How do farmers choose the professionals with whom they work to ensure herd health management? An approach based on the diversity of prescription systems in dairy cattle farming

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Abstract

Encouraged to design a more agroecological livestock system, farmers today must develop new practices to address herd health management. They must do this on their farms, alongside other farmers, but also with the support of various livestock professionals, such as veterinarians and agricultural advisers, each with their own skills and knowledge. This article analyses how these farmers enlist the aid of different professionals in their quest for a more agroecological approach to herd health management. Drawing on a conceptual framework, based on the prescription relationship concept, we refer to all the professionals involved as a "prescription system".

The qualitative analysis of the 26 interviews conducted with French dairy farmers involved in an agroecological approach reveal five types of prescription systems: i) one structured around the farm work collective and a few trusted prescribers; ii) one organised around farmers seeking prescribers and concrete solutions; iii) one extended around an autonomous operator; iv) one oriented towards prescribers capable of promoting transition by encouraging discussions around health; v) one designed to promote precise and technical herd health management.

The question, then, is how do these different systems provide farmers with learning opportunities in their quest for agroecological approaches to health management? The extent to which these systems influence farmers' representations of health management, and the manner in which the latter's perceptions of health help to shape these systems, therefore appear to be worth exploring.

Key Words: Farming, Health management, Agroecology, Prescription, Network, Support, Veterinarians

Statements and Declarations:

The authors declare that there is no conflict of interest regarding the publication of this paper.

1. Introduction

Today, the development of more sustainable modes of agriculture, such as agroecology, call for social, economic, and technical changes (Wezel et al., 2009) and for new practices. Farmers and the professionals working alongside them are now expected to embrace and evaluate new knowledge (Compagnone et al., 2018). This implies redesigning complex agricultural systems by adopting different forms of knowledge (Girard, 2015) which are often implicit, hardly formalised (Huntington, 2000), and have not necessarily been scientifically validated (Compagnone et al., 2018). Defining agricultural practices that are adapted to each system, based on the theoretical principles of agroecology, is thus a rather complicated affair (Toffolini et al., 2019).

This is particularly difficult when animal husbandry health issues are involved, notably with regard to the management of so-called "production" or enzootic diseases. These diseases, whose causes are multiple, are largely influenced by the conditions on the farm (Nir Markusfeld, 2003) and have a significant economic impact on farming (Kossaibati & Esslemont, 1997) because of their poor zootechnical performance (Nir Markusfeld, 2003). Unlike regulated diseases[1], farmers have considerable leeway in terms of the practices that they can implement to manage these diseases. They can choose when and how to address them, and are also free to choose the professionals that they believe can help to manage them.

Given today's shift towards sustainable agricultural practices, farmers now have greater options from which to choose: alongside conventional chemical medicines[2], they are now encouraged to use alternative medicine such as homeopathy, essential oils, osteopathy, and acupuncture. Although these alternative approaches are more widely used today than in the past, notably in organic farming (Lund & Algers, 2003), they are not always viewed as valid from a scientific and/or social perspective, nor are they mastered by all animal health professionals. Moreover, farmers occasionally view them as being too difficult to implement. Lastly, beyond the use of alternative medicine, the shift towards agroecological farming practices requires a more global reflection on the restructuring of livestock systems, one which is perceived as a means of preventing the emergence of diseases (Dumont et al., 2013), and which is sometimes embodied in holistic approaches such as the One Health approach (Bellet et al., 2021).

The manner in which farmers choose the professionals with whom to work with regard to herd health management, and how they interact with these professionals, are therefore critical to the implementation of sustainable animal health management practices. They can choose with whom to work from a multitude of professionals. Among those who have always been traditionally involved in farms (agricultural extension specialists, veterinarians, animal feed sales representatives, etc.), some actors, such as veterinarians, are essential from a regulatory point of view, and others have historically been present in the dairy production framework, such as livestock advisers who undertake the "performance control" that dictates the bonuses[3] that farmers receive. Others, however, are chosen by farmers for their specific skills (Hellec et al., 2021). New players have therefore emerged in the field of agroecological approaches to health management, such as acupuncturists, osteopaths, or even trainer veterinarians. These players belong to different structures and have different professional backgrounds, and their visions of health are not always compatible (Experton et al., 2021). In parallel, different forms of support for farmers are emerging in the field of alternative health management, such as peer group discussions or individual follow-ups by trainer veterinarians (Hellec et al., 2021). Farmers can therefore rely on different forms of support to adopt sustainable herd health management.

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[1] Regulated diseases are those whose management is guided by strict regulations at the regional, national, and/or international level. These diseases often pose a threat to health security (human, animal, agricultural) because of their transmissible nature.

[2] The Ecoantibio 1 (2012-2016) and 2 (2017-2021) plans are a good example of a policy aimed at increasing agroecological approaches to herd health management and at reducing veterinarians' use of antibiotics: https://agriculture. gouv.fr/ecoantibio

[3] Performance control involves undertaking quantitative (protein, fat, cell counts, etc.) and qualitative measurements of milk, according to specific protocols. The data collected can be used both for livestock management and for the management of the entire farming sector. In France, performance monitoring is undertaken by professional bodies, associations, unions, and cooperatives, or by the Chambers of Agriculture. Livestock advisers are associated with this performance control. Farmers who adhere to performance monitoring receive a bonus from dairies.

In a context in which farmers are free to decide and act with regard to managing the production diseases that impact herd health, this article seeks to explore how these farmers perceive the different forms of animal health management support that they receive. We thus propose to characterise the different forms that professional systems can take, as perceived by the farmers, and to shift away from the numerous studies that have addressed agroecological transition from the angle of agricultural practices and technical content. First, we will undertake a literature review of the studies on agricultural extension to highlight their strengths and weaknesses. Second, we will present our theoretical framework, and then show how we have used this to define the types of professional systems developed by dairy cattle farmers in the Massif Central region (France) for herd health management.

2. Issues and theoretical framework

2.1. Support for change : from agricultural extension to the social environment

Numerous studies have focused on the advice and support that farmers receive in situations of change, notably with regard to agroecological transition. The concept of "agricultural extension" takes on different meanings depending on the positions that different authors defend. While agricultural extension services are associated with processes of knowledge and technology transfer (Haug, 1999), they also involve the adoption of a given position to help to promote dialogue between a farmer and an adviser in order to solve a given problem (Hoffman & Thomas, 2003). Agricultural extension services can also be part of a learning process aimed at improving self-sufficiency (King et al., 2001). More broadly, these services can be considered as a service relationship, which one may view as, among other things, "*co-production, that is the cooperation or interaction between producer and consumer in achieving the desired outcome*" (Gadrey, 2000, p370).

Irrespective of the approach adopted, agricultural extension may be viewed as a resource at the service of the agroecological transition. Numerous studies have attempted to describe and evaluate the function and role of agricultural advisers in the development of these new and more agroecological practices (Coquil et al., 2018; Emeana et al., 2019). These have focused on the implications of this advisory relationship for farmers in terms of work, practices, and learning. For instance, the support of agricultural extension advisers can help them to explore new practices in alternative medicine by bolstering their self-confidence (Hellec et al., 2021). These advisers can therefore provide scientific expertise and proven solutions and thus enable farmers to increase their efficiency during the transition (Beaugrand et al., 2016). These different studies share one limitation: they suggest that agricultural extension advisers, perceived as playing an established and institutionalised function, are the main contributors to change among farmers. In other words, they overlook the role of other players and pay little attention to the manner in which farmers take into account various sources of advice.

In the field of animal health, veterinarians have historically been key players in production disease management (Woods, 2007; Bonnaud & Fortané, 2021). In France, the administration of drugs, notably antibiotics, requires a veterinary prescription and an Annual Animal Health Report which must be written by a veterinarian. Veterinarians are thus viewed as key players in supporting farmers in reducing the use of antibiotics (Speksnijder et al., 2015). While veterinarians have traditionally been the powerholders in the prescription relationship (Bonnaud & Fortané, 2021), their relationship with farmers has become more equal in recent years and farmers' viewpoints and expectations are now considered before prescribing medication (Bard et al., 2019). Moreover, the veterinarian/farmer relationship is special in the sense that, much like a nurse, it is farmers who are largely involved in the daily care of their animals. They are also free to decide how to address and manage production diseases (Kristensen & Jakobsen, 2011).

Beyond a one-to-one relationship between advisers and farmers, supporting the agroecological transition leads to a broader consideration of how farmers' social environment influences learning and transition processes. Analysing the approaches adopted by farmers to reduce the use of pesticides and fertilisers, Chantre and Cardona (2014) identified various learning patterns, understood as social interactions participating in the inquiry undertaken by these farmers, (Dewey,1938). A considerable number of studies have focused on the importance of social environments in agricultural transitions, and these can take the form of groups, communities, networks, or social groups. Advisory professionals are not limited to livestock advisers alone but include all agricultural professionals who work alongside farmers and who participate in the agroecological transition and in the implementation of innovations, such as peer networks, agricultural networks, consultants from private companies, or technical sales representatives (Hellec et al., 2021; King & Nettle, 2013; Kroma, 2006; Oreszczyn et al., 2010; Slimi et al., 2021). For instance, the study undertaken by Kroma (2006) sheds light on how organic farmers'

networks influence the adoption of innovations. Similarly, to characterise the interactions between farmers and their social environment in terms of the adoption of new technologies, Oreszczyn et al. (2010) draw on the example of Genetically Modified Organisms to propose the concept of a "*web of influencers*" that encompasses all people, organisations, communities, and networks that contribute to farmer learning. While these studies highlight what is allowed in terms of agroecological learning and innovation, they say nothing about how farmers organise their social environment to respond to their problems and to adopt agroecological approaches to herd health management.

2.2. From the prescription relationship to a prescription system to develop an agroecological approach to health management

To describe clearly how farmers organise their social environment to learn, and to better manage, agroecological approaches to herd health management, it seems important to be able to characterise their relationships with each member of their "web of influencers" (Oreszcyn et al., 2010). To this end, the concept of the prescription relationship, proposed by Hatchuel (1995; 1996), seems particularly relevant. Hatchuel, as well as Gallais and Bayad (2010), view the prescription relationship as a contextual and provisional equilibrium between knowledge and relationship, the two components being interdependent. This concept makes it possible to consider all forms of advice in a comprehensive manner and to go beyond the generally accepted medical sense of the term "prescription". Indeed, depending on the context, prescribing may refer to advising, recommending, advocating, guiding, or working alongside others. It therefore involves different types of relationships, and relationships to knowledge and learning, and therefore different types of prescription relationships. We suggest that farmers have a prescription relationship with the various professionals that they work with to ensure herd health management. In the rest of the article, these professionals will be referred to as prescribers, and farmers as the operators of the health management process.

In addition to prescribers, Hatchuel and Weil (1995) have shown how management instruments always possess a "managerial philosophy" that guides the action to be taken. Similarly, "guiding technologies" can also carry different types of knowledge which, depending on their form, can lead to both a relationship of subordination, by regulating the activity (Denis, 2007), and to automated actions. Actions may also become confined to what the conceiver of the technology views as appropriate. As Denis argues, this may give rise to a cognitive economy for the operators while reducing their ability to choose their own actions. For example, a written care plan for a disease, which describes the steps to follow, leaves little room for improvisation, in theory at least. In line with these studies on technologies or instruments, we thus consider that, by providing a framework to guide action, such artefacts are an integral part of the prescription, in the same way as – and alongside – the prescription verbalised by professionals in the agricultural sector.

The majority of the available literature has viewed the prescription relationship as a one-on-one relationship between an operator and a prescriber, or as originating from the top to be passed down to several operators. Our study seeks to analyse the network of prescription relationships between an operator (the farmer) and multiple prescribers, without forgetting the artefacts. To our knowledge, however, no studies have focused on how these multiple prescription relationships are structured. We therefore propose the concept of a "prescription system" in order to provide an account of this network and to conceptualise it. By "prescription system" (PS), we refer to all the prescription relationships that a farmer maintains with farming professionals and artefacts to manage their farming practice. This article therefore seeks to identify the different structures of prescription systems developed by farmers within the framework of herd health management.

3. Method and materials

Semi-structured interviews were conducted with dairy cattle farmers in the Massif Central region in France. The qualitative data obtained was then analysed using the repertory grid technique. This methodology is presented below.

3.1. Sampling and data collection

Data was collected from 32 dairy farmers working on 26 farms located in the Massif Central region, in the departments of Puy de Dôme (63), Cantal (15), Loire (42), and Haute-Loire (43). Dairy farming is particularly well developed in this low mountain region. The farms analysed had some degree of diversity in terms of work organisation, size, agricultural practices, products marketed (farms marketing only milk, or farms also producing yoghurts or cheeses, which they occasionally marketed directly), official quality marks (organic farms (AB) or conventional farms, different cheeses with a

Protected Designation of Origin (PDO): Cantal, Saint-Nectaire, Fourme de Montbrison, etc.). They also differed in terms of their pedo-climatic context and socio-economic environment (density of the agricultural network, different forms of organisation of actors upstream and downstream of agricultural production, etc.). These farms were selected because they clearly reflected this diversity (*Table 1*).

	Working group	Region	Label	DPO	Secondary workshop	Years of experience	Establishment	Direct farm sales	Transformation
E1	Single	Monts du Forez	AB	Fourme de Montbrison	no	26 years	FF	no	no
E2	Father and son (3)	Plaine du Forez	no	no	no	34 years	FF	no	no
E3	Single	Monts Dôme	no	St Nectaire	no	13 years	FF	no	yes (cheese ager resale)
E4	Brothers and mother (3)	Combrailles	AB	no	no	20 years	FF	yes	yes
E5	Brothers (2)	Combrailles	no	Fourme d'Ambert and Bleu d'Auvergne	no	20 years	FF	no	no
E6	Single	Monts du Pilat	AB	no	no	23 years	FF	no	no
E7	Single	Bassin de Maurs La jolie	AB	no	no	24 years	FF	no	no
E8	Couple	Monts du Cantal	AB	Salers and Cantal	pork	17 years	FF	yes	yes
E9	Single	Monts du Lyonnais	AB	no	no	39 years	FF	no	no
E10	Couple	Monts du Lyonnais	AB	no	no	14 years	FF	yes (bread)	yes (cereal)
E11	Couple	Chataignerais Cantalienne	AB	no	no	14 years	FF	no	no
E12	Couple	Monts du Cantal	AB	no	no	24 years	FF	no	no
E13	Single	Monts du Forez	no	no	no	16 years	FF	yes	yes
E14	Single	Combrailles	AB	Fourme d'Ambert and Bleu d'Auvergne	no	31 years	FF	no	no
E15	Couple	Monts du Pilat	no	no	no	18 years	OFF/FF	yes/no	yes
E16	Couple	Plaine du Forez	no	no	no	22 years	OFF	no	no
E17	Associates (2)	Monts du Lyonnais	no	no	no	16 years	OFF	no	no
E18	Single	Monts du Forez	no	no	no	7 years	OFF	no	no
E19	Family (4)	Monts Dôme	no	St Nectaire	no	17 years	FF	yes	yes
E20	Single	Combrailles	no	no	no	13 years	FF/ OFF	no	no
E21	Couple and partner (3)	Monts Dôme	no	St Nectaire	no	13 years	OFF	yes/no	yes
E22	Single	Livradois	AB	no	no	26 years	FF	no	no
E23	Single	Monts du Pilat	AB	no	no	8 years	FF	no	no
E24	Single	Combrailles	no	no	suckling calves	17 years	OFF	yes	yes
E25	Single	Livradois	no	no	fattening calves/ horses	4 years	FF	no	no
E26	Couple	Livradois	AB	no	fattening calves/ vegetable farming	13 years	FF	yes	no

Table 1: Description of the sample of farmers. FF: establishment within the family farm; OFF: establishment outside the family farm

In addition to their significant experience in farming (at least five years), farmers were also selected for their individual commitment to an agroecological transition and/or to the reduction of antibiotic use in farming. While there was no exhaustive checklist of the criteria to be met in order to consider that farmers had adopted an agroecological approach, they were expected to have implemented at least one agroecological practice. Examples of these practices included the adoption of grazing, adapting milk production objectives to the real potential of animals and the farm land, using alternative or complementary medicines, and/or reducing the systematic use of certain allopathic medicine treatments. The contacts of these farmers were provided by several reference groups (Approved Veterinarian Groups, Groups of Organic Farmers, Health Defence Groups, etc.) who believed that their farms met these criteria. We were therefore hardly aware of the farmers' practices before meeting them for the first time. This explains why our sample varies widely in terms of the agroecological approaches to health management adopted by each farm (*Appendix 1*). These practices thus varied from farmers who kept livestock indoors but used essential oils to treat animals, to a pasture-based system which used a considerable amount of alternative medicines to prevent diseases or to treat them.

Semi-structured interviews were conducted with farmers on their farms, primarily around the following subjects: production disease management practices, the various prescribers who advised, guided, and trained them, and the various prescription artefacts used (technical data sheets, books, biological analyses, digital herd management tools, data from a milking robot, etc.), whether or not they were associated with one or more prescribers working directly on the farm. Their relationship to the prescription relationship was also analysed by asking them how these relationships had been set up. These interviews primarily sought to characterise these farmers' prescription systems while learning about the diseases that they were treating or had treated in the past and about their background as farmers.

3.2. Analysis approach

An inductive and qualitative approach was used to analyse the data. A method whose effectiveness in representing the diversity of farmers has already been proven was also used (Girard, 2001; 2008). This method combines:

- the "prototype" theory in cognitive science (Rosch, 1975) which makes it possible to develop types – poles against which each case can be compared – rather than compartmentalised boxes that require

data to respect certain conditions strictly before being considered as belonging to a particular type. This implies defining categories depending on what constitutes their logic rather than on the basis of their boundaries;

- the repertory grid technique (Kelly, 1955) which allows researchers to express their field knowledge by proposing categories to reveal different practices without reducing these to quantitative criteria.

3.2.1. Expressing attributes as bipolar axes

The first step consists of defining attributes using dichotomous axes which oppose two poles and which make it possible to represent an evaluation of cases according to a gradual scale. For each attribute, the characteristics observed among the farmers interviewed, in terms of the construction of their "prescription system", are formalised in the form of a limited number of modalities, ordered between two extreme characteristics, and accounting for behaviours located between these extremes. For example, attribute 7 explores the relationship between farmers and their peers relative to the sharing of practices, and contrasts those who regularly engage in discussions with other farmers and those who do not. Two intermediate modalities complete this axis (*Figure 1*).

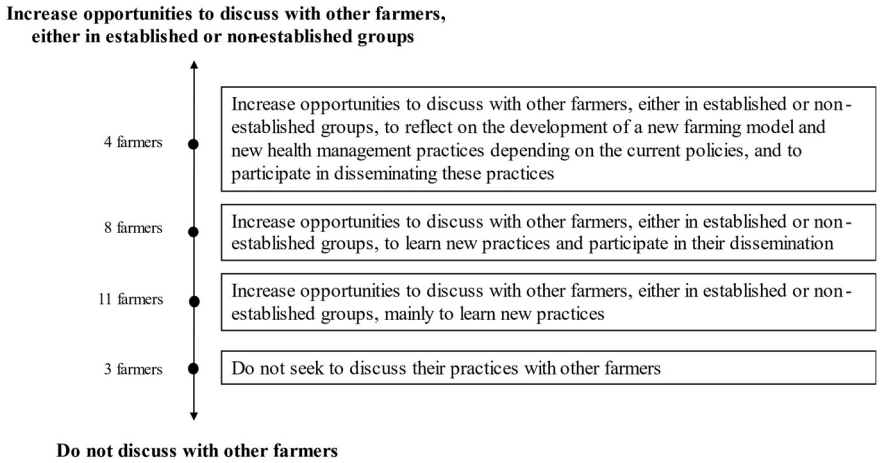

Fig. 1 : Polarised representation of attribute 7 about the sharing of practices with other farmers

Thus formalised, the 12 attributes concern different dimensions of the prescription systems which seemed important in the cases analysed, in an iterative approach involving the formalisation of the theoretical framework and the data collected during the interview. These are presented in detail in section 4.1.

3.2.2. Comparing attributes to define prescription system categories

All these attributes constitute a matrix, referred to as a repertory grid, comprising the values of the different cases (in columns) according to the different attributes (in rows). To analyse such a grid, one can draw on the different representations of the position of cases according to these attributes. A multidimensional intersection of the attributes can be undertaken by using one of the many processing tools of the repertory grid based on Principal Component Analysis. We chose RepGrid for its accessibility, interactivity, and the graphic representations that it makes possible. RepGrid notably produces decision trees for hierarchical classification, making it possible to identify the groups of cases with almost similar combinations of characteristics, and thus to determine the types of SP. This is perfectly illustrated in Figure 2 : it is possible to identify groups with considerable similarity across several characteristics, and thus to outline the SP types. This is more than just a linear process; these phases of the formalisation of attributes and types are iterative, allowing the different types to emerge gradually.

These phases make it possible to design the types described by the attributes considered as being characteristic of the type, in line with the prototype theory.

4. Results

4.1. Axes to differentiate how farmers have developed their prescription system

A total of 12 attributes (*Appendix 2*) were defined, allowing us to develop an analytical framework and thus to characterise, as finely as possible, different dimensions of the prescription systems

developed by the farmers interviewed. These attributes may be grouped together according to how the information that they provide helps to define farmers' prescription systems. Four groups of attributes, described below, emerge.

4.1.1. Number and functions of prescribers

A first step in the formalisation of a prescription system is to take note of the number of prescribers that farmers rely upon, with regard to both livestock health management and their daily farm functions. Do they call on trainers, veterinarians, or farming advisers? We first explore the prescriptions within the farm itself (attribute 1) and the number of prescribers outside the "basic prescription group" (attribute 2), understood as all those prescribers who generally work with all dairy farmers, irrespective of their practices and of whether or not they use an agroecological approach: this includes veterinarians, who are mandatory from a regulatory perspective, farming advisers, and inseminators. However, this group is not necessarily complete for all farmers (attribute 3). Whether the absence of "classic" prescribers is replaced by others therefore seems worth analysing.

4.1.2. Sources of knowledge outside the farm and the form of knowledge sought

The following attributes make it possible to explore the prescribing relationships that take place outside the context of the farm, within peer groups or training sessions for instance, suggesting the existence of a different approach to prescribing, knowledge exchange, and learning. Thus, attribute 7 explores the importance, for the farmers interviewed, of discussions with other farmers in formal or informal groups, which may be managed and facilitated by diverse organisations or by agricultural development networks, with the aim of reflecting on new ways of farming and on how these may be implemented. Through the exchanges that they make possible, these farmers and these groups are all resources that enable change, a change in practices (Experton et al., 2021), or even the restructuring of farming systems. We therefore consider that they are an integral part of farmers' SP.

Farmers also rely on training to change their practices and to develop an agro-ecological conception of livestock health management (attribute 8). Training topics vary widely. Thus the use of homeopathy, essential oils, grazing management, water management, and animal care are all areas in which farmers may have received training. We therefore attempted to distinguish farmers who sought out the most training opportunities possible from those who had ceased all forms of training as we believe that these two groups would adopt different approaches in their quest for prescriptions.

Lastly, we sought to understand how farmers related to the sources of knowledge (attribute 11) that they used, as this could explain in part the construction of the prescription system. We therefore compared farmers who adhered to a formalised and disseminated approach in terms of livestock health management, and those who used and combined different sources of knowledge and practices but did not refer to formalised approaches. By "formalised and disseminated approaches", we refer to all those approaches and methods used to manage livestock health and the livestock system that have an impact on animal health, and which have been formalised and shared with individuals or groups other than those who formulated them, irrespective of whether or not their scientific credibility has been established. In our sample, we thus identified the Obsalim® method, unicist homeopathy, Vincent's Bioelectronics, biodynamics, geobiology, and the Patur'ajust method.

4.1.3. The relationship with prescribers

We were also interested in understanding what farmers sought in their relationship with the various prescribers, irrespective of whether or not they felt that they were under some sort of obligation, or whether they themselves were interested in improving their knowledge and practices with regard to their perceptions of livestock health. Farmers without a formalised conceptualisation could also allow themselves to be carried away by the prescriber's conceptualisation. Farmers could seek out those prescribers hoping to receive a service or to learn a healthcare practice, but without having any intention to change their conceptualisation of livestock and herd health management.

The following attributes make it possible to define the relationship between farmers' healthcare prescribers (attribute 4) and prescribers specialising in the zootechnical aspects of farming (attribute 5). With regard to animal health, farmers are under the obligation to designate an "attending" veterinarian, but their relationship with the latter varies depending on the extent to which they believe that they can trust this veterinarian (Svensson et al., 2019). Some farmers may also be members of an Approved

Veterinarian Groups (AVG)[4]. They can also call on other prescribers to help them in animal health management, such as veterinarian consultants (Experton et al., 2021) who occasionally issue prescriptions that go beyond care and which take into account the management of the system as a whole (animals, soil, crop, pasture, building), or service providers called upon for specific interventions, such as osteopaths, trimmers, or acupuncturists. The prescribers of zootechnical aspects are generally technical advisers, employed by a structure which may or may not be attached to the Chambers of Agriculture or to the Regional Livestock Institution, varying depending on different departments. As mentioned previously, in the field of farming, the prescription relationship is often a service relationship. Prescribers can thus play a dual role by prescribing a product or service as well as advice. Depending on their skills, they can assist farmers in many technical aspects: ration management, fodder management, milk quality management, developing a farming plan, grazing management, crop management, etc.

Attribute 12 reveals farmers' positions regarding the prescriptions of alternative practices (unconventional medicines, new grazing and pasture management practices) by focusing on the experimentation activities that some of them undertake. We believe that farmers who engage in experimentation do so in an attempt to create a form of management that suits them by seeking to implement the practices that they view as the most appropriate. This experimental approach is somewhat akin to a scientific approach (Catalogna et al., 2018). Furthermore, farmers can freely decide to implement only part of the prescription. Thus, we believe that their positions vis-à-vis the prescriptions that they receive reflect their degree of trust in their prescribers and in the approach that they adopt towards a more agroecological approach to herd health management.

4.1.4. Farmers' relationship to artefacts as sources of prescription

Given that prescriptions are not limited to humans, we felt that it was important to explore the prescriptions made through artefacts and the important role that these prescriptions could play in farmers' livestock health management.

In dairy farming, farmers' income is related in part to the quality of their milk. The collecting body assesses this quality using various criteria: protein level, the level of butyric acid, urea levels, the presence of germs (whether naturally present in the environment or not), and "cells" (for instance, leukocytes indicating an udder infection). These criteria help to determine the base price of milk and the bonuses that farmers can obtain depending on the collecting body. Whether or not farmers take into account the milk-quality requirements is assessed in attribute 6.

Moreover, farmers can use digital artefacts (attribute 9), such as milking robots, ration management robots, herd management software (reproduction, milk analysis, activity, feed, health records, entry, exit, etc.), and the mobile applications associated with this software, which produce and/or make available a considerable amount of farming data such as fodder and forage analytical data, milk analytical data, and data relating to cow activity (heat and/or feeding). Farmers can also turn to different types of references (attribute 10): specialised articles on zootechnics, specialised magazines, non-specialist articles on agriculture or on more global subjects, feedback from peers on social networks, technical sheets obtained after training, treatment protocols, and so on.

4.2. A typology of prescription systems

[4] AVGs are an original form of organisation of the relationship between farmers and veterinarians. An AVG is made up of two entities, an association of farmers and a private veterinary practice, whose relationships are set out in an agreement. The agreement is a collective and global contract which authorises all interventions by veterinarians on the farm (from emergency interventions to training sessions) and the supply of medicines at reduced cost. This type of functioning allows, among other things, the promotion of a group dynamic (training, health actions) and the creation of economies of scale (Ruault et al., 2016).

By comparing these 12 attributes, five types of SP (Figure 2) emerge. These will be referred to by the letters A, B, C, D, and E in the rest of the article. Several cases do not strictly fit into these types. While the characteristics of cases E1 and E14 appear to be close to two types (A and B), the cases E25, E5, and E3 do not seem to fit within any of these types. The characteristics of the different types are presented in detail below.

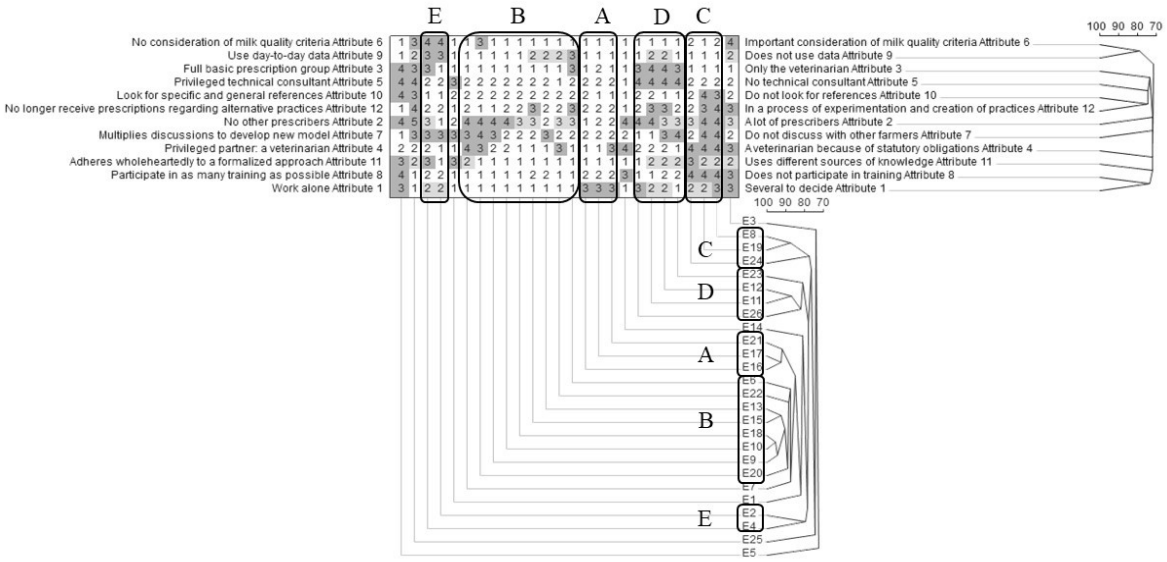

Fig. 2: *Repertory grid highlighting the correlations between cases and between attributes and allowing identification of five types of prescription system (A, B, C, D, and E). The attributes are displayed in rows and the cases in columns. Each number corresponds to a modality of each case for each attribute. Decision trees between attributes and between cases appear on the right*

4.2.1. A prescription system structured around farms' collective work and a few trusted prescribers

Three farmers in our sample were close to this type of PS (*Figure 2*, type A). In this type of system, farmers make decisions after consulting with other members of the farm (attribute 1, modality 3). The prescription system is limited to the basic prescription group (attribute 2, modalities 1 and 2) and this group is generally complete (attribute 3, modalities 1 and 2). We posit that having several people on the farm capable of making decisions and of learning new practices explains why the prescription system is limited, with farmers seeking resources directly from those within their basic group (Cournut et al., 2018).

Veterinarians appear to play an important role in this type of PS insofar as farmers rely on them considerably, irrespective of whether they are bound by an agreement (attribute 4, modality 1, see footnote n°4) or they are independent practitioners (modality 3). For their part, the prescribers of technical aspects seem to be present in this SP primarily as a matter of habit (attribute 5, modality 2). Farmers apply the prescriptions that they perceive as being useful without questioning them, validating them, or verifying them (attribute 12, modality 2), revealing their confidence in the prescriptions dispensed.

However, players in the basic prescription group are not the only source of agroecological knowledge and practice. These farmers therefore obtain training from the structures to which they adhere, without necessarily seeking training elsewhere (attribute 8, modality 2). Moreover, they regularly have discussions with other farmers to learn about their practices and their experiences (attribute 7, modality 3). The farmers that fall within this PS use different sources of knowledge, not necessarily obtained from formalised and disseminated approaches, for their herd health management (attribute 11, modality 3). They therefore seek multiple sources of knowledge from different agroecological approaches to health management. Drawing on literature, blogs, or training sheets, they seek practical solutions (attribute 10, modalities 3 and 4) to specific problems: make a diagnosis, find an alternative treatment (essential oil, homeopathy, herbal medicine), or find a solution.

In summary, one may say that this type of PS brings together farmers who place considerable trust in their prescribers, few of whom intervene on the farm. They rely heavily on the internal farm labour force and on a set of practical, concrete, and specific solutions for care, prevention, or diagnosis.

4.2.2. An open prescription system around farmers seeking prescribers and concrete solutions

Nine farmers in our sample were close to this type (*Figure 2*, type B). In this type of system, farmers made all the decisions on the farm by themselves (attribute 1, modality 1). Like those in type A, farmers in type B were surrounded by a comprehensive basic prescription group (attribute 3, modality 1), but unlike type A, they also worked with a considerable number of prescribers outside this basic group (attribute 2, mainly modalities 3 and 4).

In this type of prescription system, farmers regularly sought technical references to solve a problem, confirm a diagnosis, or find or confirm the efficacy of treatment (attribute 10, modality 2) through books or articles. They also frequently had discussions with peers to learn about new practices (attribute 7, modality 3), and occasionally participated in the dissemination of these new practices by facilitating and managing established groups (modality 2). They explored as many opportunities as possible for training in livestock health management by seeking training both within and outside the structures to which they belonged (attribute 8, modalities 1 and 2). Although these farmers did not appear to question their approach to farming or to health management, they were particularly active and committed to the acquisition of knowledge and to the development of skills which, as with type A farmers, were practical and specific but did not fall under formalised approaches (attribute 11, modality 1). Farmers in this type of prescribing system largely relied on sources of knowledge obtained from outside the farm.

Similar to farmers in type A, the prescribers of technical aspects appeared to be present out of habit (attribute 5, modality 2). However, the relationships with "healthcare" prescribers (attribute 4) varied widely within the group.

Farmers in this type seemed to view relationships with those prescribers who intervened on the farm as being less important than the prescriptions that these farmers, who were essentially seeking practical and concrete solutions, sought outside the farm through training programmes and through discussions with peers.

4.2.3. A prescription system encompassing an autonomous operator

The third type of PS (*Figure* 2, type C) brings together three farms from our sample. There were several farmers of this type on the farm (attribute 1, modality 2), although in one case only one person made the decisions related to health management (modality 3). However, unlike the farmers in type A, but similar to those in type B, farmers within this type called on many prescribers outside their basic prescription group (attribute 2, modality 4), and this group was complete (attribute 3, modality 1).

In this basic prescription group, veterinarians intervened only when required to do so to meet regulatory compliance or when there were emergencies (attribute 4, modality 4). Similarly, advisers intervened only to present the technical aspects of the farm (attribute 5, modality 2). In other words, farmers did not seek more general advice on the overall functioning of the farm. This suggests that the farmers had a certain detachment from the basic prescription group without, however, completely ignoring it. That said, the farmers had relatively different attitudes as to the implementation of prescriptions of alternative practices (attribute 12).

In addition, the farmers in this type relied on formalised and disseminated approaches to understand health management by adhering to a specific approach (attribute 11, modality 1), such as the Obsalim® method, or by combining several approaches (modality 2). Their knowledge had been acquired primarily through past training (attribute 8, modality 4), through traditional agricultural professional organisations, or through private structures, such as veterinarian consultants, and during discussions with peers (attribute 7). These discussions provided an opportunity for two farmers in type 3 to reflect on the development of a farming model and on alternative practices consistent with their vision, while participating in the dissemination of these reflections by being active participants in these groups (modality 1). The farmers of this type now have sufficient knowledge and experience to learn and choose independently the prescribers that they need for specific knowledge and skills. Moreover, any training that they undertake today is done outside the institutionalised training system (attribute 8, modality 4). Lastly, while the farmers close to this type work with written references in widely varying ways (attribute 10), they all use these knowledge sources in one way or another (modalities 2, 3, and 4).

While farmer E8 did not generally focus on the technical aspects of farming and did not really use the farming data at his disposal, with the exception of milk analyses (attribute 9, modality 3), it is

worth noting that he developed his own milk quality criteria by adapting the existing criteria (*Appendix 3*) to manage the milk quality according to his own production objectives (attribute 6, modality 2). This was not the case for farmers E19 and E24 who, like many other farmers in the sample (*Appendix 2*), did not consider these milk quality criteria in their health management practices (modality 1). This striking characteristic of E8 seems to be fully consistent with autonomisation, or even with empowerment processes, given the prescriptions that may be perceived within type C. These processes raise questions about the power relations present in the prescription relationship between farmers and the prescribers with whom they work.

This type of PS therefore brings together farmers who seem to have become empowered in herd health management and in the development of their prescription system, revealing a certain distance from the prescriptions that they receive. The prescribers and the formalised approaches that they use are thus aimed at "doing it in one's way".

4.2.4. A prescription system oriented towards prescribers capable of ensuring a smooth transition in ways of thinking about health management

The next type of PS (*Figure* 2, type D) that we identified included four farmers from our sample. The number of prescribers of this type revealed relatively large variations across cases. However, the basic prescription group was always reduced, comprising only the veterinarian and occasionally an inseminator (attribute 3, modalities 3 and 4). The typical farmer in this PS called on several players outside the basic prescription group (attribute 2, modalities 3 and 4), many of whom were trained in caring for animals (veterinarian consultants, osteopaths).

Thus, farmers in this type of PS did not call on any technical adviser (attribute 5, modality 4). Apparently, their experiences led them to stop seeking the assistance of these advisers (example in Appendix 3). However, veterinarians – or at least the prescribers associated with animal health – played an important role in this type of PS. These farmers called on one or more privileged partners including: approved veterinarian groups (attribute 4, modality 1); players proposing alternative care; or even a prescriber who proposed specialised support and a more global conceptualisation of health management on farms (modality 2). However, the manner in which farmers adopted the prescriptions of alternative practices (attribute 12) varied between cases, with some confidently adopting them and others undertaking small-scale testing first**.**

While discussions with peers (attribute 7) varied widely, the farmers were very committed to training (attribute 8, methods 1 and 2) and were active in their quest for new knowledge. They sought to construct, above all, a representation of livestock health which would help them to restructure their own systems. To this end, they sought at least one formalised and disseminated approach (attribute 11, modalities 1 and 2) which they combined with their own methods.

These farmers attached little importance to written or numerical artefacts, such as milk quality results (attribute 6, attribute 9). While these results provided an idea of the state of their herds – for instance, a high cell count could signify infection – their herd management practices were not aimed at achieving specific results based on these criteria. Similarly, they did not always refer to written references (attribute 10) for help, for the sole purpose of solving an existing problem, or for making or confirming a diagnosis. Searches were thus relatively targeted.

Thus, in this type of prescription system, farmers distanced themselves from traditional groups of technical support and turned to prescribers who were better able to support them in redesigning their production system and with whom they maintained a relationship of trust. This type of prescription system therefore appeared to be oriented towards the knowledge of certain prescribers in particular, rather than being a simple attempt to obtain as many opinions and skills as possible by multiplying the number of prescribers. Prescribers were chosen for their expertise and for their ability to help farmers to reflect on an agroecological approach to herd health management or to farming as a whole.

4.2.5. A structured prescription system to support precise and technical herd management

Two farmers from our sample fell under this type of PS (*Figure* 2, type E). In this PS, farmers were looking for more technical expertise in relation to the tools used, the assessments, and the analyses that allowed them to have quantified indicators on the health of their herds. They appeared to view the quality control of their production as an important issue in farm management. They sought to integrate as much as possible the milk quality standards developed by dairies and technical advisers, and they set quantified technical objectives around these standards (attribute 6, modality 4). However, technical advisers were not viewed as essential prescribers because they were present only for the roles to which

they were assigned, namely working on the technical aspects of farming (attribute 5, modality 2). Lastly, these farmers used digital artefacts to manage both farming and their herds' health. For example, the typical farmer in this type use a robot coupled with software on a daily basis, which provided them with real-time technical data on lactation cycles, the quality of their cows' milk, and their activity (attribute 9, modality 1). They thus controlled herd feeding patterns, reproduction management, and livestock health management by having access to constantly updated data.

These farmers placed just as much importance on their relationship with the care prescribers when determining an agroecological approach to health management (attribute 4, modalities 1 and 2). However, the approach to health management of the two farmers in this PS differed: while one adopted a formalised and disseminated approach (in this case, Vincent's Bioelectronics), the other privileged different sources of knowledge that fell outside formalised approaches (attribute 11, modalities 1 and 3). Seeking knowledge outside the farm was also very important in the prescription system. Farmers viewed discussions between peers as an effective means of staying informed (attribute 7, modality 3), and these discussions were preferred over the independent search for written references (attribute 10, modality 1) on subjects in which they had an interest. These farmers also participated in health training whenever possible (attribute 8, modality 2), but without seeking to work with more trainers. Finally, they seemed to have sufficient trust in their prescribers to integrate various elements into their practices without testing these prescriptions first (attribute 12, modality 2).

In addition to these farmers' different relationships to health management approaches, the prescription systems that they adopted also varied widely, either in terms of the composition of the basic prescription group (attribute 3) or the number of prescribers outside this group (attribute 2).

Thus, the consistency of this prescription system did not determine how health was reflected on and managed. Rather, this was determined by a strong partiality for health management approaches that relied largely on the manipulation and use, often in real time, of quantified indicators provided by artefacts, which were then compared to the objectives and standards prescribed by technical advisors.

The types of prescription systems distinguished show how farmers organised human and cognitive resources around themselves for the purposes of their herd health management. *Annexe 3* summarises the conclusions on each of the types and presents an example of each type. Occasionally extended through the consultation of various professionals, or – on the contrary – centred around a few trusted professionals, these prescription systems ultimately vary widely depending on what farmers expect from these professionals.

5. Discussion

A typology to identify how to build a prescription system

Our study made it possible to identify the types of prescription systems on which farmers rely to help them in their herd health management. As with any categorisation exercise, the types identified are the result of choices based on whether or not the dimensions were viewed as influential. We were able to develop these attributes based on our field knowledge and on the literature on the prescription relationship concept. These types shed light on the different dimensions of the PSs that we seek to describe. From a constructivist perspective, we argue that they are tools for thinking about the complexity associated with the different ways of supporting farmers. Our typology is not intended to give a statistical account of the different ways of doing things, first because our sample is too small to be representative, and second because we made no attempt to be exhaustive in terms of the socio-economic characteristics of the farms surveyed. The key advantage of our approach lies in the fact that it is able to consider all the prescribers, and the associated prescription relationships, as being engaged in farmers' prescriptive environment for an agroecological approach to herd health management. Thanks to the concept of PS, we succeeded in identifying trends in how SPs are constructed, which shed light on how farmers approach prescription when adopting an agroecological approach to animal health management.

From this perspective, it is hardly surprising that some cases only partially corresponded to the identified types. These were cases in which the organisational form of PS meant that they were close to several types. This is one of the limitations of this study in which we collected and analysed data on the actual organisation of the prescription around the farmer, but gathered little data on the history of the organisation of these prescriptions. We believe that the specific cases encountered, situated at the margins of a PS – as well as the links that one may glimpse between the PS and these cases – may reflect an evolution in how farmers develop their PSs. This brings to mind the reflections on the typologies of trajectories and the dynamics of change that farmers adopt when implementing new practices and production methods (Chantre & Cardona, 2014; García-Martínez et al., 2009; Polge & Pagès, 2022).

The multiple health management prescribers: diversity, coordination, and territorial anchoring

As mentioned earlier, veterinarians are not the only ones who adopt an agroecological approach to livestock health management. They are part of a system, which can be narrow or broad depending on farmers, and which influences the prescription of an agroecological approach to livestock health management. This confirms the need to take an interest in the multiple practitioners who work alongside farmers. The literature on livestock health management is quite extensive. While several studies have focused on the veterinarian profession (Bonnaud & Fortané, 2021; Hellec et al., 2021) and specifically on this central actor in animal health, others have revolved around the management of regulated diseases and biosecurity (Bellet et al., 2021) and antibiotic resistance (Kjæmpenes, 2021; Surdez et al., 2021), highlighting the dangers of animal husbandry for the society. By paying attention to the agroecological transition as it is practised by livestock farmers, this article does address diseases involving a risk to human health but focuses rather on those diseases that livestock farmers encounter on a daily basis ("production diseases"). It thus provides a new perspective on animal health as it is experienced on a daily basis. From this perspective, farmers view the issue of health as one related to more than just the simple issue of the medicines to be used. In other words, this issue involves more than simply questioning antibiotic resistance and the use of alternative medicine. The important role played by other PSs therefore seems logical. These prescribers can help to advise farmers on cultivation, feeding, and pasture management, and all these aspects have an impact on animal health (Wezel & Peeters, 2014).

Moreover, given the multiple prescribers, the question of possible competition, and/or complementarity between them, arises. Our interviews in the field did not reveal any conflicts or contradictions between the prescribers who worked with farmers. Farmers did not view the issue as one involving the replacement of one prescriber with another, transforming them into a "competitor", but rather as a means of reflecting on, and producing, complementarities in a set of prescribers. These complementarities could concern the areas of intervention, specific skills, or even different "roles" to help farmers to adopt a more agroecological management (reassurance, provision of information, questioning, etc.). Our analysis revealed that these complementarities were considered primarily by the farmers rather than by the prescribers. Some studies have revealed reflections on interprofessional collaboration in certain fields in the context of agroecology. For example, Adam et al. (2017) present a three-way conversation between a livestock technician, a veterinarian, and a farmer in the context of a project seeking to reinforce the autonomy of chicken farmers. The question of the coordination of various professionals with a farmer therefore remains largely unresolved.

The study also raises questions about the choices available to farmers in a given territory. These prescription systems developed by farmers are, in reality, the result of territorial constraints and opportunities. One may consider the prescriptive environment of farmers as a "prescriptive ecosystem" to take into account the fact that, by being installed in a specific region, farmers may or may not be able to choose their veterinarians, decide whether to adhere to an AVG, choose whether or not to participate in a training course close to their homes, and so on. Analysing PSs as the result of choices dictated by territorial realities thus deserves further exploration. More broadly, this raises the question of the ethical dimension of access to agricultural knowledge systems and the "cognitive justice" involved in agroecological transition (Coolseat, 2015).

Prescriptions and reciprocal learning

Historically, in animal health, prescribers, notably veterinarians, have often been viewed as those in power because of their influence on farmers (Woods, 2007). Starting from the concept of prescription relationship, we analysed the farmers' arrangements by noting that both prescriptions and prescribers can be chosen and/or imposed. Some cases revealed a symmetrisation of the power relationship in the prescription, as described by Rénier et al. (2018), relative to the relationship between farmers and homeopathic veterinarians. We thus agree with Hatchuel (1996) who argues that a prescription can be reciprocal and can give rise to cross-learning, with each actor constructing their own objectives, in interaction with other actors, meaning that each actor is then likely to prescribe to the other (Stenger, 2011). For instance, one may consider that farmers developing an SP "*extended around an autonomous operator*" will, in some ways, specify to prescribers the form and content of the prescription that they seek. These results also encourage us to go beyond the concept of adherence to prescriptions (Aronson, 2007), which is an obstacle that many animal health studies encounter (Ritter et al., 2019; Svensson et al., 2019). In line with our comprehensive approach, we believe that the concept of the prescription system can shed light on the prescription useful to farmers according to their objectives, and help to avoid the application of a prescription designed externally.

Lastly, our conceptual proposal to approach the prescription within a system built by the operator goes beyond the concept of Hatchuel's prescription relationship (1995), which is centred on a dual relationship between prescribers and operators, of the doctor/patient or seller/buyer type. Beyond the reciprocal prescription between farmers and veterinarians, our results show how some farmers also choose the various prescribers with whom they work. In certain situations, such as the homeopathy situation that Rénier et al. (2018) analysed, farmers themselves became the bearers of knowledge, and even reflected on health in ways that involved learning about values, standards, and pragmatic judgments, corresponding to double-loop learning (Argyris, 1982). This was particularly true for types C and D where farmers sought support to restructure their herd health management in line with their own standards which revolved around what should or should not be done, their values, and their vision of the future of their farming activity. Analysing the relationship of reciprocal prescriptions within a prescriptive ecosystem developed by farmers thus leads to considering these relationships in the context of longer-term professional development.

6. Conclusion

This article has distinguished five types of prescription system that shed light on the socio-professional configurations to which farmers engaged in an agroecological approach to herd health management belong: i) one structured around the farm work collective and a few trusted prescribers; ii) one organised around farmers seeking prescribers and concrete solutions; iii) one extended around an autonomous operator; iv) one oriented towards prescribers capable of promoting transition by encouraging discussions around health; v) one designed to promote precise and technical herd health management..

Our conceptual proposal, which has drawn on the concept of the prescription system, allows us to consider all the prescribers in the management of health, beyond the traditional players alone, and including, in a broad interpretation of the prescription, the forms of more "invisible" prescriptions, such as those driven by artefacts. In addition, our proposal makes it possible to go beyond a medical apprehension of herd health prescriptions to understand how the relationship to animal health management also passes through a heterogeneous system of recommendations, specifications, and advice. By going beyond questions of adherence to prescriptions, we shift away from an impersonal interpretation of the prescription as a unilateral and top-down influence of the prescriber towards the operator, and take a more in-depth look at how these prescription relationships unfold.

Lastly, in a perspective of agroecological transition perceived as a professional transition, it seems essential to consider the learning processes of farmers within their prescription systems. If one considers experiential learning (Blackmore, 2007; Mayen, 2015), attempting to understand the purpose of what is learned in the different prescribing relationships becomes a natural question. This therefore requires one to pay attention to farmer's perceptions of "health". Future studies will thus explore the representations of farmers regarding how health management should be practised in order to identify the relationships between these representations and the prescription systems as they have been explored here.

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Appendix

Appendix 1 : Practices of farmers involved in herd health management.

E1	Homeopathy / Essential Oil (EO) / Phytotherapy / Bach Flowers / No dry cow therapy
E2	HE / Trimming / Balanced feed ration / Building hygiene
E3	Trimming / Feeding kefir to calves/ Pasture / No cereals in rations / Building hygiene / Balanced feed ration / Building hygiene
E4	Dynamic rotational grazing (DRG) / EO / Deworming only heifers / Balanced feed ration / Coproscopy / Curative trimming
E5	Pasture / Water electrolysis / Geobiology / Vincent's Bioelectronics / Phytotherapy (complement) / Balanced feed ration
E6	DRG / Homeopathy / Preventive minerals / Selective dry cow therapy (SDCT) / Obsalim® / Animal welfare / Aromatherapy and herbal medicine (complement) / Balanced feed ration
E7	Homeopathy / DRG / Boosted plants (mineral intake) / 100% fresh ration / SDCT
E8	Pasture / Small herd / Mother-fed calf / Grass-based ration / Seasonal calving / Homeopathy / Aromatherapy / Osteopathy / Energy medicine / Hardy breed
E9	Phytotherapy / Aromatherapy / EO / Hardy breed / Pasture / Group calving / Acupuncture / Homeopathy / Animal welfare / Balanced feed ration
E10	Pasture / Lunar cycle / Mother-fed calf / Phytotherapy / Aromatherapy / EO / Homeopathy / Boosted plants / Acupuncture / osteopathy / Trimming / Low milk production demands
E11	DRG / Aromatherapy / Homeopathy / Trimming / Osteopathy / SDCT
E12	DRG / Phytotherapy / Aromatherapy / EO / Coproscopy / Physiotherapy / Obsalim® / Balanced feed ration
E13	EO / DRG / Trimming / Balanced feed ration
E14	Obsalim® / Phytotherapy / Coproscopy / osteopathy / Acupuncture / DRG / Low milk production demands/ Balanced feed ration
E15	DRG / Shearing heifers' backs / Trimming / EO/ SDCT / Osteopathy
E16	DRG/ Phytotherapy / Aromatherapy / EO / Balanced feed ration / Building hygiene
E17	DRG / Preventive trimming / SDCT / Phytotherapy / Reasoned food ration
E18	DRG / Phytotherapy / Trimming / Balanced feed ration
E19	DRG / Phytotherapy / Aromatherapy / Osteopathy / Geobiology / 0 pest control
E20	DRG / Mother-fed calf / Vitamin water / Phytotherapy / 100% dry ration / 0 grass supplement / SDCT / Curative trimming / Antibiogram
E21	Buildings hygiene / Preventive trimming / SDCT / Balanced grazing / Mineralisation and energy supply / Balanced feed ration / Animal welfare
E22	DRG / EO / Low milk production demands / Trimming / SDCT / Obsalim® / Animal welfare
E23	DRG and Routes/ Mother-fed calf/ Preventive trimming / Low milk production demands / Coproscopy / 0 pest control / Little or no concentrates
E24	Obsalim® / Mother-fed calf/ Pasture / EO / Phytotherapy (deworming) / Homeopathy / Hardy breed
E25	Pasture / Osteopathy / Shiatsu / Acupuncture / Geobiology / Homeopathy / Phytotherapy / Aromatherapy / Trimming / Ethology (behaviouralism) / Biokinesiology / Kephyr / Coproscopy / Metabolic profiling / Physiotherapy
E26	Pasture / EO / Trimming / Acupuncture / Obsalim® / Mother-fed calf / Building hygiene / SDCT / Homeopathy / Phytotherapy / Balanced feed ration

Appendix 2: Attributes and modalities characterising prescription systems and associated cases

Attributes	Modalities	Case
1. Who makes the health management decisions?	1. I work alone	1. E1, E6, E7, E9, E10, E13, E14, E15, E18, E20, E22, E23, E25
	2. Several of us work on general ideas but one person is more responsible	2. E2, E4, E11, E12, E19, E24
	3. Several of us	3. E3, E5, E8, E16, E17, E21, E26
2. How many prescribers outside the basic prescription group (BPG)?	1. I have no other prescribers	1. E2, E16
	2. I only have one prescriber outside my BPG	2. E1, E13, E17, E21
	3. I have a few other prescribers (2-4) outside my BPG	3. E3, E4, E6, E12, E15, E18, E22, E23, E24
	4. I have many prescribers (5-8) outside my BPG	4. E5, E7, E8, E9, E10, E11, E14, E19, E20, E26
	5. I accumulate prescribers (more than 8) outside my BPG	5. E25
3. How is the basic prescription group composed?	1. I have a veterinarian, a technical consultant, and an inseminator	1. E1, E2, E3, E7, E8, E9, E10, E13, E14, E15, E16, E18, E19, E20, E21, E22, E24
	2. I have a veterinarian and a technical consultant	2. E17
	3. I have a veterinarian and an inseminator but no technical consultant	3. E4, E6, E23, E25, E26
	4. I only have a veterinarian	4. E5, E11, E12
4. What prescription for health management?	1. I have a privileged partner: a veterinarian who does practically everything	1. E1, E2, E6, E13, E15, E16, E17, E18, E23
	2. I use a veterinarian for emergencies because of statutory obligations but I also have several alternative medicine practitioners for more general reflections	2. E4, E5, E9, E10, E11, E12, E25, E26
	3. I call upon a veterinarian whenever necessary	3. E3, E20, E21, E22
	4. I call upon a veterinarian because of statutory obligations and for emergencies	4. E7, E8, E14, E19, E24
5. What prescription for zootechnical aspects?	1. I have my technical consultant whom I trust and with whom I discuss all aspects of my farming operations	1. E14, E22
	2. I have one or more technical consultants with whom I discuss the technical aspects of farming but from whom I expect nothing further	2. E2, E3, E4, E6, E7, E8, E9, E10, E13, E15, E16, E17, E18, E19, E20, E21, E24
	3. I have a technical consultant but I hardly engage with him, nor do I really listen to his advice except with regard to one or two aspects in which I lack the necessary skills	3. E1
	4. I do not have a technical consultant	4. E5, E11, E12, E23, E25, E26
6. How do milk quality criteria shape my practices?	1. These criteria inform me about the quality of the milk produced, but I hardly take them into account in my health management practices	1. E1, E5, E6, E7, E9, E10, E11, E13, E14, E16, E18, E22, E12, E17, E23, E26, E15, E19, E21
	2. I create my own criteria by reorganising the criteria provided to control the quality of the milk according to my own objectives	2. E8, E24
	3. I take these criteria into account in my health management practices to improve milk quality	3. E20, E25
	4. I am particularly attentive to these criteria in my health management practices to manage milk quality and achieve specific objectives	4. E2, E3, E4
7. What discussions with other farmers on one's practices?	1. I engage in multiple discussions with other farmers to develop a breeding model and alternative practices and to disseminate these practices	1. E8, E19, E20, E23
	2. I engage in multiple discussions with other farmers to learn new practices but also to participate in their dissemination	2. E1, E2, E4, E7, E9, E12, E13, E25
	3. I engage in multiple discussions with other farmers, either in established or non-established groups, to learn new practices	3. E3, E6, E10, E14, E15, E18, E16, E17, E21, E24, E22
	4. I do not attempt to discuss my practices with other farmers	4. E5, E11, E26
8. Do I receive health management training when I participate in professional training?	1. I seek as many opportunities as possible to receive training either via the structures to which I belong or elsewhere	1. E1, E6, E7, E9, E10, E11, E18, E20, E22, E25, E26
	2. I receive training from the structures to which I belong but do not look elsewhere	2. E2, E4, E12, E13, E15, E16, E17, E21, E23
	3. I participate in training sessions to see what is being done but I am not really committed	3. E3, E14
	4. I no longer participate in training, I learn by myself	4. E5, E8, E19, E24

9.	**How do you use the data provided by herd artefacts?**	1.	I use digital tools to obtain real-time data on my herd	1.	E2, E4, E6
		2.	I use breeding data regularly		
		3.	Milk analysis is the only livestock data that I really use	2.	E3, E11, E12, E13, E15, E22
				3.	E1, E5, E7, E8, E9, E10, E14, E16, E17, E18, E19, E20, E21, E23, E24, E25, E26
10.	**How do you use references?**	1.	I seek references to enrich my vision of agriculture and livestock, to learn new alternative practices, and to gain a better understanding of my cattle	1.	E5, E19
		2.	I seek technical references to gain a better understanding of my cattle and to solve a problem, confirm a diagnosis, or confirm or find treatment	2.	E8, E25
		3.	I only seek technical references to solve a problem, confirm a diagnosis, or confirm or find treatment	3.	E1, E3, E6, E7, E9, E10, E11, E13, E15, E16, E18, E20, E22, E24, E26
		4.	I do not look for references	4.	E2, E4, E12, E14, E17, E23, E21
11.	**What sources of knowledge?**	1.	I adhere to a formalised and disseminated approach for herd health management, and also occasionally to manage my farm operations as a whole	1.	E1, E4, E5, E24
		2.	I combine several formalised and disseminated approaches to manage, in my own way, herd health and my farm operations	2.	E3, E7, E8, E11, E12, E19, E23, E25
		3.	I use different sources of knowledge, which are not necessarily formalised approaches, to manage the health of my herd and my farm operations in my own way	3.	E2, E6, E9, E10, E13, E14, E15, E16, E17, E18, E20, E21, E22 E26
12.	**How do you position yourself vis-à-vis the prescriptions of alternative practices?**	1.	I do not receive, or no longer receive, prescriptions regarding alternative practices	1.	E1, E5, E9, E14, E20
		2.	I apply the prescriptions that I view as useful without trying to question, validate, or verify the solutions proposed	2.	E2, E4, E7, E10, E13, E16, E17, E18, E21, E22, E23, E24, E26
		3.	I first test on a small scale, in non-risky situations, to verify that the prescription works on my animals before applying what seems to work and what I am experienced in without question	3.	E3, E6, E11, E12, E15, E19
		4.	I am currently experimenting to understand, learn, and create my own practices which will be specific to my own farm	4.	E8, E25

Appendix 3: Summary of the different types of prescription systems identified, associated socio-professional characteristics, and typical examples of each case

Type	Typical example of this type
Structured around the farm work collective and a few trusted prescribers	E16 represents a couple of farmers who have been working in a jointly-run farm since 2012. They have approximately 70 Prim'Holstein cows in a building built when the jointly-run farm was created. They have 195 hectares of land on which they produce cereals and practice rotational grazing from spring to early summer (approximately three months). They are committed to the "Omega 3 Quality" approach to milk, which determines the feeding of dairy cattle. Cattle feeding is an aspect to which the couple attach a lot of importance by paying special attention to feed, its nutritional quality, its quantity, and also the return on investment, with the help of the technical consultant from the Chamber of Agriculture. This consultant proposes an external view that allows them to discover new practices: *"E: Well, today, doing away with external advice, 100%, some will say the opposite, uh, but it's really hard, uh, because...* *E2: It's a necessity for us. Because we sit around the table, and then we discuss, he tells us 'well, you should do that, that', and then he tells me 'ah, of course, there are things we wouldn't have necessarily thought of because we do this all the time…'* *E: Yes, it's an external opinion.* *E2: It's the day when we take a moment and we say, like then, he suggested that we buy alfalfa… We wouldn't have bought it…"* Ever since they began their farming activity, these farmers have also been members of a group of veterinarians attached to the health system, from whom they received considerable assistance around livestock health management. They thus received training in animal health and on the use of alternative medicines, advice on the phone, and herd-specific interventions. Working with these veterinarians helped them to gain substantial confidence, as well as confidence in their own skills, and they knew that they could contact these professionals whenever necessary "*E2: Well, because we work with X, they have already taught us things that we can do ourselves. And then when we see that we can't, for example everything relating to milk fever, if the cow doesn't get up after calving… that, he tells me he knows how to infuse nutrients. We know how to do first aid because we were trained by the veterinarians in the cooperative. Because that's exactly what they do, they teach us things, for… I mean, when we call them, it really has to be that, there has to be a real need. They mustn't come for nothing. And well, otherwise… […] We find it comforting, because it can be on Saturday, Sunday, we just call. That, for the others, they know that, if you call on Sunday, it's going to be more expensive. And nights as well, so we see it as a way to take better care of our animals."*
Structured around a farmer seeking prescribers and concrete solutions	E22 is an individual dairy production farm that has been in operation since 1994 (family takeover) and has had an organic farming label for five years. It has 40 Prim'Holstein cows. It has 63 hectares of which about eight are used for cereal production and the rest for pasture. These are natural and temporary meadows that allow dynamic rotational grazing for approximately eight to nine months a year. Together with a former livestock consultant of the Chamber of Agriculture, this farmer participated in the creation of a Group of Economic and Environmental Interest (GIEE) whose objective is to *"plant anew 'cap-flora' type meadows with varied flora*". This consultant also replaced milk control processes. The farmer thought him to be efficient and had confidence in him: "*E: His… passion, and where he is super efficient, that's it. It's everything that involves prairies and all that, but in herd monitoring as well, well, 2-3 of us use him, yeah, and then, well, it's actually still developing, it'll soon be hiring, and well, we explained to him, we told him 'well here, milk control does this. Listen, can you do it for us: enhance its value, do the calculations, and all that?'*". The recent transition to organic farming has been accompanied by many changes in meadow management (sowing of many floristic varieties) and in cereal crop management (ceasing the cultivation of corn) and thus in cattle feeding. This farmer also chose to reduce milk production. The regulations on drugs for livestock treatment encouraged him to obtain training in phytotherapy, and more particularly in aromatherapy. This training was provided by the Chamber of Agriculture, by veterinarian consultants associated with a laboratory offering aromatherapy-type phytosanitary products for sale on one occasion, and by a group of veterinarian consultants specialising in alternative medicine on another occasion. "*I: And did what the consultants teach you correspond? I mean, there were times when they were at odds, didn't you…?* *E: The products to be used for treatment are practically the same.*" These training opportunities provided him with practical solutions for specific animal diseases. They also allowed him to choose how to address herd health management, with fewer chemical treatments, as their veterinarian was not trained in the use of alternative medicines. He appeared to have a somewhat distant relationship with the veterinarians because they used chemicals and proposed no preventive measures, even if their views tended to change over time: *E: the five of them all work together, for the rotation. From that angle, we are extremely well served, on that point it's perfect.*

	I: And the fact that you use essential oils, I mean, do your vets know that you use…? *E: Yes, now it's better, but at the beginning, there were… out of the five, there was one who was 'neither for nor against', maybe more for than against. The others were totally against it, uh: 'No, no, but it sucks, it's useless, you're stupid to do that, it'll never work!' And then, well, well he too, they're, they're really, they take advantage, they're the only ones around. There's no one else so maybe they're exhausted, it's expensive, they can't take it anymore, but well… But suddenly the people, it's not just me, everyone did a bit of it and all, and they must have noticed… Well, now they're less against it, and* [they're like] *"why not?", and sometimes, they themselves propose something."*
Extended around an autonomous operator	E8 is a couple of farmers in a jointly-run farm. They took over the family farm and made numerous modifications to the agricultural model used by their parents to align it with their values and their expectations of an ecological and sustainable agricultural model. The farm has operated under the Organic Farming label since 1998. The couple have a main barn with 51 Abondance cows and they transform part of their milk into Salers cheese (Cantal). They supply a second pig-fattening workshop with their dairy residues. Meat and cheese are sold to customers directly. The farm counts 90 hectares of grazing meadows, of which about 34 hectares can be mowed. They both participate in reflections on the general operation of the farm and the design of the system, according to a model close to the "*traditional Auvergne systems*". Thus calving takes place in the spring and no fermented harvest product is used. They aim to reduce the number of milking cows to around 35. Choosing which heifers to keep is the first step in their herd health management approach. These farmers believe that the absence of heifer diseases largely influences the quality of their milk production. Quality is particularly important in cheese production. Milk control thus enables them to obtain "*a monthly follow-up on cell levels, and an analysis to detect pathogenic bacteria with regard to cheese*". They also independently interpret the results of these analyses by choosing the criteria that they view as the most important. *"E: Well, we interpret them in a different way, because: for dairy milk, well they focus on, some… uh… on milk payments, they focus on 'cells, germs', on criteria, on certain criteria; and for us with regard to cheese processing, we focus more on pathogenic bacteria more precisely, so basically listeria, salmonella, E. coli, staphylococcus. […] They're related, everything concerning listeria, salmonella, E. coli relates to hygiene or overall herd health issues, hygiene, and overall herd health, and everything that relates to staphylococcus is more related to udder health problems associated with mastitis cells. That's it, we know all this and we manage our herd, that's how we manage our herd".* Their objective, in terms of health management, is to "*reconnect a little bit, nature, the soil, the grass, the cow, what it produces, us who are behind it all, and what we do with it all. And so, the fact of being, of trying to be as unobtrusive as possible*". To this end, they notably replace, whenever possible, allopathy with homeopathy, aromatherapy, and osteopathy, after having participated in numerous training courses in the past. Today they independently and consciously select different references: "*So we have a huge library on homeopathy, because it's something that is extremely more difficult to, it's much more difficult to understand*"; advice from peers; or the training that can help them to pursue their goal. They also facilitate an organic farming group, and call on service providers to carry out certain tasks such as mowing and haymaking.
Oriented towards prescribers capable of promoting transition in terms of reflections around health	E11 is a "*family farm*" jointly-run by a couple and their parents. It specialises in dairy farming and obtained the organic farming label in 2016. The farmers have approximately 77 hectares, including 35 hectares of natural grassland, and close to 20 hectares of temporary meadows that make dynamic rotational grazing possible. The rest is used for cultivation. The couple breeds approximately 60 cross-bred Prim'Holstein and Simmental cows, with calvings relatively spread out throughout the year except in summer. The livestock is managed on the dynamic rotational grazing principle, thanks to their collaboration with a training and consulting company specialising in individual or group support on dynamic rotational grazing and nutrition: *"So personally I work with X, so that has changed, it's changed my vision of grazing, after reading "Productivité de l'Herbe"* [Grass Productivity] *thrice, without understanding everything, when they explained it to me in a different way, I understood!"* The farmer largely responsible for the herd is a former feed technician consultant and this now helps him to manage his cow rations and allows him to do without a livestock consultant. This past experience also allowed him to acquire different types of knowledge, such as the evaluation of animal health and buildings hygiene. He, however, called on the services of a technical sales representative with whom he had built a relationship of trust over time. He expected this prescriber to provide a new perspective on his system: "*E: Yeah, the one who sells the product. And he, well, he provides… an external vision on the herd. Afterwards I work, it's with someone I've worked with for 10 years, in whom I trust so I... He's quite an animal-lover, he's got animals himself so... (laughs) He knows... yeah. But he doesn't particularly push for consumption, so it's already something (laughs)…"* As part of the transition to organic farming, he was also involved in training in homeopathy and aromatherapy: "*E: Homeo, I started small, around calving, things like that, with the well-known basics: arnica, lemon balm, things like that, to help in delivery and such. I got good results. Then I tackled mastitis… oh, not always with*

	big successes, uh. It's not, overall it's going well, 2021, I have, no, 2020, I had zero antibiotic treatment for mastitis, I treated everything... Afterwards I followed an additional aroma training the year before, 2019. Well, it's been… 20, yes, it's been a year. So there I did 'mastery', uh... So, me, we did mastery... And, uh, so now I have the two, with homeotherapy and aroma..." to deal with the regulations on allopathic treatments. In addition to the hoof trimmer, this breeder also relies on an animal osteopath to treat his cows: "*E: Yeah, that's all I do. I don't do acupuncture, and I don't do, what do they call it, I haven't done those, I can't do everything…* *I: Osteo?* *E: Yeah, osteo, but I bring the osteo doctor here. She comes, I have 2-3 cows like that, that she… Yeah, but they play a little, when I feel like they're starting to limp a little, that's it!"* Although he works with a veterinarian, the latter only manages the regulatory aspects of farming or emergencies. Lastly, to manage selection and reproduction, which are important factors in health management, this farmer is largely independent and is personally involved in selecting bulls, crossbreeding, managing the breeding schedule, and performing inseminations. He uses an inseminator only to perform the ultrasounds.
Structured to support a precise and technical management of the herd	E2 is a farm jointly-run by two brothers and their father. They have a herd of approximately 60 Prim'Holstein cows. Cattle feed is important in their approach to herd health management. They also call on an agricultural consultant who plays an important role, notably on aspects relating to food and milk quality. The quality of the milk largely regulates the management of the farm, given that dairies' quality criteria act as a reference for farmers and influence how they address the different aspects of their work. Herd management is aided largely by the presence of a heat detector and a milking robot connected to herd monitoring software. These tools help farmers to control many aspects in real time, such as animal activity, milk quality, animal treatment, ration balance, and so on: "*E: [about the robot] The arm measures the conductivity of quarter milk samples for the diagnosis of mastitis. When there is mastitis, there is an increase in conductivity. So it measures the variations in conductivity, it tells us 'Ah, be careful! Alert on this sample, etc…'. It collects data on the colour of the milk […]. It takes the temperature of the milk, it takes... a sample, then divides it into four quarters, afterwards it takes a sample, adds a little bit of reagent, and it gives an idea of the leukocytes present in the mixture. So often, when there's mastitis, there's an increase in activity in a quarter sample, and an increase in leukocytes.* *[…]* *E: In fact, when the robot detects sick cows… Each red square means that there is something abnormal. So here, we have the conductivity of each quarter sample: so this is the one that's infected, this one is that one, this one is that one, this one is that one, yeah. Here we had the indication of the cells, so that's the mixture on the four quarters, yeah. So Neige, for instance, the treatment there… besides, she hasn't come out, what the hell? Unless if they stole her, I haven't seen her... So yeah, so Neige, she'd had a calf about then, colostrum, then we start... So the quarters have a normal conductivity of 70-68, there's nothing abnormal. That's the temperature of the milk, nothing abnormal. I didn't panic at all, and then it started to rise."* The inseminator is also an important prescriber in their prescription system, and his prescriptions are scrupulously respected: *"I: And it is the inseminator who works with your cows? (laughs)* *E: It's the inseminator who draws up the schedules with the computer. And then we follow the schedule we have".* Lastly, they have been working with a group of veterinarians attached to the health system ever since the group was created nearly 40 years ago. They rely heavily on this group for implementing alternative treatments based on essential oils and for trimming. While they participate in the trials and experiments proposed by the group, they are not totally convinced by the use of alternative medicine, quickly switching to allopathic treatments when they feel that the alternative treatments are not working: *"E: Yeah, but well, the vets, we have healthcare protocols, etc. And then when there's something abnormal, if one weekend I'm not there, and there's something abnormal, they give me a call and yeah.* […] *I: And so that's a whole box that X gave you?* *E: I was the one who decided to buy, I belong to a research group, an experimentation group, etc. And that, that's more aroma. […] Yeah, that's intra-uterine, I never use it, it goes to the flowers. And that's for calves with cryptosporidiosis, that's the same thing, that's the first one I bought, it's not finished. Because when the oils no longer work, we move on to the strong-arm approach".*