Perceptions of genome editing in farm animals by livestock stakeholders

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Abstract

The objective of this study was to better understand the positions of the stakeholders of the livestock sector with respect to the use of genome editing techniques. A qualitative survey by semi-directive interviews was conducted with different actors of the livestock sector. It allowed to establish a typology of stakeholders in five categories (opponent, skeptical, cautious, enthusiastic, convinced) and to characterize the main arguments associated with the position of the different stakeholders.

Introduction

Since the development of the Crispr-Cas9 system (Jinek et al., 2012), genome editing (GnEd) staktools have gained a major place in biological research and the prospects for applications are numerous, in medicine for the treatment of many diseases, medical diagnosis or eradication of disease vectors (Ashmore-Harris and Fruhwirth, 2020), in bioindustry (biofuels - (Lu et al., 2022) or in agriculture. The application of GnEd in agriculture is nevertheless controversial. For some, its use is essential to be able to feed 9 billion people in 2050 and to succeed in the agroecological transition (Fan et al., 2021). For others, there is a risk that genetic engineering is used to perpetuate unsustainable agricultural systems (Jacobsen et al., 2013) and its use involves risks that are not yet fully controlled (Norris et al., 2020). However, the controversy is currently limited to the scientific and professional communities directly concerned.

On the other hand, the status of genome-edited organisms varies around the world. In Europe, they fall within the scope of the regulation on Genetically Modified Organisms (Directive 2001/18/EC) since the July 25, 2018 ruling of the Court of Justice of the European Union. In the USA, the regulatory approach in animals is also very strict, based on the food, drug and cosmetic act. In other American countries (Argentina, Brazil…), GnEd organisms produced by cisgenesis or intragenesis are not considered GMOs. In some European countries (United Kingdom, Norway), which have regulations similar to those of the EU, changes in regulations are being considered. In the EU, the question of regulatory changes is also being raised, at least for plants, following a recent report by the European Commission (Commission, 2021).

In this context (controversy, regulatory uncertainty), it seemed relevant to us to better identify the positions of the various actors in the field of livestock selection with regard to the potential use of genome editing techniques in livestock breeding. To this end, a qualitative survey was carried out by means of semi-directive interviews with people involved in the breeding sector. The objective of this article is to present the main results of this survey.

Materials & Methods

The semi-structured interview is an approach widely used in sociology. It consists of a series of open-ended questions, prepared in advance by the interviewer, which allows the respondents to organize their answers as they wish. It aims to be representative of the diversity of opinions, without any quantitative objective (Delanoue et al., 2018). In the present case, the question grid was completed by cards presenting typical cases of genome editing use (hornless cattle, resistance to PRRS, hypoallergenic milk, myostatin) presented during the interview.

The interviews took place from October 2020 to February 2021. Most of the interviews were conducted by video conference, due to the Covid-19 pandemic. Respondents were mostly alone, but some interviews were conducted with 2 or even 3 respondents. They were recorded once the respondents had given their consent. The average duration of the interviews was 1 hour and 25 minutes. A total of 48 people were interviewed. Their distribution by activity sector is given in Table 1.

Table 1. Distribution by activity sector of the interviews

Activity sector	Number of interviews
Research (livestock and crops)	12
Public authorities	4
Breeding	8
Livestock industry (outside breeding)	7
Retailing	3
Non-governmental organisations (NGO)	14
Total	48

The respondents belonged to four sectors (ruminants, pigs, poultry and aquaculture) and, for some, to the plant sector. Two interviews were withdrawn from the survey because answers were vague an unclear. The final corpus studied was 46 respondents in 36 interviews. The interviews were analyzed by viewing the videos using a standardized analysis grid.

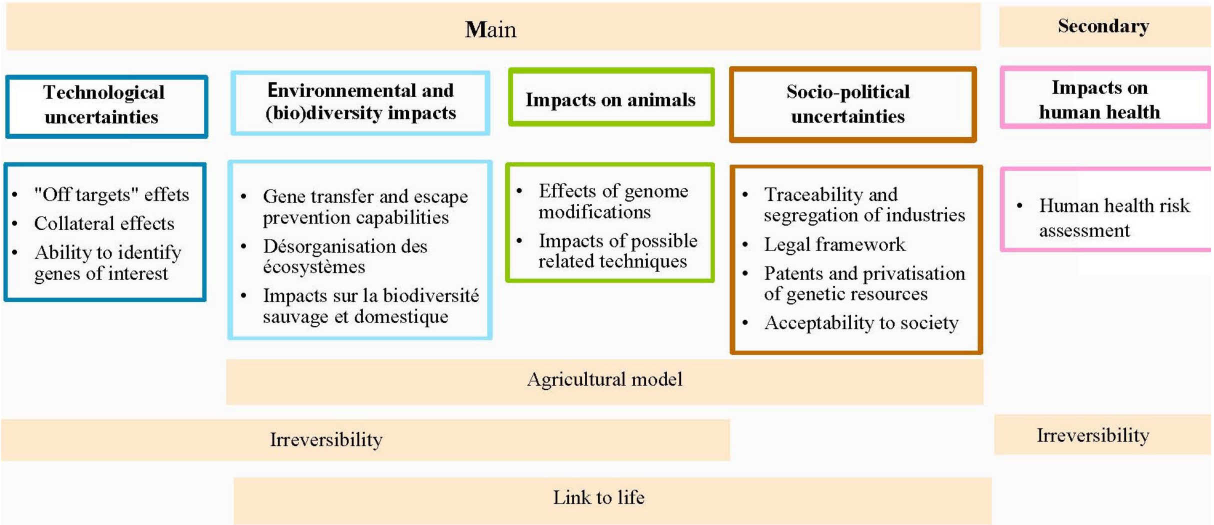
Results and discussion

The analysis of the surveys quickly revealed that knowledge of the subject was still limited to a very narrow sphere (mainly research and breeding sectors), who were familiar with the subject (specialists). The other respondents had varying degrees of knowledge of the subject and were grouped into 3 categories, layman (did not know), novice (superficial knowledge) and expert (followed the subject).

The controversy is built around uncertainties. We have grouped together in the diagram below (Figure 1) the main uncertainties expressed by the respondents. They were linked to the technology, its impact on the environment and/or biodiversity, on the animal and its socio-political impact. An uncertainty related to human health impact was also mentioned by a small number of respondents and was therefore classified as secondary. The uncertainties were linked to the major cross-cutting issues raised almost systematically by the respondents, namely: 1) the type of agricultural model in which GnEd tools is used, 2) the impacts of their use, particularly their irreversible nature, 3) ethical issues (link to living organisms, man's right to modify nature) and ownership of living organisms. The technological uncertainties concerned the mastery of the tool and the maturity of the related scientific knowledge, with references to older techniques and the "Recombinetics" affair (Norris et al., 2020), and fears about collateral effects on animal welfare or the environment.

Once the uncertainties had been identified, we looked to see if a typology of actors could be identified within our sample. As already indicated, one of the first differentiating factors was the level of knowledge of the subject. We also tried to get the respondents to express their position or that of their organization with regard to the use of GnEd (are you in favor or against the use of GnEd in livestock farming?). The individual positions were analyzed, as the structures very rarely had any official or unofficial position on the subject. This analysis made it possible to construct a typology in five categories (see Figure 2).

Figure 1 – Uncertainties at the origin of the controversy on genome editing in livestock



Two categories, located at the ends of the graph, represented the committed actors. They had a good or even very good knowledge of the subject and had a definite position on the use of GnEd. The convinced, who were closely linked to the R&D sector, were in favor of one or more types of use and considered that GnEd was compatible with all farming systems. Opponents often had a long-standing commitment against the use of genetic engineering in agriculture.

The other categories represented the bulk of the respondents (37/46). They expressed a less assertive position, but with differences in viewpoints that made it possible to group them into three categories: the sceptics, the cautious and the enthusiasts. Enthusiasts differed from the convinced in their lack of commitment and in their level of knowledge of the subject, from the specialist researcher who did not wish to get involved in the debate to the layman who saw many possibilities linked to the use of GnEd. Many in the agricultural sector hoped that GnEd will be an additional solution to the challenges facing their industry. The sceptics included respondents who were very skeptical about the use of GnEd, expressing doubts about the technological interest of GnEd and the possibility of using these tools in animal welfare friendly systems. This category included a larger number of NGOs and a researcher specializing in the subject. The cautious were a more difficult category to characterize. It included more actors with little knowledge of the subject and who had often not expressed a clear position on the use of GnEd.

Beyond the controversy over GnEd, the question of the farming system in which these techniques are used was a central issue for many stakeholders. This was often equated with highly intensive and unsustainable systems. The question of their use in more agro-ecological and sustainable systems remained highly debated.

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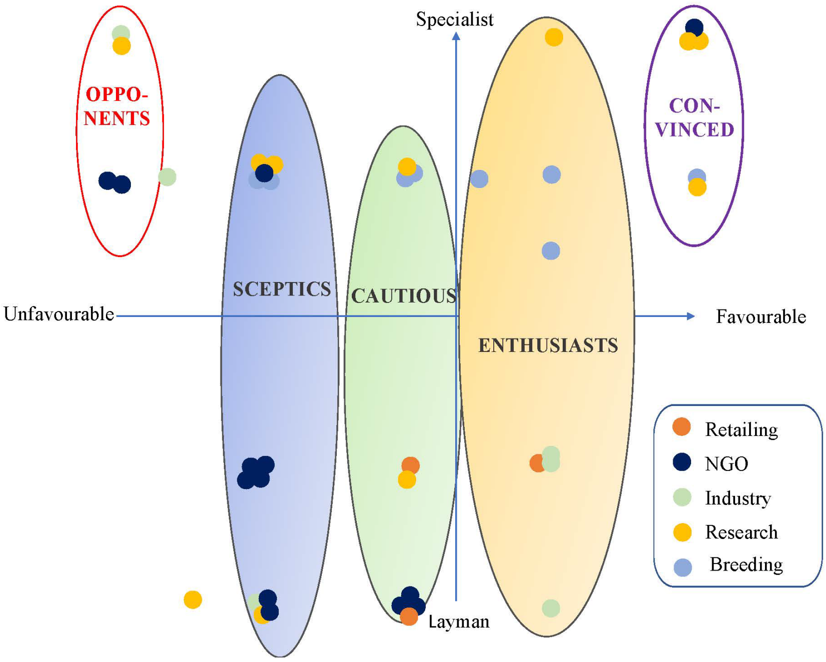
Figure 2 – Typology of actors



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