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The trade-off between farmers' autonomy and the control of parasitic gastro-intestinal nematodes of sheep in conventional and organic farms

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ABSTRACT

Farmers value autonomy in the management of their farm. Amongst organic farmers especially, autonomy is thought to contribute to the success of the farm. Wider integrated farming systems however oppose such autonomy by making farm management decisions remotely. One of the greatest threats to the success of meat sheep farms is the presence of parasitic gastrointestinal nematodes. This study questioned whether a greater level of farmer autonomy could be correlated to the better control of the gastrointestinal nematode infections and whether this could be associated with farmer specific health beliefs. Data was collected across 36 meat sheep farms with similar climatic variables but with different beliefs and attitudes to health care in farming. These farms fell within three groups: French organic, French conventional and Algerian conventional farms. Information regarding farmers' health beliefs and their level of autonomy in management was gathered using questionnaires to address autonomy in the following variables: agriculture production, husbandry, feed, therapeutics, commercialization, and farmers' education. The intensity of gastrointestinal nematode infections was also measured on each of these farms using faecal egg counts on composite sheep samples. Statistical and correlation analyses of autonomy variables to gastrointestinal nematode infection intensities were carried out. The results showed farmer autonomy was not associated with better gastrointestinal nematode control in any of the three groups of farms studied. Greater level of autonomy in husbandry and therapeutics specifically were associated with greater levels of infection. Farmers across the 36 farms studied were unanimously concerned about the threat gastrointestinal nematodes present to their flocks. Yet their current knowledge was clearly not sufficient to control infections irrespective of their health beliefs. This paper makes suggestions to facilitate communication with farmers and to improve the integration of gastro-intestinal nematode control measures.

1. Introduction

Craftsmen place a high value on their work. They learn their craft mostly by practicing alongside a more advanced craftsman rather than in school and often their families are involved, to varying degrees, in their enterprise (Dubar et al., 2011). Autonomy for craftsmen is therefore a major priority. Farmers share a similar profile with craftsmen however their inclusion into a wider system of contractors/integrators such as for commercial farming seems in opposition to their autonomy (Nicourt and Cabaret, 2014). Autonomy is particularly appreciated in organic farming (Barres et al., 1985) since each farm should be self-sufficient in agreement with organic regulations; autonomy is also valued in the western agrarian thinking in relation to individual entrepreneurship (Emery, 2010). Autonomy has two meanings: the ability to decide on all aspects of farm management (this can be common to organic and non-organic farms) and the fact that the farm should produce the food for the animals, and the animals provide fertilisation to the soil, ideally without the use of synthetic chemical products. These visions of autonomy are different from the ones presented by Stock et al. (2014), who distinguishes between neoliberal autonomy (based on individualism, produced according to the market and to compete with other farmers) and actual autonomy (based on collectivism (organise one's own work and work with other to realise collective interests). The definitions of Stock et al.

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(2014) do not apply well to organic system or production in developing countries, which were well represented in our samples. Integration in farming systems can be applied at two different levels: 1) the general integration of a production system such as in the poultry and pig industries where a private integrator provides young animals, food and sometimes housing and therapeutics, leaving famers with a very limited autonomy of decisions, 2) local integration at farm level were the farmer decides on the complementarity of agriculture and husbandry, the animals to be bred, food management, housing and therapeutics. Local integrated farming systems refer to agricultural systems that integrate livestock and crop production within a farm (Chan, 1985). In this paper we will consider only farms with local integration where farmer autonomy can be expressed in terms of decisions on feed, health and general management. Gastrointestinal nematode infections (GIN) are agreed to be a frequent problem to grazing meat sheep husbandry among both veterinarians (Perry et al., 2002) and farmers (Cabaret et al., 2009; Ouzir et al., 2011; Saddiqi et al., 2012). The GIN parasitise the sheep abomasum provoking substantial pathophysiological damage to the sheep. Typical symptoms include anaemia (specifically for the nematode *Haemonchus contortus*) and loss of condition (all the GIN). The adults shed eggs in the host faeces onto pasture. These eggs then develop into infective larvae stages in the external environment to complete the life cycle when they are once again consumed by the grazing sheep. Farmers have real difficulty in accurately evaluating the importance of GIN in their flocks/herds (Cabaret, 2003; Saddiqi et al., 2012). They use a variety of systems to try and control the GIN, either directly (with the use of anthelmintics) or indirectly (*via* pasture management) (Barger, 1997; Thamsborg et al., 2009; Cabaret, 2003). These systems, although based on a similar technical knowledge, are likely influenced by the farmers' own beliefs: this is reflected in the differing uses of synthetic anthelmintics by organic farmers which are authorised to a limited frequency (Cabaret et al., 2009). To understand the personal belief system of farmers which drives their GIN control systems, we adopted the use of the health belief model. This was originally established (Abraham and Sheeran, 2009) to understand how humans make medical and healthcare decisions and focuses on threat perception and behavioural evaluation of the health problem. This model is readily extended to any kind of decision (feeding, use of pasture etc) even when not related directly to health. Threat perception constitutes the perceived susceptibility to a health problem (here GIN) and the perceived consequences on health that will ensue. Behavioural evaluation consists of the benefits of a recommended health behaviour (for example lambs weight gains after anthelmintic treatment) and the barriers to enacting the behaviour. For example, the cost of a therapeutic drug and the time spent treating the flock weighed against the time needed to manage pastures in trying to reduce flock contact with GIN transmission stages. Thus, certain GIN control practices will be more or less attractive depending on a farmers beliefs relative to the importance of GIN and the expected returns from these practices. Other beliefs, not directly related to GIN, may also have some impact on the intensity of GIN infection on a farm. There is a strong belief that farmer autonomy may contribute to the success of the farm (and possibly GIN control included) especially amongst organic meat sheep farmers (Cabaret et al., 2009). Furthermore, the general level integration decreases autonomy and increases social vulnerability of farmers in most animal productions (Nicourt and Cabaret, 2014). In this paper we will describe in detail what is meant by autonomy in various contexts (i.e. diversity of productions, feed origin, therapeutics, commercialization of farm production, and how farmers learn their agricultural knowledge). Our view, in line with that proposed by Kristensen and Jakobsen (2011) was that the farmers organise disease control based on their beliefs (Dillon et al., 2015). Our research questioned whether greater levels of autonomy (and hence higher influence of belief) had a positive influence on the control of GIN. Specifically, we intended to relate the level of autonomy on sheep farms from similar climatic conditions to the intensity of gastrointestinal nematode infection and to different beliefs and knowledge situations.

2. Materials and methods

2.1. The farms

The 36 farms studied were private meat sheep breeders. They were all involved with extension technicians and the farmer visits and faeces sampling were incorporated in the extension system; no ethical statement was necessary in these conditions in France and Algeria. They all relied primarily on pasture to feed the sheep and were sustainable since they were in activity for more than five years. The French farms had average or good economic returns and long term interactions with agricultural development structure (Benoit, 2014). The Algerian farms were also in relation with extension technicians but their economic return was not assessed. Twenty of the farms were conventional farms based in eastern Algeria (coded A) in the Batna region with a steppic climate. The coldest month in the area was January (average 5 °C) and the hottest was July (average 25 °C). The drought period extended from June to September. Sixteen of the farms were in France in the semi-mountainous region of Auvergne (centre of France) with a fresh temperate climate. Here the coldest month was January (5 °C) and the hottest was July (21 °C). Nine of these French farms were reared in a conventional way (coded FC) and 7 under organic regulation (coded FO). The farmers in organic farms used less anthelmintics and more of the natural pastures than the conventional ones; the flock sizes were similar (Cabaret et al., 2009). Data on the farms' autonomy variables were collected *via* questionnaire completed by one of the investigators on the farm.

2.2. Parasitological data

Faecal egg counts (EPG: nematode egg per gram of faeces)) were used as a proxy to reflect GIN infection intensity. These were carried out at the end of spring on the faeces of non-lactating adult sheep using two (Algeria) or three (France) composite samples. The spring period is one when access to sheep was easy in the three situations. Composite sample samples were a mixture of faeces collected *per rectum* from 10 to 15 sheep (Morgan et al., 2005). The egg counting technique was standardized (MAFF, 1986, modified McMaster technique) and accurate to 50 or 15 gastrointestinal nematode eggs per gram (EPG) of faeces, respectively, for FO/FC or A (the less infected). The highest accuracy of EPG on A was due to the fact that previous studies showed that their infection was relatively low.

2.3. The autonomy variables

These were constructed expressly for the purpose of this research; a holistic approach of autonomy was privileged (e.g. autonomy cannot be restricted to only one aspect of husbandry management but concerns all issues related to husbandry and whole farm management). Variables were coded from 0 (absence of autonomy) to 3 (highest autonomy) (Table 1). All variables were established with the concept of autonomy in mind (decisions of the farmer and farm independence from economical/sociological/ecological points of view). The presence of several husbandries and agriculture implies that different productions may succeed whatever the climatic conditions and consumers demand. The