional R study would allow determining repartition of the four discourses and identifying potential socio-demographic determinants of these mind-sets (i.e. age, generation, location, farm size, etc).

Besides, one can notice that our P sample is not representative of the entire arable farming population in Adour-Garonne, but only agroecology practitioners. Indeed, only agroecology "insiders" were selected in an attempt to define the concept from within, rather than including perspectives from agroecology "outsiders", who do not implement such practices. This was a methodological choice to focus on how farmers who practice agroecology understand and define it, because we believe it allowed a deeper and more detailed appreciation of the term. Outsiders' discourse would be interesting in order to grasp prejudices regarding agroecology and perhaps identify some barriers to its adoption. However, this was not the purpose of this study, which was a first step in agroecological performance evaluation.

Nevertheless, this choice brought up an unexpected result that would benefit further investigation. Indeed, it was quite striking that, although interviewed farmers were able to speak for hours about their vision of agroecology and how they implement it on their farm, none of the participants claimed to be "agroecologist" or to run an "agroecological farm". This term was never mentioned when we asked to describe their farming style at the end of the interview. Hence, agroecology was not a direct source of the actors' social identity. One can formulate hypothesis; do farmers consider agroecology as another dogmatism, which they generally despise? Is agroecology exceedingly associated to recent French top down policies in agriculture? Is this a typically French phenomenon? Or, does this come down to an impostor syndrome since farmers consider they do not manage to fully implement of the principles they account for agroecological? These hypotheses would be worthy to further investigate to broaden the scope of the present reflection.

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