

# 491. Societal aspects of animal breeding: a bibliometric analysis

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## Abstract

Societal and ethical issues addressed in animal breeding studies from 1990 onwards were examined by means of a bibliometric analysis. Using a specific set of search terms in Scopus, 673 publications of potential interest for societal aspects of animal breeding were found. Subsequent manual selection resulted in 270 relevant studies. Across the period from 1990 to the present, the number of publications addressing societal or ethical aspects of animal breeding, mainly focussing on animal welfare and behaviour or genetic modification, increased from the year 2000 and peaked around 2010. Of the 270 publications, 24% explicitly mentioned ethics, mainly in relation to genetic modification, biotechnology or animal welfare/behaviour. The minority of the publications (32%) were experimental studies. To conclude, only a minor part of publications on animal breeding explicitly address societal issues and, of these, the minority explicitly addresses ethics.

## Introduction

Societal awareness of animal production has increased (Busch and Spiller, 2018), and animal breeding plays an important role in animal production. Animal breeding activities can be a cause for societal, and ethical, concern. Examples are concerns regarding genetic modification or gene editing, such as animal integrity or naturalness (e.g. Eriksson *et al.* (2018)), and regarding the impact of genetics, or the choices made by breeders, on animal welfare (e.g. Fernyhough *et al.* (2020)). To obtain a broader overview of the degree to which societal and ethical concerns in relation to animal breeding are addressed in the animal breeding literature, we here performed a bibliometric analysis in which we assessed general trends in publications on societal aspects of animal breeding, regarding the species and main societal or ethical issues under study. We specifically focussed on dairy cattle, pigs, and chickens, as these represent the major food producing sectors.

## Materials & methods

**Bibliometric approach.** Scopus was used as the data source for this bibliometric analysis. The selection was performed in three steps (Table 1). The first step comprised the combination of a set of key words regarding: (1) animal; (2) breeding; (3) society; and (4) concerns. In the following two steps, false positive hits were excluded. To reduce subjectivity in the selection process, at least two people decided together which decision should be made in steps 2 and 3.

**Data analysis.** After selection of the final data set of publications, we assessed for each of the publications, based on the title and key words (and when not conclusive, based on the abstract), what topics were examined (Table 2). Moreover, each abstract was analysed for characterisation of the type of study as either 'experimental' (based on an experiment, a data set, simulation study or similar) or 'descriptive' (reviewing literature, reporting from expertise, et cetera), and to assess whether the term ethics was explicitly mentioned ('ethic', with potential prefixes or suffixes) or not.

## Results

In total, 270 papers met all criteria (steps 1, 2 and 3). In total, 86 out of the 270 papers (32%) were experimental studies, with the remainder being mainly overviews, reviews, foresights and state of the

**Table 1.** Workflow and selection criteria used in the bibliometric analysis.

Steps in the workflow	
Step 1: Literature search (n=673)	Automated search in titles, abstracts and key words, in publications from 1990 onwards (search performed on the 3 <sup>rd</sup> of December, 2021). Only publications with at least one of the required search terms for each of the categories below were included: - <i>Animal</i> : animal AND production; animal AND farm*; dairy AND cattle; poultry; pig* - <i>Breeding</i> : breeding AND selection; genetic AND selection; breeding AND genetic - <i>Society or ethics</i> : soci*; public; ethic*; moral* - <i>Concerns or discussion forms</i> : concern*; issue*; problem*; dilemma*; question*; demand*; worry; worries; debate; discourse; discussion
Step 2: Selection based on titles (n=400)	Manually excluding titles not meeting the criteria, mainly excluding publications on species outside the scope of this study (for example pigeons and guinea pigs, due to the term pig*)
Step 3: Selection based on animal breeding aspect (n=270)	Manually excluding publications that did not have animal breeding or genetic engineering in the species of interest as a topic of focus, based on the title, key words and abstract

**Table 2.** Structuring of topics examined in the publications.

Species under study	What societal or ethical issue is explicitly mentioned?	
	Animal (trait) related	Methodology related
Chickens	Animal health	Animal genetic resource management
Pigs	Animal welfare/behaviour	Biotechnology
Dairy cattle	Environment	Breeding goal definition
Across species	Food safety/security	Genetic modification
	Heat stress	General methods
	Meat quality	
	Multiple	
	Resilience/robustness	

art reports. The topics that were studied differed per species (Table 3). For chickens, the vast majority of publications focused on animal welfare and behaviour, while for pigs many studies focused on meat quality, besides animal welfare and behaviour. For cattle, aside from animal welfare and behaviour, many studies focussed on animal health. For the across-species papers, the majority focused on genetic modification. Out of the 270 publications, 65 (24%) mentioned ethics explicitly, resulting in 90 species-topic combinations that included ethics. Most ethics-mentioning papers were related to biotechnology, genetic modification or animal welfare and behaviour (Table 4).

The number of publications on societal or ethical aspects of animal breeding appears to start increasing around 2000, peaking in 2010 (Figure 1). Although this increase was visible for all three species, the topics that were discussed were different for the different species, with mostly trait-related publications for chickens and pigs, and more methodology-related papers for across species studies (Figure 1).

## Discussion

In this study, we aimed to provide an overview of societal and ethical concerns that are raised in relation to animal breeding, using a bibliometric approach. Methodology-wise, it became clear that the specificity of the search string was low. After applying the manual exclusion steps in our initial search results, only 40% of the publications remained, highlighting the importance of manual selection steps in bibliometric analyses. The analysis revealed that a small number of topics received substantially more attention than others.

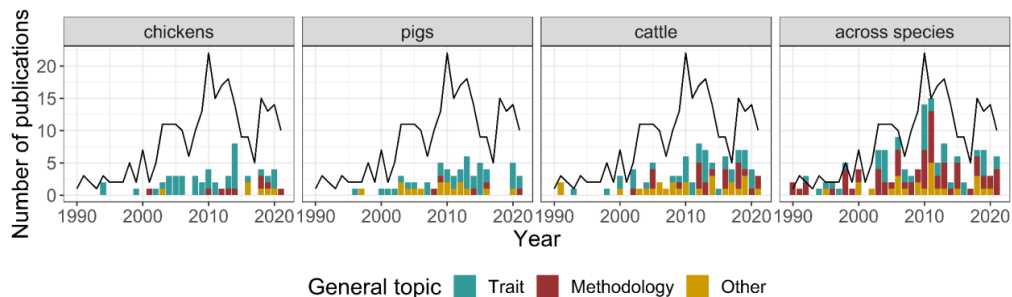
**Table 3.** Number of publications addressing specific topics by species. Publications addressing multiple topics or multiple of our key species (chickens, pigs and/or dairy cattle) are included multiple times, resulting in n=335. AGRM = animal genetic resource management.

Topic under study		Chickens	Pigs	Dairy cattle	Across species
Animal (trait) related	Animal health	3	5	12	9
	Animal welfare/behaviour	26	15	13	20
	Environment	0	1	4	5
	Food safety/security	2	1	6	3
	Heat stress	1	1	1	0
	Meat quality	1	11	0	1
	Multiple	4	2	2	4
	Resilience/robustness	2	1	1	2
Methodology related	AGRM	2	3	5	14
	Biotechnology	1	0	1	14
	Breeding goal definition	1	0	5	4
	Genetic modification	4	1	7	27
	General methods	1	1	5	7
Other	Other	6	16	26	25

**Table 4.** Publications explicitly mentioning ethics per species and topic, in percentages of the total number of publications mentioning ethics. Publications addressing multiple topics or multiple of our key species (chickens, pigs and/or dairy cattle) are included multiple times, resulting in n=90. AGRM = animal genetic resource management.

Topic under study		Chickens	Pigs	Dairy cattle	Across species
Animal (trait) related	Animal health	0%	1%	2%	2%
	Animal welfare/behaviour	7%	7%	6%	16%
	Environment	0%	1%	2%	2%
	Food safety/security	0%	0%	1%	0%
	Heat stress	0%	0%	0%	0%
	Meat quality	0%	3%	0%	0%
	Multiple	1%	0%	0%	0%
	Resilience/robustness	2%	0%	0%	1%
Methodology related	AGRM	0%	0%	0%	0%
	Biotechnology	1%	0%	1%	8%
	Breeding goal definition	0%	0%	0%	2%
	Genetic modification	2%	1%	3%	17%
	General methods	0%	0%	0%	1%
Other	Other	0%	3%	1%	4%

Unsurprisingly, animal welfare and behaviour, and genetic modification, were commonly addressed, also within the subset of studies that explicitly mentioned ethics. However, there were differences between species in what topics were mainly studied. This raises the question why, besides differences in the physiology or use of the animals, some topics are potentially considered of greater societal relevance in one species than in another. Future work examining the publications in detail, that is, (a selection of) the publications will



**Figure 1.** Number of publications on the different general topics and species. The black line represents the total number of publications by year ( $n=270$ ), whereas the bars represent, per species, the number of studies focussing on certain general topics. Publications addressing multiple topics or multiple species categories are included multiple times, resulting in  $n=335$  for the bar graphs.

be fully read, can possibly provide insight into the context in which the societal issues are raised and the reasoning behind the choice of topic. Even though the number of studies that address societal aspects of animal breeding increased after the year 2000, it appears that only a small proportion of the publications on animal breeding do so. A search for animal breeding studies on our species of interest from 1990 onwards, without the societal aspects constraint, resulted in approximately 24,500 publications (results not shown), of which the selection in this study forms only about 1%. Thus, only few publications on animal breeding address societal issues explicitly and, of these, the minority explicitly addresses ethics, mainly focussing on only a small subset of topics.

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