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Organic-PLUS

Deliverable 4.1, Current use and legal status of livestock contentious inputs

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Authors:

Massimo De Marchi, Carmen L. Manuelian, Federico Righi, Giulio Grandi, Sara Burbi, Mauro Penasa, Rosann Johanssen

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1. Summary

The organic livestock sector in the European Union has been experiencing a fast growth in recent years. The most important species reared organically, with the exception of poultry which is by far the greatest one, are sheep (42%) and cattle (34%), followed by pigs (9%) and goats (7%). The largest producer of organic cattle is Germany. Austria is the one with the greatest number of organic dairy cows. Organic pig production is mainly in Denmark and that of organic poultry in France. Organic sheep production is mainly in the United Kingdom, and goat organic production is mainly located in Greece.

Organic production and labelling of organic products in the European Union are regulated by the Regulation (EU) 2018/848 of May 30, 2018, and although the principles for organic farming seem easy to follow, the regulation is comprised of several exceptions since sometimes a compromise has to be taken to ensure animal health and welfare. To help in fully achieve the principles of organic livestock farming, effective alternatives for the use of synthetic vitamins, anti-infective and immune-stimulators, and bedding materials have to be examined and developed.

The lack of the availability of statistical information about the use of synthetic vitamins, antibiotics, antiparasitics and conventional bedding materials (straw) supports the need for conducting a survey among organic livestock farmers to get a more accurate picture of the use of these contentious inputs in the organic livestock sector.

A bibliometric review revealed that 306 articles have been published focusing on organic livestock farming since 1993. The country with most papers published in this area is Germany with 50 articles, followed by Denmark with 29 articles. Within the top 10 authors' keywords, only the term 'cattle' appeared as an indicator of the species studied. None of the other species farmed organically was used as a keyword within the 10 most used keywords. Only about 60% of the scientific papers has been published in journals of the 1st and 2nd quartile of the relevant subject area, which suggests the need for offering high-quality research on that topic.

A literature review on potential plant alternatives to the use of synthetic vitamins, antibiotics and antiparasitics is being conducted to support the further activities within the Organic-PLUS project, notably the selection of components to be tested in in-vitro studies.

In order to compare the academic production and the degree of interest on the "contentious inputs" theme in organic livestock farming with the farmers perception and understanding of these issues and how they face them, an on-line questionnaire comprised of 36 questions divided into 6 sections has been developed. The same questionnaire should allow to gather information about the current contentious issues, the use of alternative allopathic products (vitamins, antibiotics and antiparasitics) and bedding materials across the EU and bordering countries. The questionnaire has been developed in English and translated to 2 languages to carry-out a multi-country analysis including Denmark, France, Germany, Greece, Italy, Norway, Poland, Spain, Sweden, United Kingdom and Turkey. The questionnaire in English, Italian and Spanish has been validated by a pilot study including 3 farms (one in each country). The target population of the survey is the one of farmers following organic livestock production principles in those countries that will receive the questionnaire by e-mail or will be contacted by telephone or in person, with a maximum of 4 contacts.

2. Introduction

Organic production and labelling of organic products in the European Union are regulated by the Regulation (EU) 2018/848 of 30 May 2018, where organic production is defined as "the use, including during the conversion period […], of production methods that comply with this Regulation at all stages of production, preparation and distribution" (Regulation (EU)2018/848).

Livestock organic production shall comply with the following principles:

- use of animal breeds with a high degree of genetic diversity and capacity to adapt to local conditions, along with considering their breeding value, longevity, vitality and resistance to disease or health problems;
- livestock production site-adapted and land-related;
- animal husbandry to enhance the immune system and natural defence against diseases;
- regular exercise and access to open air areas and pastures;
- feed composed of organic feed from agricultural ingredients of organic production and natural non-agricultural substances;
- products obtained from animals raised on organic since birth or hatching.

The regulation allows to rear in the same holding animals in organic and in-conversion, and in non-organic if they are clearly split and effectively separated, and, in the case of non-organic livestock, if it involves different species than the ones in organic.

Regarding feeding, even though minerals, trace elements, vitamins or provitamins have to be of natural origin, products of non-natural origin can be used if no alternatives are available. Moreover, non-organic spices, herbs and molasses can be used when they are produced or prepared without chemical solvents and limited to 1% of the feed ration (annual percentage in feed dry matter).

Regarding health care, chemically synthesised allopathic veterinary medicinal products are prohibited for preventive treatment, along with substances to promote growth or production and hormones or similar to control reproduction; however, immunological veterinary medicinal products may be used. The first option for the veterinary treatment should be phytotherapeutic and homeopathic products, as well as minerals and nutritional additives allowed for organic production. However, when chemically synthesised allopathic medical products (including antibiotics) are prescribed, the withdrawal period should be twice of the withdrawal period adopted in conventional farming and at least 48 hours. Moreover, if an animal receives more than 3 courses of treatment with those chemically synthesised allopathic meds within 12 months, or more than 1 course if the productive lifecycle is <1 year, the treated animal (and their products) cannot longer be considered organic and should undergo a conversion period in order to be considered organic again.

Therefore, even if the principles for organic farming seem easy to follow, several exceptions result and sometimes a compromise has to be taken to ensure animal health and welfare. To help achieve the principles of organic livestock farming, effective alternatives for the use of synthetic vitamins, anti-infective and immune-stimulators, and bedding materials have to be examined and developed.

The Work Package 4- Livestock (WP4) of the Organic Plus European project will investigate the use of contentious inputs in organic livestock farming sector, carrying out a survey among livestock organic farmers and a review of synthetic vitamins, antimicrobial and bedding materials alternatives for organic production, and provide scientific evidence of their efficiency and effect on animal derived products. The countries and research centres involved in WP4 are represented in Figure 1.

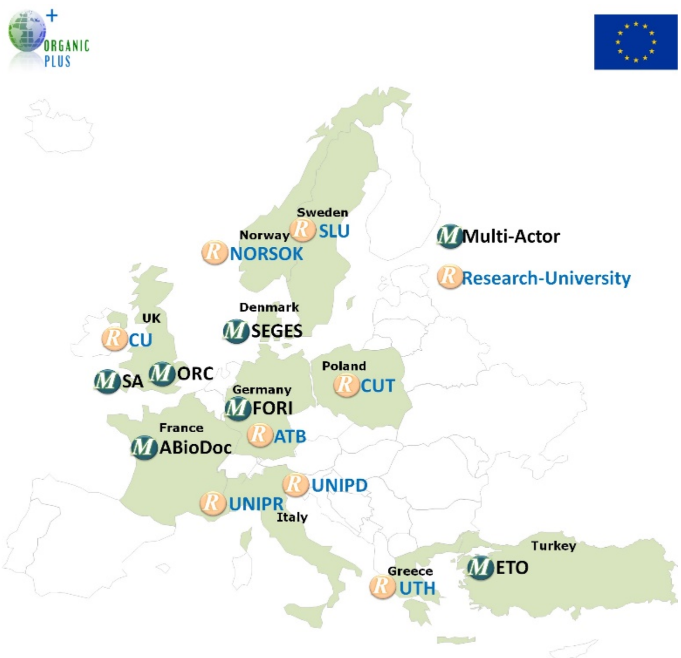

Figure 1. Map of participating countries in the "mapping task" and partners involved in WP4-LIVESTOCK.

The aims of this report are (i) to summarize the most relevant statistics on organic livestock farming in the EU available at Eurostat in terms of amount of animals reared organically by species and countries; (ii) to highlight the lack of scientific papers on livestock organic farming and detect the most productive countries in terms of published papers; (iii) to set the foundations for the literature review of potential plant alternatives to the use of synthetic vitamins, antibiotics and antiparasitics in organic livestock farming; and (iv) to develop and validate a questionnaire for organic livestock farmers to detect contentious inputs in organic livestock farming across Europe.

2.1 Main statistical findings for organic livestock farming in the EU

The organic sector in the European Union has been experiencing a fast growth in recent years. Data registered at Eurostat in 2015 (Table 1) indicates that the most important species reared organically, with the exception of poultry, are sheep (42%) and cattle (34%), followed by pigs (9%) and goats (7%) (European Commission, 2016).

Table 1. Evolution of animals (heads) under organic production in the EU-28, 2015 (European Commission, 2016).

EU	2000	2001	2002	2003	2004	2005	2006	2007
Cattle	228 202	320 936	500 637	766 001	1 323 182	1 311 335	1 564 707	1 515 877
of which Dairy cows	94 088	140 938	178 537	298 931	389 275	381 622	338 277	265 196
Pigs	113 693	123 957	220 163	234 362	295 506	412 514	445 515	498 356
Sheep	45 847	600 504	1 572 984	1 423 068	1 815 166	2 249 195	2 588 599	2 907 096
Goats	18 693	20 160	149 987	318 984	348 333	470 629	497 847	634 506
Poultry	1 561 078	11 607 083	12 157 766	6 547 160	8 599 132	8 695 705	10 868 633	10 048 873
of which Laying hens	947 842	3 237 882	3 614 725	4 342 233	5 146 327	5 893 347	6 879 479	5 820 947

EU	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	1 905 669	2 077 374	2 157 205	2 611 544	3 322 749	3 552 014	3 630 385	3 709 233
of which Dairy cows	453 583	670 233	607 157	719 408	714 007	749 269	792 350	864 142
Pigs	787 277	767 149	697 125	855 535	864 685	923 595	915 065	978 559
Sheep	3 718 133	3 229 511	3 147 534	3 957 496	4 443 421	4 332 667	4 366 042	4 485 075
Goats	489 896	579 945	425 709	480 139	664 629	732 519	739 215	718 094
Poultry	14 998 166	13 489 731	15 113 326	26 185 341	23 582 122	29 125 765	33 625 436	31 667 375
of which Laying hens	8 197 090	6 334 479	9 837 409	9 768 111	11 768 628	11 299 152	12 490 768	13 856 636

Pigs showed the lowest shares probably due to the difficulties to obtain organic feeds (i.e. internal supply and organically certified external supply), and the resulting high price for consumers. The greatest shares refer to ruminants (Lernoud and Willer, 2017). Between 2007 and 2015, the greatest increase was observed in the poultry sector (+108%), partly to the high demand for eggs, followed by beef and dairy cattle (+58%), pigs (+46%), sheep (+35%) and goats (+15%) (Lernoud and Willer, 2017). Moreover, organic milk production has almost doubled since 2007, from 2.7 to 4.7 million metric tons (Lernoud and Willer, 2017).

As shown in Figure 2, referring to the EU-28 in 2016, Austria had the largest shares of 'sheep and goats' (34.3% of total sheep and goat production) and pig (2.32%) organic production and the second greatest share of organic bovines (20.7%) after Latvia (22%) (Eurostat, 2017).

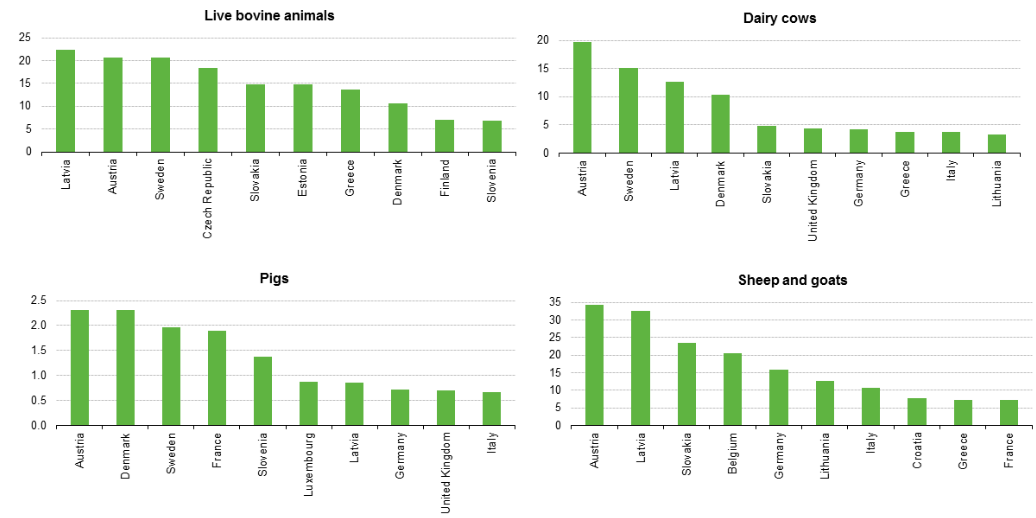

Figure 2. Share of organic livestock in all livestock by country (% of number of heads). Retrieved from Eurostat (2017).

The document elaborated by the European Commission on organic production (European Commission, 2016) reported that the largest producers of organic cattle are Germany, France, Austria, the United Kingdom, Sweden, Italy, the Czech Republic and Spain. Moreover, Austria (171 000 heads), Germany (150 000 heads), the United Kingdom (127 000 heads) and France (113 000 heads) are the ones with the greatest number of organic dairy cows. Organic pig production is mainly in Denmark (260 510 heads), France (219 812 heads) and Germany (190

471 heads). The organic pig sector still holds a very minor share in the European pig market. Ovine organic production is mainly in the United Kingdom (868 554 heads), Italy (785 170 heads), Greece (609 616 heads), Spain (600 000 heads) and France (450 000 heads). Greek and Italian ovine production is oriented towards cheese manufacturing, while the United Kingdom and Spain are focused on meat production. Goat organic production is concentrated in Greece (344 479 heads), Italy (100 852 heads), France (72 542 heads) and Spain (69 448 heads). The organic poultry sector has registered a 14% yearly increase between 2005 and 2015 and is currently led by France with >13 million animals, of which about 30% are laying hens.

In terms of demographics, it is important to notice that the age distribution of farm managers between organic and non-organic farms in Europe is quite different, being the former younger than the latter (Figure 3). This could suggest that a greater number of organic farmers could be able to have access to the internet and participate in an online survey. This will be reviewed later with the support of the demographic data that will be collected during the survey.

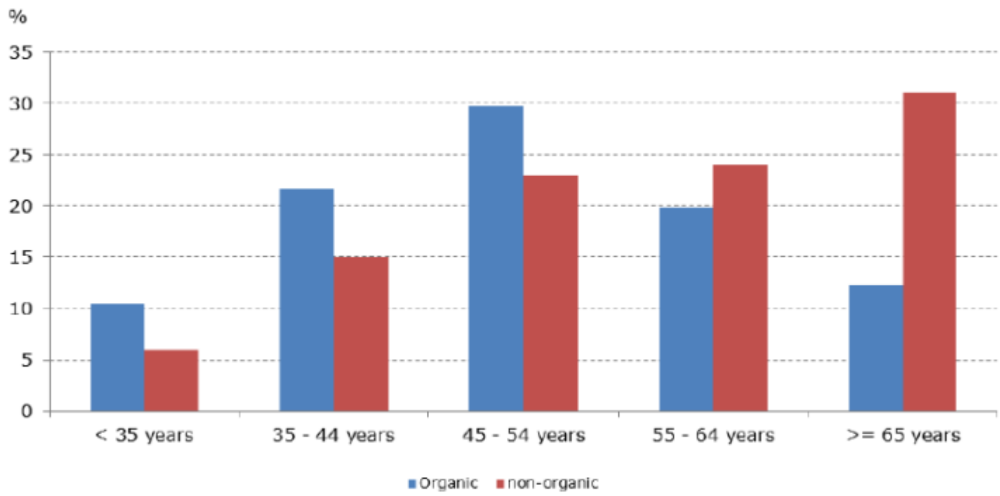

Figure 3. Comparison of age distribution of farm managers in the organic and non-organic sector in the EU-28 in 2013 (European Commission, 2016)

2.2 Norway organic livestock farming situation

A total of 488,058 animals were registered as organic in 2017, which is the 31% of the animal production in Norway (Table 2). Laying hens was the animal production with the greatest percentage of animals reared organically (6.1%), followed by beef cows (5.0%). On the other hand, pigs, broilers, and other poultry productions showed the lowest percentage. Those data agreed with the European statistics reported in 2.1.

There are no registrations about the use of synthetic vitamins, antibiotics, antiparasitics and conventional bedding materials (straw) in organic livestock production in Norway that is specific for organic production.

Regarding antibiotics, Debio (Bjørkelangen, Norway) did a survey in 2017 about practice in organic cattle production (Debio, 2017). They got answers from 229 producers where 109 of them had dairy cows and 120 had beef cattle. Among other things, Debio asked if the producers had used antibiotics in treatment the last calendar year: 115 answered yes and 108 answered no. They also asked if the producers had used any homeopathic medicines in treatment the last calendar year: 22 answered yes and 194 answered no. Norsøk (Tingvoll, Norway) asked the organic broiler chicken producers in Norway about use of antibiotics first for 2012-2015 in 2016 (Sørheim, 2016), and then for 2016-2017 in 2018 (data not published). There are only four producers of organic broiler chicken in Norway and only one of them used antibiotics one time between 2012 and 2017. Any of these studies covered the use of antiparasitics for organic livestock in Norway.

Table 2. Number of organic livestock per species in Norway 2017, and percent of organic livestock of the total number of livestock.

Livestock	Organic number 2017	% organic of total 2017
Dairy cows	8340	3.8
Beef cows	4141	5.0
Other cattle	17 450	3.1
Cattle in total	29 931	3.5
Pigs	3474	0.6
Sheep	49 237	4.4
Goats	1544	2.6
Laying hens	264 146	6.1
Broiler chickens	98 646	0.2
Ducks, geese, turkeys	11 149	1.8
Total	488 058	31.1

The production of organic grains revealed that probably most of the organic farmers that use straw as bedding for animals have to use mostly conventional straw, because there is very little production of organic grains in Norway and therefor very little access to organic straw from organic grain production. Only 1.2% of the total Norwegian grain production in 2016 was organic (Bye et al., 2017).

In Norway only Felleskjøpet (Oslo, Norway) produces organic concentrates for cattle, sheep, pigs and poultry. Organic farmers in Norway who buy and use organic concentrates buy these from them. They use the same types and amounts of synthetic vitamins in organic concentrates as they use in conventional concentrates. They do not add “natural vitamins” since this is known to be exposed to oxidation by mixing with minerals and heat treatment (as is the case for the concentrate). For example, the concentration of synthetic vitamins in concentrate for dairy cows, both the organic and the conventional, per kg concentrate is vitamin A: 5000 IE, vitamin D: 2000 IE, and vitamin E: 80 mg. Other than concentrates, there are several supplementary feed or vitamin- and mineral mixtures that are allowed for organic livestock in Norway. These mixtures also usually contain synthetic vitamins. And they have different kinds of mineral stones with vitamins.

The lack of statistical information about the use of synthetic vitamins, antibiotics, antiparasitics and conventional bedding materials (straw) exposed in this section regarding Norway, applies also for all the other countries involved in the Organic Plus project. That supports the need of conducting a survey among organic livestock farmers to get a right picture of the use of these contentious inputs for organic livestock.

3. Review of organic livestock farming research situation and potential alternatives to the use of antibiotics, antiparasitics and synthetic vitamins

After a bibliometric review, three literature reviews have been started to detect possible alternatives on vitamins, antibiotics and antiparasitics plant products to be used on organic livestock farming. From the literature evidence, some of the plant products will be selected to test their effects on animal health and performance, as well as on the quality of the animal products. The following points explain the procedure that will be used. Some preliminary summary documents for those reviews are shown in Annex I.

3.1 Bibliometric analysis of organic livestock farming research

Note: The bibliometric analysis has been published in the peer-reviewed open-access journal 'Animals' (IF: 1.832 (2018); 1st Quartile). Online early access to the document is available at: https://www.mdpi.com/2076-2615/10/4/618 [Accessed: 8 April 2020]. The reference is:

Manuelian, C.L.; Penasa, M.; da Costa, L.; Burbi, S.; Righi, F.; De Marchi, M. Organic Livestock Production: A Bibliometric Review. *Animals* **2020**, 10, 618; https://doi.org/10.3390/ani10040618.

The pdf document of the published bibliometric review is attached below. Figures and table numbers follow the original ones that are indicated in the published document.

animals

MDPI

Review

Organic Livestock Production: A Bibliometric Review

Carmen L. Manuelian [1], Mauro Penasa [1], Luciana da Costa [2], Sara Burbi [3], Federico Righi [4] and Massimo De Marchi [1,*]

1 Department of Agronomy, Food, Natural resources, Animals and Environment, University of Padova, Viale dell'Università 16, 35020 Legnaro (PD), Italy; carmenloreto.manuelianfuste@unipd.it (C.L.M); mauro.penasa@unipd.it (M.P.)
2 Department of Veterinary Preventive Medicine, The Ohio State University, Columbus, OH 43210, USA; da-costa.2@osu.edu
3 Centre for Agroecology, Water and Resilience, Coventry University, Ryton Gardens, Wolston Lane, Ryton-on-Dunsmore CV8 3LG, UK; sara.burbi@coventry.ac.uk
4 Department of Veterinary Science, University of Parma, Via del Taglio 10, 43126 Parma, Italy; federico.righi@unipr.it
* Correspondence: massimo.demarchi@unipd.it.

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Simple Summary: The organic livestock sector has been experiencing a fast growth and, lately, organic farming has become a trending topic. However, the scientific research behind the organic livestock sector is not often clear. A bibliometric review is the first approach to a topic because it helps to provide an overview of the research conducted on the topic itself. It identifies the countries involved in organic livestock production research and the scientific interaction between countries and authors, and it allows to map the keywords of the published papers. These are all key aspects to bear in mind when starting a new research area or writing a research proposal. The bibliometric analysis conducted here includes peer-reviewed documents to guarantee, from a scientific point of view, the quality of the selected studies. In this paper, we present a new technique to analyze the literature from a bibliometric point of view, and the results and conclusions extracted from the investigated topic (i.e., organic livestock production).

Abstract: Due to the increasing interest in organic farming, an overview of this research area is provided through a bibliometric analysis conducted between April and May 2019. A total of 320 documents were published up until 2018 on organic livestock farming, with an annual growth rate of 9.33% and a clear increase since 2005; 268 documents have been published in 111 journals. Germany is the country with the largest number of published papers (56 documents). Authors' top keywords (excluding keywords used for running the search) included: animal welfare (29 times), animal health (22 times), cattle (15 times), grazing (10 times), and sheep (10 times). This could indicate that more research has been done on cattle because of the importance of this species in Germany. Moreover, the prevalence of the terms 'animal welfare' and 'animal health' may indicate that the research on organic livestock production has been focused on these two areas. The bibliometric analysis indicates that: i) countries focused the organic livestock production research on their main production, and ii) more research in species other than cattle and sheep is needed.

Keywords: bibliometrix R; cattle; organic; poultry; sheep

1. Introduction

Lately organic farming has become a trending topic and research on it has increased to support the interest of consumers in organic products. An interesting approach to have an overview of the research developed on organic livestock farming is to conduct a bibliometric review which helps to identify the countries that have worked more on this topic, the most relevant authors in the field, and their connections, among others. Bibliometrics, also known as scientometrics, is based on the concept that scientific literature mirrors scientific activity because publishing papers is an important goal for the scientific community [1]. Thus, bibliometric analysis provides metrics to assess scientific interests, productivity, and impact, starting from the count of published documents and their frequency of citation [2,3]. However, it is not possible to assume a linear relationship between scientific quality and citation counts, which is the main disadvantage of that methodology [3,4]. Moreover, citations from articles to articles or from countries to countries are indicators of intellectual linkages between authors and organizations [2,3]. Co-citations analyses follow the principle that 'the more researchers who cite the same two publications, the bigger the probability that the double citation is not a chance event' [4], which highlights the relevance of the two references on a specific research area. Similarly, co-occurrence of keywords can be mapped and interpreted. Thus, bibliometric analysis helps understand patterns in a specific field and allows to analyze structure and dynamics. In addition, bibliometric analysis is a useful tool when planning a proposal because it highlights research hotspots and detects trends [3].

Recently, an R package (bibliometrix) was developed to easily extract the main information from a bibliometric point of view. Based on the R philosophy, detailed information of the package is available elsewhere [5]. Four main bibliographic databases (Web of Science, Scopus, Cochrane Database of Systematic Reviews, and Pubmed) can be used to extract the information to run the bibliometrix package. The Cochrane Database of Systematic Reviews focuses on systematic reviews in health care while Pubmed focuses on biomedical literature. Thus, for the topic proposed in the present paper, Web of Science and Scopus were the most adequate databases. Both databases may introduce biases in favor of natural sciences and engineering, biomedical research areas, and English-language journals [6]. The coverage of journals related to natural sciences and engineering is quite similar between both Web of Science and Scopus [6].

Therefore, the aim of this paper is to perform a bibliometric review on organic livestock farming to detect the most relevant countries, authors, cited papers, keywords, document sources, and their collaboration and co-occurrence networks.

2. Materials and Methods

2.1. Description of the Procedures Used to Select and Analyse Documents

The literature search was conducted within peer-reviewed journals as a guarantee of the quality of the selected documents. Moreover, based on preliminary search and results, we decided to keep only the information provided by Web of Science Core Collection using Web of Science v.5.32. Web of Science Core Collection fully covers 21,000 peer-reviewed, high-quality journals published worldwide in over 250 sciences, social sciences, and humanities disciplines [7]. The search in Web of Science Core Collection includes the following citations indexes: science citation index expanded (from 1985 to present), social sciences citation index (from 1985 to present), arts and humanities citations index (from 1985 to present), conference proceedings citation index-science (from 1990 to present), conference proceedings citation index-social science and humanities (from 1990 to present), and emerging sources citation index (from 2015 to present).

Keywords combinations used were: Organic + Livestock + Farming and Organic + Husbandry + Animal. We decided to minimize the keywords used to perform the search to avoid interfering with subsequent keyword analysis. The search considered the article title, abstract, authors' keywords, and keywords Plus®. Keywords Plus® are words or phrases extracted from titles of the references cited in an article using a special algorithm developed for Clarivate Analytics [8]. The search started in April 2019 and ended on 2 May 2019 and considered a timespan for the analysis that ranged from 1985 (first year available in Web of Science Core Collection) to 2018. The 'Organic + Livestock + Farming' keywords combination returned 1278 documents, and the 'Organic + Husbandry + Animal' combination retrieved 346 documents. Thereafter, a selection based on the title and abstract was conducted to include only papers that dealt with organic livestock. Although some documents appeared in both searches, by creating a single 'Marked list', documents selected in one search were not allowed to be selected twice. Information regarding the documents in the marked list were exported in a BibTex file for subsequent analysis.

The analysis was carried out with the package 'bibliometrix' v. 2.2.0 [9] for R v. 3.6 software [10]. Briefly, the package 'bibliometrix' creates a database with all the information extracted (title, authors, keywords, etc.) for its analysis. It analyzes what is known as the bibliographic attributes, by creating a column for each field tag, and network structure. More updated and detailed information regarding the script is available elsewhere [11]. In addition, the last published journal impact factor (JIF; 2018) for each journal was retrieved from Journal Citation Reports provided by Clarivate Analytics and assigned to each journal in the dataset. In case the journal no longer exists, the JIF corresponds to the last year of publication of the journal. Each journal was assigned to a quartile; if a journal belonged to two or more subject categories, the category with the best quartile for the journal was considered.

2.2. Limitations of the Study

The criteria and the approach adopted in the present study may have some potential limitations:

- a search conducted for a bibliometric analysis does not allow to read and analyze the full paper because of the large number of documents selected;
- the search focused on peer-reviewed documents as a guarantee of the quality of the documents themselves, but this could have excluded some relevant not peer-reviewed research publications;
- only one database was used, which may result in the loss of some information. Nevertheless, the use of a single database avoids removing false duplicates when merging the selected documents from more than one database, as well as inconsistent information such as total citations of a document which may differ, albeit slightly, among different databases;
- Web of Science favors English-language journals;
- only documents with the abstract in English were included;
- fluctuations of JIF across years are greater than the ones observed for the quartile.

3. Results and Discussion

3.1. Trend of Organic Livestock Production Research

Although the first year available in Web of Science Core Collection was 1985, the first document that accomplished the criteria of the present review was published in 1993. Therefore, the timespan of information reported in figures and tables ranged from 1993 to 2018. A total of 320 papers complied with the selection criteria. The compound annual growth rate during that period was 9.33%, with a clear increasing trend in the last years (Figure 1). It is assumed that the counts of published articles are indicative of scientific activity [2].

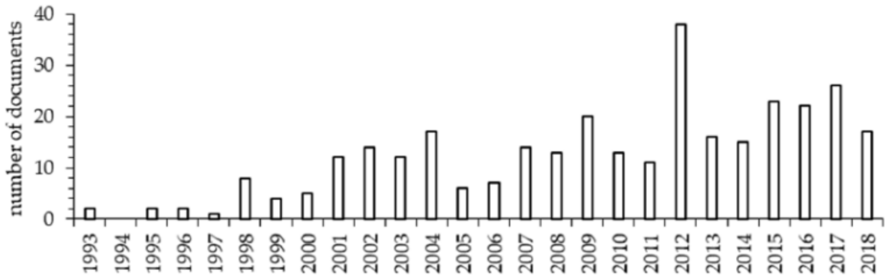


Figure 1. Number of documents published on organic livestock farming from 1993 to 2018 retrieved from Web of Science Core Collection using the following keyword combinations: Organic + Livestock + Farming and Organic + Husbandry + Animal.

Another important aspect that reveals the increasing interest of the scientific community to organic livestock production is the number of projects funded by institutions such as the European Commission (EC) and the United States Department of Agriculture (USDA). An overview of the EC funding allocation from 1993 to 2018 is depicted in Figure 2. Data were generated with a search for the keywords 'organic' and 'organic farming' on the Community Research and Development Information Service (CORDIS) and Quality of Life and Management of Living Resources (LIFE) Programme databases. While the EC maintains the Coordination of European Transnational Research in Organic Food and Farming Systems (CORE Organic) initiatives coordinated by Aarhus University (Denmark), which provides a platform for organic-only research, it also increased the number of projects and financial investment in research directly addressing issues of organic production systems. Between 1993 and 2007, the EC co-funded 37 projects on organic farming with a total investment of €57,834,611. The vast majority of the projects, however, focused on several aspects of farming, including organic practices, and only five projects were exclusively on organic livestock farming. Between 2008 and 2019, the EC co-funded 81 projects on organic farming, with a total investment of €166,738,406, and 21 projects specifically addressed organic livestock production. Gradually, the CORE Organic initiatives have become the main point of reference for organic-specific research; two livestock-specific projects were under CORE Organic in 2004, four under CORE Organic II in 2010, three under CORE Organic Plus in 2013, and six under CORE Organic CoFund in 2016. However, in the past decade there has been a growth in funding calls unrelated to CORE Organic initiatives; these calls clearly include requirements and expected impacts for the organic farming sector.

Data generated to create Figure 2 for USA projects targeted keywords 'organic', 'organic livestock', and 'organic farming' on the USDA database from 1998 to 2018. Briefly, the Sustainable Agriculture Research and Education (SARE) program was funded by the USDA program and included research and education grants, as well as professional development and producer grants. The Current Research Information System (CRIS) primarily focuses on National Institute of Food and Agriculture (NIFA), a federal agency within the USDA that supports broad research, education, and extension in agriculture, food, environment, and community programs. The CRIS/NIFA also provides data on researches conducted under other USDA programs such as the Organic Agriculture Research and Extension Initiative (OREI) and Organic Transitions Program (ORG). Similar to Europe, projects funded were invested in a wide range of research from soil health, food safety in organic crop, and transitioning organic livestock to sustainable agricultural production systems.

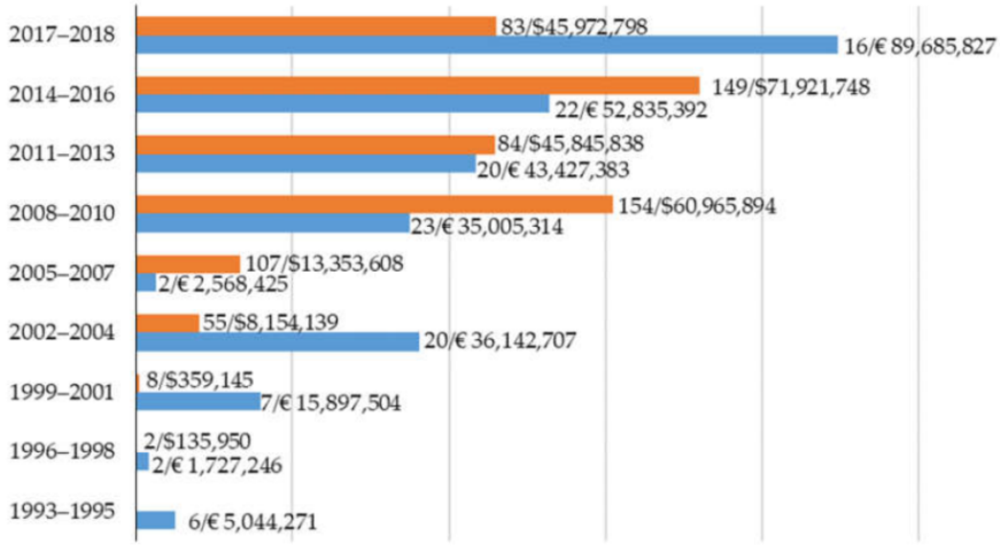


Figure 2. Number of projects and total funding by the European Commission (from 1993 to 2018; blue) and United States Department of Agriculture (from 1998 to 2018; orange) related to organic farming research.

The increase of published papers and funded projects seems to follow the increasing interest for organic production by consumers and markets, including organic livestock production. Indeed, in the European Union organic livestock production increased from 1.97×10^6 animals in 2000 to 41.6×10^6 animals in 2015 [12]. Data from USA-certified organic cows, pigs, and sheep revealed that the number of animals increased from 56×10^3 in 2000 to 492×10^3 in 2011, and the number of poultry increased from 3.16×10^6 to 37.0×10^6 in the same period [13]. The estimated sale of organic fluid milk in the USA increased by 12% from January 2015 (210 million lbs) to January 2018 (236 million lbs; [14]).

3.2. Countries: Publishing Overview and Collaborations

Considering the corresponding author's affiliation, the selected documents were from 44 countries worldwide. Germany was the country with the most scientific papers published on organic livestock farming (56 documents), followed by France (31), and Denmark (30) (Figure 3). This statistic reflects the pioneer countries in organic farming. The organic farming concept started in German-speaking (Germany, Switzerland, etc.) and English-speaking countries (the United Kingdom, USA, etc.) in the early 20th century due to a crisis in agriculture and agricultural science, the appearance of biologically oriented agricultural science, the Life (Germany) and Food (American) Reform movements, and the growing Western awareness of farming cultures of the Far East [15]. In addition, in German-speaking countries, the biodynamic agriculture movement started in 1924 [15]; however, biodynamic agriculture comes from an anthroposophic and spiritual view of the world [15]. At the beginning, the movement was more focused on soil fertility, plant growth, and gardening. After World War II some concepts of the Life Reform were dropped, such as vegetarianism and farming without animals, which helped to spread the organic farming concept to the mainstream of agriculture, society, and politics [15]. During the 1950s, due to the influence of British and German science-based organic farming, France embraced this movement too [15]. Therefore, countries that started the organic farming movement still account for most of the published papers.

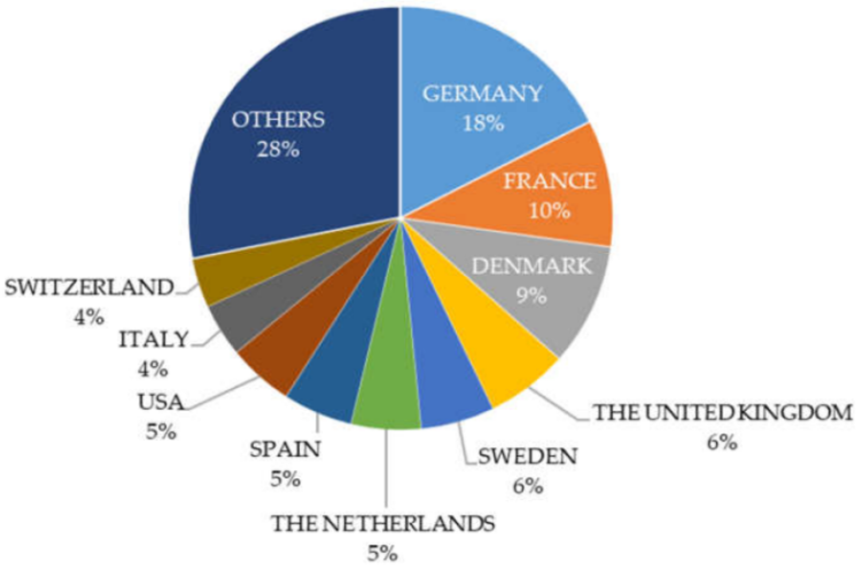


Figure 3. Breakdown of selected papers (*n* = 320) according to the country of the corresponding author. The group 'OTHERS' includes 34 countries. Documents were retrieved from Web of Science Core Collection (timespan 1993 to 2018) using the following keyword combinations: Organic + Livestock + Farming and Organic + Husbandry + Animal.

Considering the corresponding author's country as the country of the paper, the origins of the other co-authors, based on their affiliation, were used to classify papers as single country or multiple country. Most of the documents were single country publications (255 out of 320). For example, when the corresponding author was from Germany, only 12 out of 56 documents were in collaboration with authors from other countries (Figure 4). From the 10 top producing countries, those with the greatest percentage of papers in collaboration with other countries were Sweden (31%) and Switzerland (33%), whereas when the corresponding author was from France, papers only included co-authors from France. The lack of multiple country publications for France is likely related to the fact that most papers were published in journals where the language was French, as will be discussed later.

The most cited countries, within the 320 selected documents, were Germany (751 citations), the United Kingdom (728 citations), and Denmark (596 citations; Figure 4). These results are in line with Figure 3, except for France. Indeed, the fact that the most cited documents were from Germany and the United Kingdom agrees with the long organic farming tradition of these two countries and, probably, is also related to the language in which the documents were written. Documents were mainly in English (267 out of 320), but other languages were found even if the abstract was always available in English. In particular, other languages were German (26 documents), French (20 documents), Dutch, Polish, Spanish (2 documents each), and Portuguese (1 document). The number of documents in French was close to the total number of documents from France (31 documents; Figure 4) and the number of papers published in French journals (18 papers), which supports the hypothesis that the language of the documents influences their chance to be cited. The prevalence of documents in English was expected because the search was conducted among peer-reviewed journals, which are more frequently published in English.

The total number of citations in the United Kingdom was close to that of Germany, even if Germany produced many more documents (Figure 4); this further reinforces that language has an impact on the likelihood that a document is cited. Another interesting result was that at an even number of published papers, the Netherlands had 2.5-fold more citations than Spain (Figure 4). Considering the total number of papers of the 10 top producing countries, the highest average number of citations per article was observed in the United Kingdom (36.40) and the lowest in France (4.97), which again confirms the hypothesis that non-English documents are less cited.

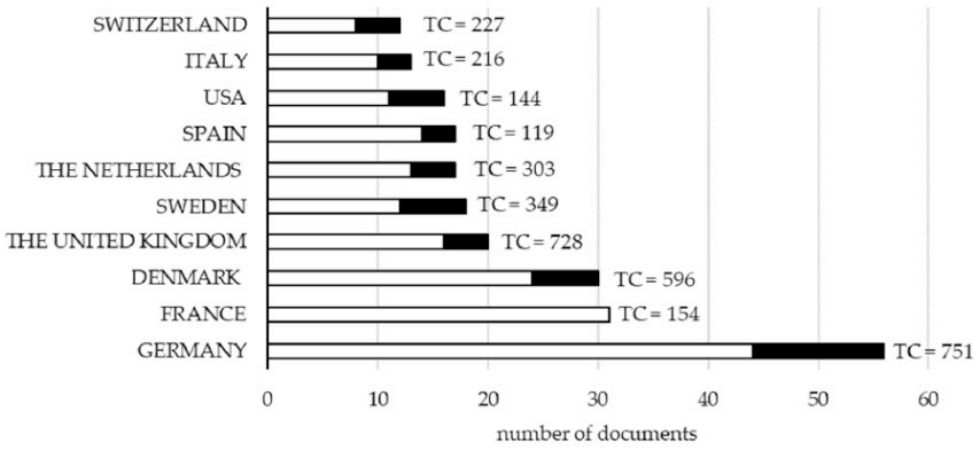
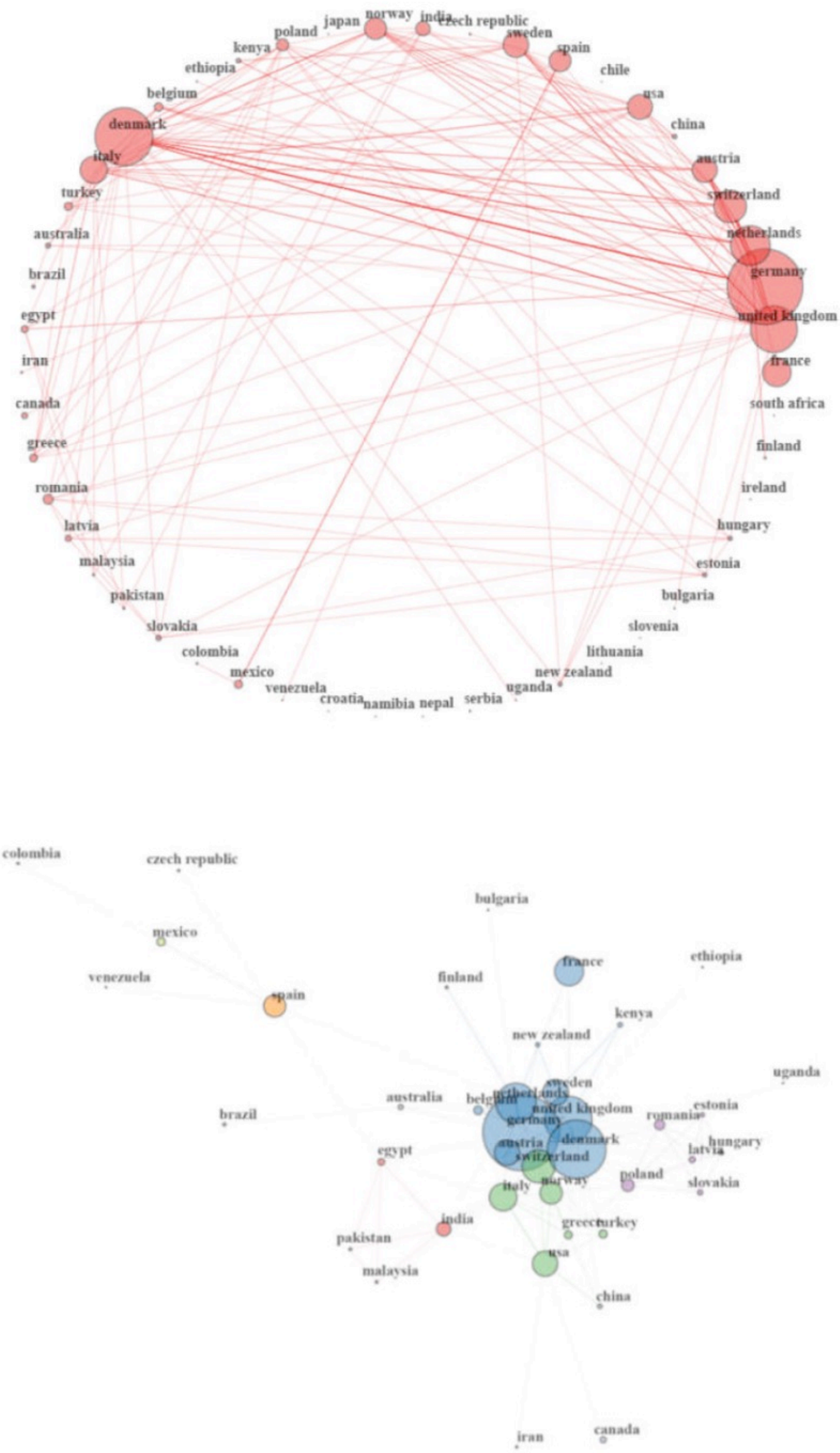


Figure 4. Number of documents published from 1993 to 2018 and total citations (TC) according to the country of the corresponding author (total papers = 320). Single country publications are represented by white bars and multiple country publications by black bars. Publications were retrieved from Web of Science Core Collection using the following keyword combinations: Organic + Livestock + Farming and Organic + Husbandry + Animal.

Collaborations among countries for the selected papers are depicted in Figure 5. To define collaborations, the country of each author of the paper was extracted from the affiliation [9]. Countries that presented more collaborations (biggest nodes) were Germany, Denmark, and the United Kingdom (Figure 5); this was expected because those countries published more multiple country documents (Figure 4) compared with other countries. Figure 5 reveals that French researchers were involved in publications from other countries, even if they were not the corresponding authors in any of those documents (this is also clear from Figure 4, where France does not present multiple country publications). Thus, based on the results observed for France, language used in the document impacts the possibility of collaboration among countries.

Some of the collaborations among countries can be explained based on the language or geographical proximity; for example, there was a strong collaboration between Mexico and Spain, and between Canada and the USA (Figure 5a). Strong collaboration was also observed between Germany and Denmark (Figure 5a). When using a Fruchterman–Reingold visualization (proximity of the nodes indicates stronger relation), Spain, Mexico, Colombia, and Venezuela cluster close or together (Figure 5b) which supports that language (in all these countries the official language is Spanish) and historical relationships influence the collaboration among countries. Moreover, even if Mexico and Spain are in different clusters based on the algorithm used, we can consider that all four countries are part of the same cluster because Mexico depends on the Spain node. Considering proximity of the nodes and the clusters, Poland, Slovakia, Romania, and Hungary, which are geographically close, are also in the same cluster and close in the graph, as well as Latvia and Estonia, and India and Pakistan (Figure 5b).



(a)

(b)

Figure 5. Country collaboration among countries of the database (**a**) without clusters using circle visualization and (**b**) with clusters and removing isolate vertex using Fruchterman–Reingold visualization. Each node size is proportional to the number of direct connections. The bigger the node,

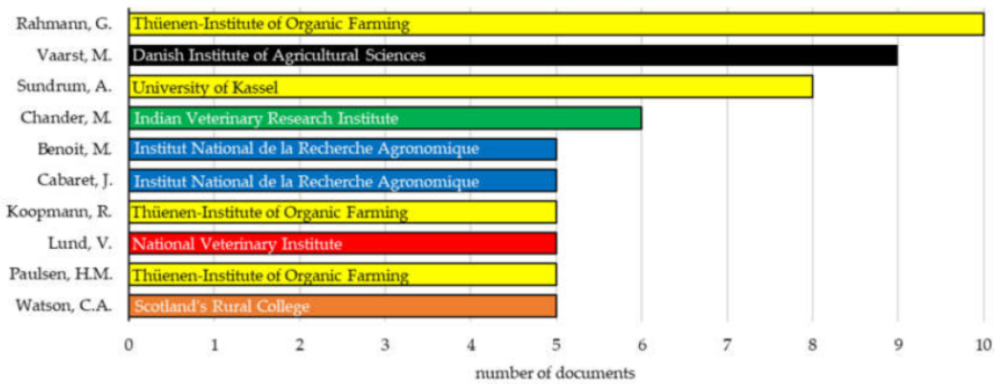
the more connections it has. Lines (link) between nodes represent direct connections and thickness is proportional to the number of studies involved in each direct connection. In (b), node colors identify clusters using the Walktrap algorithm and dash lines connect nodes of different clusters. The closer two countries are located on the map, the stronger the relation between them.

3.3. Authoring: Most Productive Authors and Collaborations

Most of the selected papers (275 out of 320) were contributed by several authors, and only 14% of them were single-authored documents. A total of 1000 authors were identified, from which 38 were authors of single-authored documents and 962 of multi-authored documents. Considering only the authors of multi-authored documents and documents with more than one author [16], the collaboration index was 3.5, which implies that the average research team falls between three and four in the field of study. Within the 320 selected documents, the 10 most productive authors, in terms of number of published papers and based on their current affiliation, were from Germany (4 authors), France (2 authors), and Denmark, India, Norway, and the United Kingdom (1 author from each country; Figure 6a). In addition, the number of documents per author ranged from 5 to 10 considering those 10 authors.

In terms of number of published documents per author, G. Rahmann [17] was the main author who has published papers on the topic covered from 2002 to 2015. In terms of longevity, A. Sundrum [18] covered the widest timespan (1993 to 2017), publishing papers related to organic livestock production. Thünen Institute of Organic Farming [19] in Germany (G. Rahmann, R. Koopmann, and H.M. Paulsen) conducts interdisciplinary research in organic farming, mainly in organic livestock farming and crop production. Organic farming and, in particular, organic livestock research is also covered by M. Vaarst [20], M. Chander [21], M. Benoit [22], and J. Cabaret [23]. However, J. Cabaret has dealt with parasitology research [23].

Moreover, Figure 6b highlights that some authors have not been involved in organic livestock production research so far. For example, V. Lund was a specialist in animal welfare and animal ethics whose thesis was related to organic animal husbandry and this explains the five articles included [24]. In addition, Figure 6 reveals interdisciplinary research groups when publishing in organic livestock. For example, C.A. Watson's research area was related to soil science [25]. However, the documents co-authored by C.A. Watson in our database (n = 5) were organic farming reviews also covering livestock or research papers with crop-livestock farms. This was somehow expected because, as indicated above, the 'organic farming' movement started in soil and plant science, and a more holistic approach is used than in conventional farming [15].



(a)

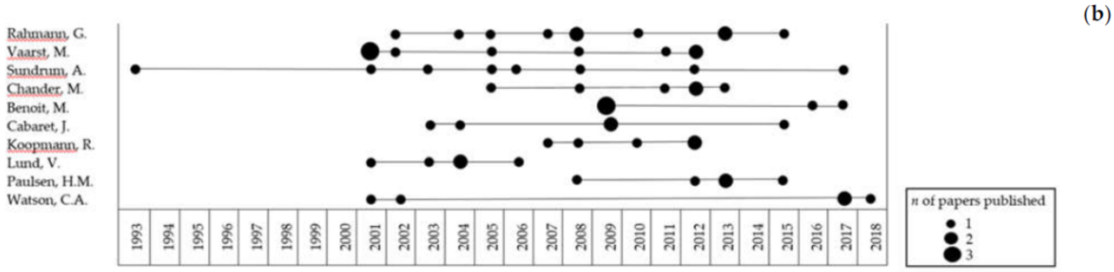


Figure 6. (**a**) Number of documents published by the 10 most productive authors from 1993 to 2018 on organic livestock farming. Current affiliation of the authors and country (orange, the United Kingdom; yellow, Germany; red, Norway; blue, France; green, India; and black, Denmark) are provided; (**b**) Papers published by the 10 most productive authors in a timeline scale. Publications were retrieved from Web of Science Core Collection using the following keyword combinations: Organic + Livestock + Farming and Organic + Husbandry + Animal.

3.4. Most Cited Documents, Used References, and Co-citations

Among the 320 selected documents, the top 10 with the greatest number of citations up until May 2019 are listed in Table 1. Considering only the top five, four documents were tagged as reviews, which supports that the most important citing reason of a reference is reviewing prior work on the topic [1]. Nevertheless, the classification of a document as an article or a review is sometimes questionable. Although we used the metadata linked to the document regarding the type of document, we realized that some documents tagged as 'articles' were in fact 'reviews'. For example, the paper of M. Hovi as first author (Table 1) was a review that described the state and the future challenges of organic livestock in Europe. The number of citations of a paper depends on the year of publication, among other things, and most recent papers have had less of a chance to be cited, which partially explains why the year of publication of the most cited papers ranged from 1998 to 2011 (Table 1a). The number of citations usually indicates the impact (influence) of the article [2]. However, as already mentioned, citations are not a synonym of quality, and they depend also on the type of research and long-term significance for the scientific community [4]. Methodological articles and reviews are cited more often than other papers; in addition, papers considered of bad quality are cited more than papers considered mediocre due to 'negational citation' [4]. Therefore, more than the number of times an article is cited, it is interesting to consider the number of articles (in our database, 320) that used the same reference (Table 1b) or co-citation analysis (Figure 7).

The 10 most used references within our selected database were documents from 2000 to 2006 (Table 1b). In particular, the most used reference cited by 17 out of the 320 documents was published by M. Hovi as first author (Table 1), followed by the paper of T.W. Bennedsgaard as first author (Table 1b). Only one of the most used references was tagged as a review article (Table 1b). However, as indicated above, some documents classified as 'articles' are in fact 'reviews'. Along with the paper of M. Hovi as first author, those from J.E. Hermansen, E. Von Borell, and H.F. Alrøe as first authors, were also reviews (Table 1b). Therefore, half of the references in Table 1b are reviews, and two of them are within the top five of the list.

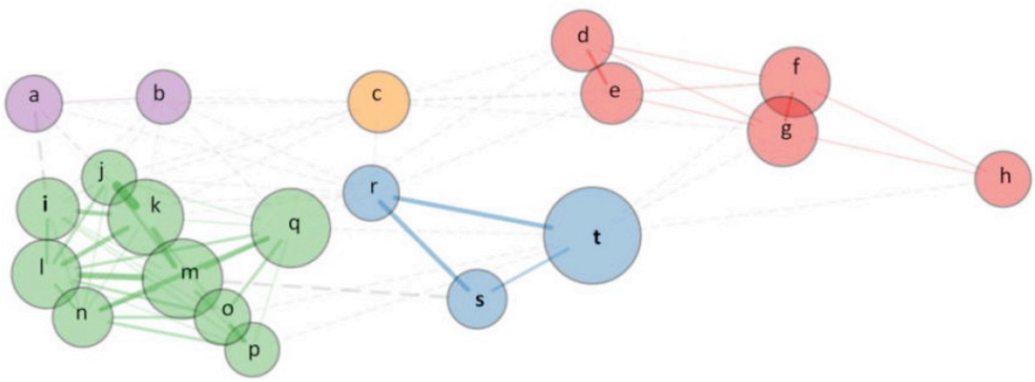
Table 1. (**a**) The 10 most cited papers among the 320 selected documents on organic livestock farming. First author name, year of publication, digital object identifier (DOI), total citations, and type of document. Total citations were extracted on May 2019. (**b**) The 10 most used references on organic livestock farming in the 320 selected documents. First author name, year of publication, DOI, number of times the reference was cited, and type of document.

a) Document	Total Citations	Type of Document
G. Haas, 2001; DOI: 10.1016/S0167-8809(00)00160-2.	273	Article

C.A. Watson, 2002; DOI: 10.1079/SUM2002131.	200	Review
G. Huyghebaert, 2011; DOI: 10.1016/J.TVJL.2010.03.003.	190	Review
E.A. Stockdale, 2011; DOI: 10.1016/S0065-2113(01)70007-7.	175	Review
A. Sundrum, 2001; DOI: 10.1016/S0301-6226(00)00188-3.	171	Review
T. Nemecek., 2011; DOI: 10.1016/J.AGSY.2010.10.002.	128	Article
J.E. Olesen, 2006; DOI: 10.1016/J.AGEE.2005.08.022.	124	Article
K. Refsgaard, 1998; DOI: 10.1016/S0308-521X(98)00004-3.	120	Article
M. Hovi, 2003; DOI: 10.1016/S0301-6226(02)00320-2.	101	Article [1]
N.E.H. Scialabba, 2010; DOI: 10.1017/S1742170510000116.	92	Review
b) Document	**Times Cited by the 320 Documents**	
M. Hovi, 2003; DOI: 10.1016/S0301-6226(02)00320-2.	17	Article [1]
T.W. Bennedsgaard, 2003, DOI: 10.1016/S0301-6226(02)00312-3.	13	Article
A. Sundrum, 2001; DOI: 10.1016/S0301-6226(00)00188-3.	11	Review
F. Hardeng, 2001; DOI: 10.3168/JDS.S0022-0302(01)74721-2.	10	Article
I. Hansson, 2000; DOI: 10.1046/J.1439-0450.2000.00313.X.	9	Article
J.E. Hermansen, 2003; DOI: 10.1016/S0301-6226(02)00313-5.	9	Article [1]
E. Von Borell, 2004; DOI: 10.1016/J.LIVPRODSCI.2004.07.003.	9	Article [1]
H.F. Alrøe, 2001; DOI: 10.1023/A:1012214317970.	8	Article [1]
A. Busato, 2000; DOI: 10.1016/S0167-5877(00)00104-5.	8	Article
W.J. Nauta, 2006; DOI: 10.1016/J.LIVSCI.2005.06.013.	8	Article

[1] classified as an 'article' by the metadata linked to a document, but the paper is in fact a review.

Co-citations of the references within a specific area of research allow to identify the most relevant references. They indicate the frequency with which two documents are cited together by other documents [26]. Those patterns can vary over time as a result of changes in interests and intellectual patterns of a field [26]. Co-citation analysis of the 20 most co-cited references revealed five clusters (Figure 7). The red cluster includes two studies on ethnoveterinary (letters f and h), and papers that dealt with the use of plants in livestock (letters d and e) or in vitro studies with essential oils (letter g). The green cluster includes studies more related to agriculture (soil, environmental studies, and crops; letters i to k). The blue cluster identifies papers more focused on livestock (letter s and t) or quality of animal-derived products (letter r). The biggest nucleus (letter t in Figure 7), which means that it is the most co-cited, refers to the review published by M. Hovi as first author . This document was also the most cited in our dataset (Table 1b), which confirms that two documents frequently co-cited are also frequently cited individually [26]. Moreover, this review (letter t in Figure 7) was written in collaboration with A. Sundrum, who is one of the most productive authors in our dataset (Figure 6). Nucleus 's' (Figure 7) refers also to a review paper published by A. Sundrum about organic livestock farming (Table 1). Furthermore, A. Sundrum is the author who has published on that topic for a longer time, and he is currently affiliated with a university in Germany (Figure 6).



Reference	Letter

IFOAM, 2005; http://infohub.ifoam.bio/en/what-organic/principles-organic-agriculture	a
Reganold and Watcher, 2016; DOI: 10.1038/NPLANTS.2015.221	b
Woods and Fearon, 2009; DOI: 10.1016/j.livsci.2009.07.002	c
Cross et al., 2007; DOI: 10.1080/00071660701463221	d
Windisch et al., 2008; DOI: 10.2527/jas.2007-0459	e
Akerreta et al., 2010; DOI: 10.1016/j.jep.2010.05.023	f
Zenner et al., 2003; DOI: 10.1051/parasite/2003102153	g
Benitez et al., 2012; DOI: 10.1016/j.jep.2011.11.029	h
Watson et al, 2002; DOI: 10.1079/SUM2002131	i
de Ponti et al., 2012; DOI: 10.1016/j.agsy.2011.12.004	j
Seufert et al., 2012; DOI:10.1038/nature11069	k
Mäder et al., 2002; DOI: 10.1126/SCIENCE.1071148	l
Pimentel et al., 2005; DOI: 10.1641/0006-3568(2005)055[0573:EEAECO]2.0.CO;2	m
Drinkwater et al., 1998; https://www.nature.com/articles/24376.pdf	n
Halberg et al., 2005; DOI: 10.1016/j.agee.2004.04.003	o
Refsgaard et al., 1998; DOI: 10.1016/S0308-521X(98)00004-3	p
Bengtsson et al., 2005; DOI: 10.1111/j.1365-2664.2005.01005.x	q
Hansson et al., 2000; DOI: 10.1046/j.1439-0450.2000.00313.x	r
Sundrum, 2001; DOI: 10.1016/S0301-6226(00)00188-3	s
Hovi et al., 2003; DOI: 10.1016/S0301-6226(02)00320-2	t

Figure 7. References co-citation network of the top 20 references using Fruchterman–Reingold visualization. Each node size is proportional to the number of direct connections. The bigger the node, the more connections it has. Lines (link) between nodes represent direct connections and thickness is proportional to the number of studies involved in each direct connection. Node colors identify clusters of references using the Walktrap algorithm. Dash lines link nodes of different communities. The closer two references are located on the map, the stronger the relation between them.

3.5. Documents Sources

The 320 documents were published in 111 journals (268 articles), 25 proceeding books (51 articles), and a bulletin (1 article). The sources identified in our study mirror the characteristics of the database used to conduct the search [6]. Based on 2018 JIF, 38 of those journals were from the 1st quartile of their category, 26 from the 2nd quartile, 14 from the 3rd quartile, and 28 from the 4th quartile. In addition, 63.8% of the papers were published in 1st and 2nd quartile journals (93 and 78 documents, respectively), and 27% were published in 4th quartile journals (72 documents). Only 5 out of 268 papers were published in journals without a JIF in 2018. The 10 journals with the most published papers are presented in Figure 8 and accounted for 101 out of 320 documents. Moreover, the journals in the top three positions are classified nowadays in the 2nd (Livestock Science) and 4th (Fourrages and Landbauforschung) quartiles of their category, and account for 40 papers.

From the top 10 journals, Fourrages and INRA Productions Animales are published in French, and included 18 out of the 320 documents, which could partially explain the fact that Fourrages and INRA Productions Animales are in the 4th quartile of their category, and the lack of multiple country publications when France is the country of the corresponding author (Figure 4). Landbauforschung and Acta Veterinaria Scandinavica are classified as multi-language journals (use of more than one language) by Web of Science. The use of German and English in Landbauforschung was confirmed by visiting the journal website; however, in the website of Acta Veterinaria Scandinavica, papers were only in English. The low rank of those journals in their respective category supports that publishing in languages different to English impairs the impact factor because there is lower visibility of the papers.

Nowadays, JIF is considered a quality parameter of published research with regard to assessment and prioritizing the allocation of funds [4]. However, because JIF is calculated on the basis of the previous two years, it favors journals whose papers are cited intensively for a very short period after their publication, but not in the long term [4]. Moreover, JIF is influenced by the type of articles that the journal publishes (original research papers, reviews, etc.), the number of articles published in that journal during the previous two years, and the journal accessibility (which includes language of the articles) [4]. However, the use of quartile distribution allows to compare journals across categories. Most of the proceeding papers (42%) were published in the book of abstracts of the 2nd Organic Animal Husbandry conference that took place in Hamburg in 2012.

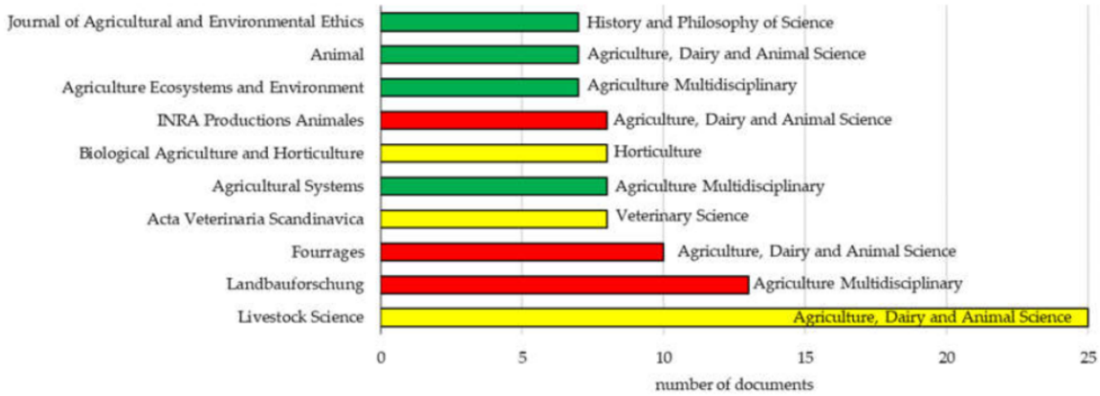


Figure 8. The 10 journals with more papers published from 1993 to 2018 on organic livestock farming. The quartile of the journal (quartile 1, green; quartile 2, yellow; quartile 3, orange; and quartile 4, red) is based on the 2018 Journal Impact Factor (JIF) published by Clarivate Analytics. When the journal was included in several categories, the one with the best quartile was considered. Categories considered to establish the quartile are also included in the graph. Publications were retrieved from Web of Science Core Collection using the following keyword combinations: Organic + Livestock + Farming and Organic + Husbandry + Animal.

3.6. Most Important Authors' Keywords and Co-occurrence

A total of 842 authors' keywords were extracted from the documents. Without editing synonyms, the authors' top 10 keywords were: 'organic farming' (89 times), 'animal welfare' (29 times), 'organic' (25 times), 'animal health' (22 times), 'organic agriculture' (17 times), 'cattle' (15 times), 'livestock' (12 times), 'organic livestock production' (12 times), 'grazing' (10 times), and 'organic production' (10 times). 'Sheep' was also used 10 times. It is important to bear in mind that the words used to conduct the search (in our case, Organic + Livestock + Farming and Organic + Husbandry + Animal) are overrepresented. For example, we expect an overrepresentation of the terms 'organic farming', 'organic', 'organic agriculture', 'livestock', 'organic livestock production', and 'organic production'. Therefore, the top 10 keywords when excluding those overrepresented terms were: 'animal welfare' (29 times), 'animal health' (22 times), 'cattle' (15 times), 'grazing' (10 times), 'sheep' (10 times), 'grassland' (9 times), 'health' (9 times), 'dairy' (8 times), 'sustainability' (8 times), and 'forage system' (7 times). Poultry was also used 7 times. The presence of 'cattle' among the authors' top 10 keywords is in line with Germany being the country that has published the greatest number of articles on organic livestock farming and has the greatest number of organic cattle. The presence of 'poultry' in the top 10 keywords (after removing the words used to conduct the search) was not surprising considering it is by far the most important species reared organically in Europe with a share of 76% in 2015. Based on information from the USDA and accredited state and private organic certifiers, the growth of certified organic operations/number of birds from 2000 (6592/3,159,050) to 2011 (12,880/37,028,242) demonstrates not only the importance of the poultry industry (layer hens, broilers, and turkeys) to the economy of the USA, but also the increased interest in organic production for this commodity [13]. Although Denmark is the second most prolific country in terms of scientific papers and the leader in organic pig production, 'pig' or any related word was not represented in the authors' top 10 keywords.

As indicated for the co-citation analysis, co-recurrent keywords are interpreted in a similar way. The more times that the same two words are listed in the keywords section of an article, the more we can rely that they are not there by chance. The analysis of the keywords co-occurrence gives an overview of the research performed. The analysis of the 20 more co-recurrent keywords revealed the presence of two clusters (red and blue; Figure 9); the blue one included the terms 'animal welfare', 'organic agriculture', 'animal health', and 'organic livestock production'. The most co-occurring keywords among papers were 'organic farming' and 'animal welfare', being both the principal keywords in their cluster. Most papers combined the keyword 'animal welfare' with 'animal health' and 'organic livestock production'; and 'organic farming' with 'cattle', 'grazing', 'grassland', 'forage system', and 'sheep'. However, intra-cluster connection was also observed; indeed, the term 'organic farming' was strongly connected with 'animal health'. This analysis highlights the relation of welfare with health, organic production with pasture, and organic production with animal health and welfare. As previously stated, it is likely that the words 'organic farming', 'organic livestock production', 'livestock', 'organic', and 'organic agriculture' were overrepresented because of the word combination used for conducting the search.

Only three species appeared in the top 20 co-occurring keywords: 'cattle', 'sheep', and 'poultry', with 'cattle' as the most important. The presence of links among those species, although scarce, suggests multi-species studies. Studies seemed more focused on feeding, mainly forage and pasture, than on other issues. Regarding animal products, only 'meat' was present in the co-occurring keywords analysis. However, 'cattle' was one of the terms with the biggest nucleus, which could reflect the relevance of organic milk. In fact, organic milk production has almost doubled since 2007, from 2.7 to 4.7 million metric tons [27]. This could be related to the fact that animal health and welfare, and not product quality, were the main areas of research detected in Figure 9. However, it has to be taken into consideration that some important keywords could be in the title of the document and not in the authors' keyword list, and guidelines of some journals recommend to use terms in the keywords list that differ from those in the title.

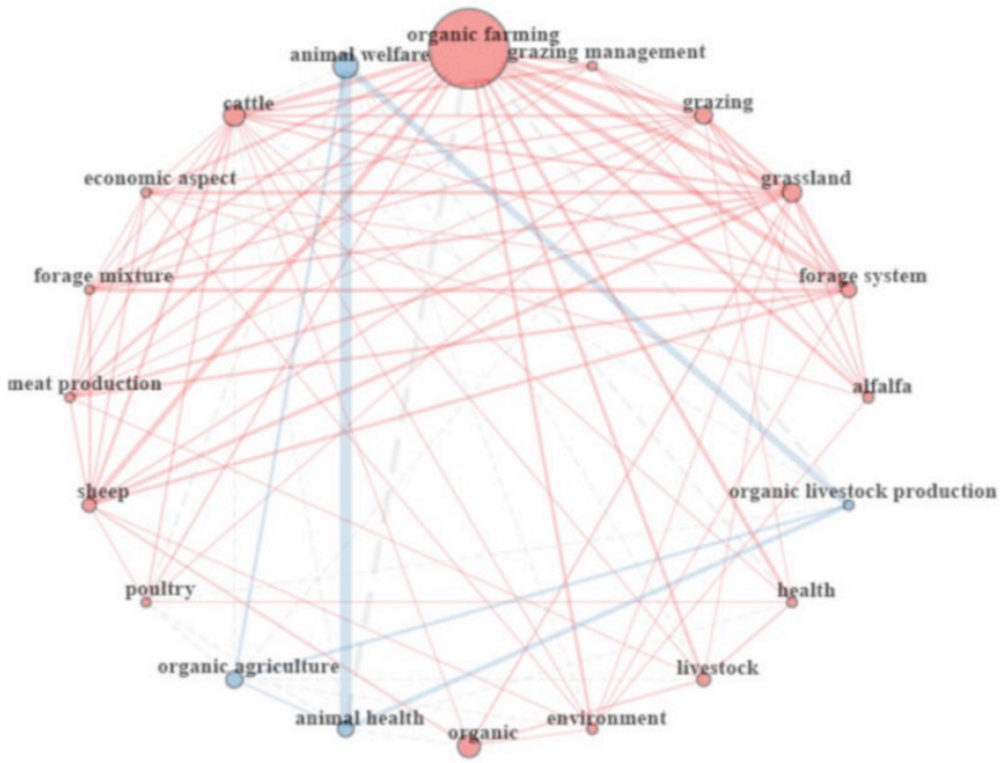


Figure 9. Network plot of the top 20 authors' keywords co-occurrence using circle visualization. Each node size is proportional to the number of direct connections. The bigger the node, the more

connections it has. Lines (link) between nodes represent direct connections and thickness is proportional to the number of studies involved in each direct connection. Node colors identify clusters of words using the Walktrap algorithm. Dash lines link nodes of different communities.

4. Conclusions

The bibliometric approach offered an overview of the topic of our study—organic livestock production. It allowed us to manage a huge amount of references to highlight tendencies and science mapping, such as topics investigated, most prolific authors and countries, co-citations of the references, and co-occurrence keywords. Our study reveals an increasing interest in organic livestock production, which can be scientifically measured by the number of funded projects by governmental organizations and the number of published papers. Countries with a long-tradition in organic farming (German-speaking and English-speaking countries, and France) are still the predominant countries in organic livestock research. Our results also highlight the impact of the language used to write the papers on their visibility and scientific impact (e.g., citations and JIF of the journal). Collaborations among countries are still scarce, and probably triggered by geographical and historical relations and languages. It also seems that multidisciplinary research including authors from several research areas (e.g., ethnoveterinary, plants/soil science, in-vitro studies, economic studies) is conducted when investigating organic livestock production. Some limitations of the search (e.g., database used, keywords, software for the analysis, language of the documents) and metadata linked to the documents (e.g., type of document, total citations) have to be accounted for when interpreting the results. Therefore, a bibliometric review is an interesting and reliable way to have an overview of a specific topic being approached for the first time.

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3.2 Literature review on vitamins

The European regulation for organic livestock production allows the use of vitamins in the following circumstances: 1) vitamins are derived from raw materials occurring naturally in feedstuff, 2) synthetic vitamins are identical to natural vitamins for monogastric animals, 3) synthetic vitamins A, D, and E are identical to natural vitamins for ruminants with prior authorisation of the Member states based on the assessment of the possibility for organically farmed ruminants to obtain the necessary quantities of the above mentioned vitamins through their feed rations. It is completely forbidden to include synthetic vitamins in the diets of animals other than monogastric.

Scientific evidence on the alternatives to the use of synthetic vitamins has been searched using the specialised browser www.pubmed.com, www.scopus.com, www.webofscience.com, and www.sciencedirect.com. The keywords and phrases used for the literature research were:

Regulation 889/2008, Regulation 834/2007, organic farming, vitamins supplementation in conventional and organic livestock, vitamins requirements, feed sources rich of vitamins, alternative feed sources rich of vitamins, feeding strategies in organic livestock, vitamins and antioxidant activity, bioactive compounds with antioxidant activity (phenolic compounds), olive oil by-products, grape by-products, citrus by-products, carob pulp, tomatoes by-products, wheat germ oil, and algae supplementation. The literature review covered material from 1969 to 2018. First, a selection of the articles was carried out based on the title and the abstract. Then, a deeper reading was done to discard the ones that did not match the criteria of the review. As a result, a total of 157 articles have been included.

From each article the following information has been extracted: alternative source of vitamin used and dose, synthetic vitamin and dose, species (and breed) on which was tested, number of animals, study design, length of the study, samples collected, and main results observed.

3.3 Literature review on microbicides (antibiotics and antiparasitics)

3.3.1 Literature review on antibiotics alternatives in organic livestock farming

Article 24, paragraph 3, of the European Regulation on organic livestock farming allows the use of chemically-synthesised allopathic veterinary medicinal products or antibiotics under the responsibility of a veterinarian when measures referred to in paragraphs 1 (preventive measures to ensure animal health) and 2 (phytotherapeutic, homeopathic products, trace elements and other products of natural origin) of the same article are not effective in combating illness or injury, and if the treatment is necessary to avoid suffering or distress of the animal. It is prohibited to use chemically-synthesised allopathic veterinary medicinal products or antibiotics for preventive treatment, without prejudice to Article 24 (paragraph 3) previously cited. Moreover, it is forbidden to use substances to promote growth or production (including antibiotics, coccidiostatics and other artificial aids for growth promotion purposes) and the use of hormones or similar substances to control reproduction or for other purposes (e.g. induction or synchronisation of oestrus), according to Article 23, paragraphs 1 and 2, on disease prevention (Section 4 “Disease prevention and veterinary treatment”).

Scientific evidence on the alternatives to the use of antibiotics has been searched using www.scopus.com, www.sciencedirect.com and https://scholar.google.it/. The keywords used for the literature research were: EU Regulation 889/2008, EU Regulation 834/2007, natural antimicrobials, plant antimicrobial molecules, essential oils, natural anti-infective, drugs organic livestock, plant derived antibiotics, plant derived antimicrobials, alternative antibiotics poultry, alternative antibiotics dairy cattle, alternative antibiotics swine. The literature review covered material from 1998 to 2018. First, a selection of the articles was carried out based on the title and the abstract. Then, a deeper reading was done to discard the ones that did not match the criteria of the review. As a result, a total of 26 articles have been included.

From each article the following information has been extracted: alternative antibiotics used and dose, allopathic antibiotic and dose, species (and breed) on which was tested, number of animals, study design, length of the study, samples collected, and main results observed.

From the literature, natural compounds with antimicrobial effects are:

- plant-derived compounds: phenols and terpenes;
- plant by-products: peels, seeds, husk and kernels which presented phenolic compounds like polyphenols, tannins and flavonoid, as well as other bioactive components;
- essential oils;
- plants and plant extracts: oregano (*carvacrol*), thyme (*thymol*), clove (*eugenol*), mustard (*allysothiocyanate*), cinnamon (*cinnamaldehyde*), and garlic (*allicin*), *Mentha pulegium, Nepeta cataria, Melissa officinalis, Agastache foeniculum, Lavandula angustifolia, Origanum vulgare, Althaea officinalis, Plantago lanceolate, Artemisia absinthium, Populus nigra* and *Evernia prunastri*.

3.3.2 Literature review on antiparasitics alternatives in organic livestock farming

The European Regulation on organic livestock production does not specify what is allowed or forbidden regarding antiparasitic products, thus making even more urgent the need to define alternatives to conventional antiparasitic drugs.

Scientific evidence on the alternatives to the use of antiparasitics has been searched using www.ncbi.nlm.nih.gov/pubmed/. The keywords used for the literature research were: antiparasitic plants, antiparasitic essential oil, antiparasitic natural, anthelminthic plants, anthelminthic essential oils, anticoccidial essential oil, anticoccidial plants. The literature review covered material published in 2017 and 2018, and a total of 720 articles were screened. First, a selection of the articles was carried out based on the title and the abstract. Then, a deeper reading was done to discard the ones that did not match the criteria of the review. A total of 10 articles from 2018 and 24 articles from 2017 were included. In order to gather a more comprehensive overview of the topic, reviews from previous years (10 in total, from 2000 to 2016) were included in the preliminary screening. The major topics covered were anthelmintic alternatives for ruminants and anticoccidials for broilers. The purpose of this approach, which is slightly different from the searches reported in section 3.3.1, was to obtain a better understanding of the fields that were major topics of discussion within the scientific community.

From each article the following information has been extracted: alternative source of antiparasitics used and dose, target organism of the substance (helminths, ectoparasites, protozoans), allopathic antiparasitics and dose, species (breed) on which was tested, number of animals, study design, length of the study, samples collected, and main results observed.

The final results of those three literature reviews will be deeply reported and discussed on the next deliverable D4.2. In that deliverable, we will indicate the plant products selected to be tested in-vitro.

4. Development and validation of a multilingual questionnaire to detect contentious inputs in organic livestock farming across Europe

4.1 Introduction

As mentioned in section 2.1, organic livestock farming has gained more relevance in the latest years. However, research and education on organic farming are still scarce (Jouzi et al., 2017), especially with regard to livestock. The bibliometric review analysis of organic livestock farming in section 3 revealed that the annual scientific production growth rate of this topic was 1.70% from 1993 to early 2018.

Questionnaires are one of the most used tools to collect epidemiological data. Due to reasons such as shorter delivery time, lower delivery cost, additional design options, and shorter data entry time, web surveys have gained popularity in the last years (Fan and Yan, 2010). However, web surveys critical point usually is Internet access (Fan and Yan, 2010). Although rural areas usually lag behind in digital access (Basu and Chakraborty, 2011), nowadays farms are more connected than ever before. Moreover, demographic data suggest that organic livestock farms tend to be managed by younger people and better educated rather than conventional ones (Rigby et al., 2001; European Commission, 2016), which could suggest a better access to the Internet.

Therefore, an online questionnaire has been developed to collect information about current contentious issues in organic livestock farming, the use of alternative allopathic products (vitamins, antibiotics and antiparasitics) and bedding materials across the EU and bordering countries.

4.2 Materials and Methods

A descriptive epidemiological study of prevalence is being conducted on organic livestock farmers from 10 European countries (Denmark, France, Germany, Greece, Italy, Norway, Poland, Spain, Sweden and United Kingdom) and Turkey. Variables will be collected through a self-administered anonymous questionnaire with multiple-choice, multiple-check, and open (short answers) responses.

4.2.1 Questionnaire development

A coordinator group of academic experts in livestock farming has been created to develop the questionnaire in English. The group was composed of four members of Work Package 4: Dr. Massimo De Marchi (University of Padova, Italy), Dr. Federico Righi (University of Parma, Italy), Dr. Giulio Grandi (Swedish University of Agricultural Sciences, Sweden), Dr. Carmen L. Manuelian (University of Padova, Italy); and one international advisor, Dr. Luciana da Costa (The Ohio State University, USA).

Questions were based on several survey studies in conventional and organic farming (Riddle, 2004; Calsamiglia et al., 2007; Jouany and Morgavi, 2007; Mayer et al., 2014; Habing et al., 2016), and designed following Dillman (2007) recommendations for structure and wording. To reduce the non-response rate, questions were ordered from the most salient to the least one, with objectionable and demographic questions at the end, once the trust has been established (Dillman, 2007). As a reward, a Certificate of Collaboration in the study and the possibility to include the link of the farms in the Organic Plus project website (www.organic-plus.net) is and will be offered to the farmers to motivate their participation in the study (Dillman, 2007).

The questionnaire includes 36 questions divided into 6 parts: (i) knowledge and beliefs about organic production matters; (ii) medication administration; (iii) vitamins and bedding; (iv) product commercialization; (v) general questions about the farm, and (vi) demographic questions (see Annex II). The total number of questions has been minimized to avoid deterioration of data quality and to keep each section response time under the threshold of 30 min suggested by Dufour et al. (2010). To ensure that only organic farms participate in the study the question regarding whether they are organic producers is repeated in two different section with a different wording.

The resulting questionnaire has been pre-tested by 9 colleagues from different countries (Italy, Germany, Sweden, Spain, and United Kingdom) to verify if all the necessary questions were included, if all possible answers were considered for each question, if words were understandable, and if the layout was clear and easy to follow.

4.2.2 Questionnaire translation

The English version of the questionnaire is going to be translated into 9 languages (Italian, Spanish, German, Danish, French, Polish, Norwegian, Greek and Turkish) following Brislin's translation model (Dufour et al., 2010). Initially, the original questionnaire (English version) is translated to the target language by a bilingual person expert in animal production whose mother tongue is the target language. Then, a backward translation to the original language is done by a second translator who is blind to the original version. Finally, the original is compared to the back-translated version and any disagreement between the translated version and the original version is solved and corrected. For all languages, the English version is considered the original document, and no corrections are done on it after the comparison with the back-translated version in each language to maintain the same original document. The translation into Italian and Spanish has already been done (see Annex II).

4.2.3 Questionnaire pre-testing

The questionnaire has been tested in English, Italian and Spanish in 3 organic livestock farms rearing different animal species (dairy cow, goats and dairy sheep). The questionnaire was sent by e-mail to each farmer in their own language. After the answers were submitted, a personal interview (telephone or in person) was done to discuss the questionnaire (see Annex II). Any adjustment considered was also applied to all the versions of the questionnaire in the other languages available to keep the same question order and answers categories and allow a multi-country analysis.

4.2.4 Sample collection

The sample was selected by a non-probabilistic technique. Each of the 11 countries enrolled in the study will be responsible for providing the contact information of livestock organic farms in their country. Farm with a functional e-mail address will receive the online questionnaire (link to a web survey), while the rest of the farms will be contacted by telephone or in person and the interviewer will complete the on-line questionnaire for them. To reduce the non-response rate, each farm will be contacted 4 times (Dillman, 2007). In each contact, farmers will receive a cover letter asking for their collaboration in addition to the questionnaire link. In those countries where the response rate will possible be calculated, we are expecting an optimal response rate of at least 40%.

4.2.5 Questionnaire layout

The online questionnaire was prepared through Google form. To avoid having duplicate records from the same farmer and to provide the token to the corresponding participant, we ask to submit their mail address and farm name at the end of the questionnaire, with acceptance of privacy terms and conditions. An alphanumeric code will be assigned to each participant to substitute the e-mail address and farm name from the answers database, and the correlation between the code and the farm identification data will be saved in a completely separate file to keep the answers anonymous.

4.2.6 Study limitation

Regarding the online questionnaire, the main limitation will be the coverage error; in fact, only organic livestock farms with a valid e-mail address will be contacted. To diminish this error, those farms without e-mail address will be contacted by telephone or in person and the interviewer will complete the on-line questionnaire for them. Moreover, difficult access to the internet or not familiar with compiling on-line questionnaires could increase the non-response error, as well as other technical issues like Internet service down or spam-blocking tools (Fan and Yan, 2010).

4.2.7 Statistical analysis

To assure that all participants are organic farmers, questionnaires which presented a disagreement in questions 2 (Do you consider yourself as an organic producer?) and 20 (How many years have your farm being certified Organic?) will be discarded.

Dataset will be analysed with SAS and R (R Core Team, 2018). A description of the variable, frequency for categorical variables and mean and standard deviation for quantitative variables, will be provided. A bivariate analysis to evaluate the relationship between two categorical variables will be done with Chi-square test or Fisher's exact test when one or more cells have an expected frequency of five or less. The bivariate analysis of quantitative variables will be done through a one-way ANOVA using GLM of SAS.

4.3 Results of validating the questionnaire

Based on the pre-test of the questionnaire in the three farms we observed that all were able to complete the questionnaire on-line. The average time of answering it was 20 min. Only one farmer left one question without answering to it. None of the questions seemed as irrelevant or superfluous. Everyone accepted to take the offered, Certificate of Collaboration and to be linked to the project website.

The control questions to verify that the producers were organic were answered correctly. The questions where punctuation was used were correctly answered for all the items proposed. On the multi-check questions, more than one answer was selected.

After their feedback, the following modifications to the questionnaires were done. On question 8, a column was eliminated, so all the columns were visible in the same page, and the title for each column reduced. The format of question 8, 9, 15 and 17 was changed from multi-choose to a multi-check. Some wording was corrected for the Spanish version on question 4 and question 6.

With that validation on those three language versions of the questionnaire, the questionnaire was considered finished and the phase of collecting records in United Kingdom (and other countries that wanted to use the English version), Italy and Spain started.

4.4 Summary

A questionnaire with 36 questions divided into 6 sections [(i) knowledge and beliefs about organic production concerns; (ii) medication administration; (iii) vitamins and bedding; (iv) product commercialization; (v) general questions about the farm, and (vi) demographic questions] has been developed for gathering information about organic livestock farming problematics and the use of alternative allopathic products (vitamins, antibiotics and antiparasitics) and bedding materials across Europe and bordering countries.

The questionnaire has been developed in English and translated to 2 languages to carry-on a multi-country analysis including Denmark, France, Germany, Greece, Italy, Norway, Poland, Spain, Sweden, United Kingdom and Turkey.

The questionnaire in English, Italian and Spanish has been validated by a pre-test study with 3 farms (one in each country). The target population was farmers in organic livestock production in those countries that will receive the questionnaire by e-mail or will be contacted by telephone or in person, with a maximum of 4 contacts.

5. Experts' and stakeholders' engagement

5.1 Academic experts

- Dr. Luciana da Costa (DVM). Assistant professor and extension veterinary at The Ohio State University (https://vet.osu.edu/about-us/people/luciana-da-costa). She is an expert in organic livestock production in USA, focus on dairy cattle. We had several Skype meetings. She has collaborated with us in the development of the questionnaire in organic livestock to farmers.
- Prof. Johan Höglund. Full professor in veterinary parasitology at SLU (Swedish University of Agricultural Sciences, Uppsala, Sweden). He is an expert in parasitic diseases in grazing animals and he has worked in the past with alternative substances. He provided advice in the preparation of review on antiparasitic substances.

5.2 Stakeholders

- Julián Sancho (DVM) from Coteve S.L. (www.coteve.com). Coteve offers veterinary services to small ruminants' farms in Teruel region (Spain). He will be able to provide us contact information of organic livestock farms in their region, and, if necessary, access to those farms.
- Fernando Freire Fernández from the sheep association Assaf. España (Asociación nacional de criadores de Ganado ovino de la raza assaf; www.assafe.es).
- Exopol (www.exopol.com/es/) is a pharmaceutical company that provides autovaccines. They have given us the contact information of 3 organic livestock farms and a veterinary that works with organic livestock farming.
- Dr. Xavier Such, Professor at the Universitat Autònoma de Barcelona. He is teaching about organic farming at the Facultat de Veterinària.
- Beatriz Agudo, Director of Research and Innovation at EA. Group. (www.eagroup.es) Grupo Cooperativo Ovino, Spain. This is a cooperative resulting from the merge of OVISO (Ovinos del Suroeste) and Corderos del Sur. EA. Group is the largest commercial sheep/lamb producers cooperative in Europe with approximately 1.2m animals.
- Russell Carrington, Executive Secretary of the Pasture-Fed Livestock Association (PFLA, www.pastureforlife.org) in the United Kingdom.
- Dr. Angelo Stavro Zambrini, R&D manager of Granarolo Dairy industry. This industry is the biggest in Italy and has a relevant part dedicated to organic dairy production.
- Dr. Mirko Breda, head of Centro Caseario del Cansiglio. This dairy center collected and manufacture dairy products by organic milk collected in the north-east of Italy.
- Dr. Pier Andrea Odorizzi, coordinator of Organic farmers of Coldiretti.
- Maud Gustafsson Fahlbeck, marketing and regulatory developer of KRAV (incorporated Swedish association dedicated to the organic sector in Sweden, nowadays with 27 members). They represent farmers, processors, trade and also consumer, environmental and animal welfare interests).
- Caludio Malavasi, owner of Biotrade snc, di Malavasi Claudio and C., that develops and trades herbal products for both conventional and organic livestock.
- Dr. Sujen Eleonora Santini, DVM, PhD, livestock responsible in COMAZOO (cooperativa miglioramento agricolo zootecnico), expert of organic farming.
- Veterinarian Kristin Sørheim (Norway).
- Felleskjøpet, Norwegian agricultural cooperative (Norway).
- Debio, organic control body (Norway).

6. Discussion and conclusion for contentious inputs use in organic farming in Europe

The bibliometric review showed that there is a limited number of articles on organic livestock farming. A similar bibliometric review could be carried out by WPs PLANT and WP SOIL so as to compare the literature available in those two topics with the one obtained for livestock. That comparative study will help to understand potential causes for the low scientific production on organic livestock.

Only about 60% of the scientific papers have been published in journals of the 1st and 2nd quartile of their subject area. This could indicate that studies on organic livestock are difficult to be accepted on relevant journal because they could be seen as too "local" (e.g., local breeds and area of study), or the experimental design weak due to limitations of on-field studies (e.g., number of animals, environmental factors, and replicates), or because of low interest or scepticism of the scientific community on that topic.

Although the bibliometric review on organic livestock farming research has been done without limitations in terms of species, only 'cattle' has appeared among the authors' top 10 keywords. This is in line with Germany being the country that published the greater number of articles on organic livestock farming and being the country with a greater number of organic cattle. Although Denmark is the second most productive country on scientific papers, and the leader in organic pig production, 'pig' or any related word was not represented in the authors' top 10 keywords. The lack of presence of other species on the 10 more used keywords could be because the species studied were indicated on the title and not repeated as a keyword, or because fewer studies have been done with those other species. Therefore, the studies that Organic-PLUS has planned for next year with pigs, small ruminants and broilers seem to fit on providing new insights on rearing those species organically, filling scientific knowledge gaps.

The questionnaire has been developed and validated in the English, Italian and Spanish language version and organic farmers in those countries will be contacted in the following months. The questionnaire in English will be also sent to the other countries involved in the study to be used in English or to be translated to their own language following the procedure proposed in this report.

The literature review on potential plant alternatives to the use of antibiotics, antiparasitics and synthetic vitamins has been started and a selection of components to be tested in *in-vitro* studies will be available in the next deliverable.

Finally, bibliometric reviews are interesting because they provide an overview of the scientific information available on a given topic. In the present study, it helped to detect the countries that have done more research on the topic and the most prolific authors. This offers the opportunity to involve those countries and those authors on the on-going research to present more reliable studies. Moreover, the bibliometric review can provide clues on where information is missing, so that research can focus on fulfilling those gaps. The lack of statistical information available about the use of synthetic vitamins, antibiotics, antiparasitics and conventional bedding materials (straw) supports conducting a survey among organic livestock farmers to get an accurate picture of the use of these contentious inputs in the sector.

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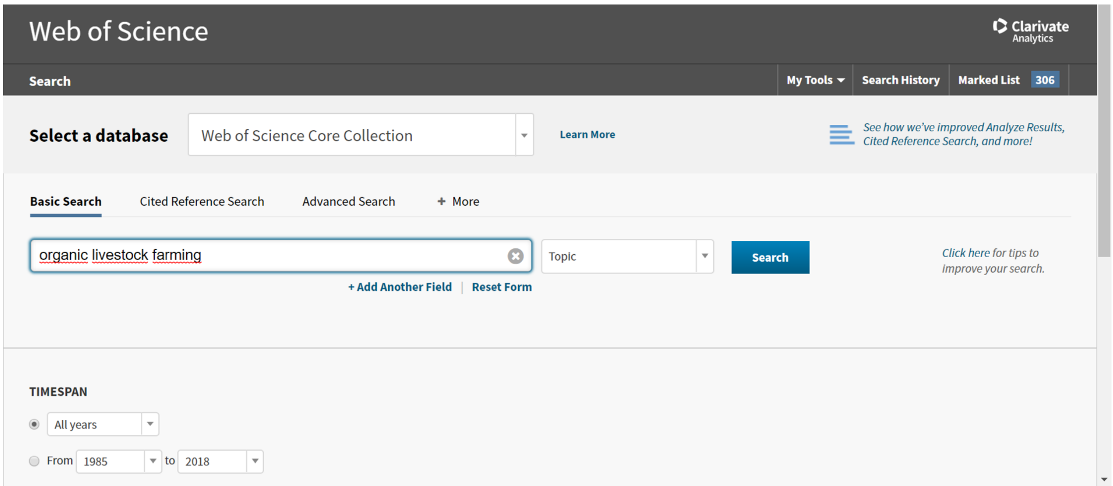
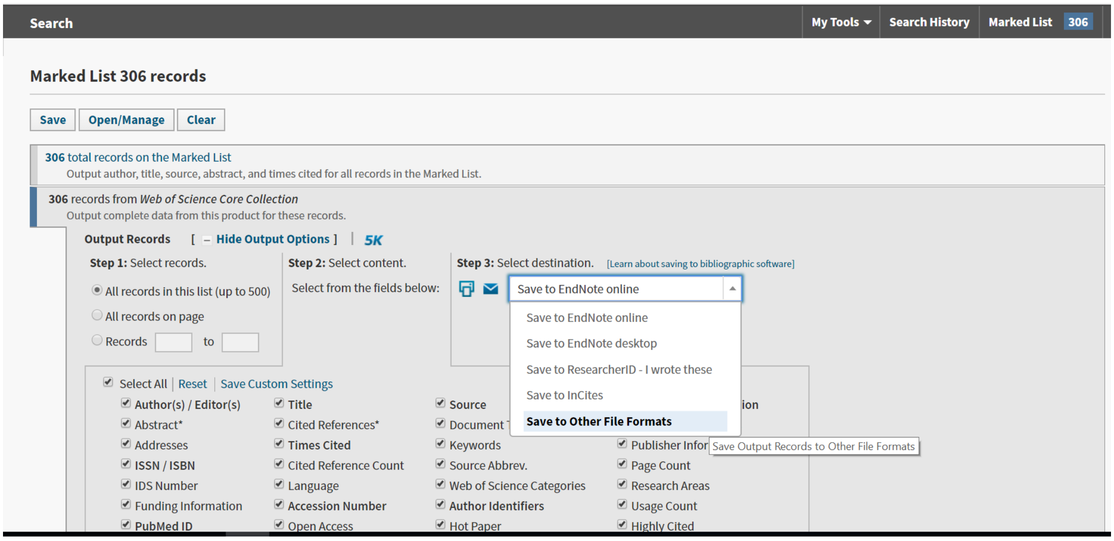
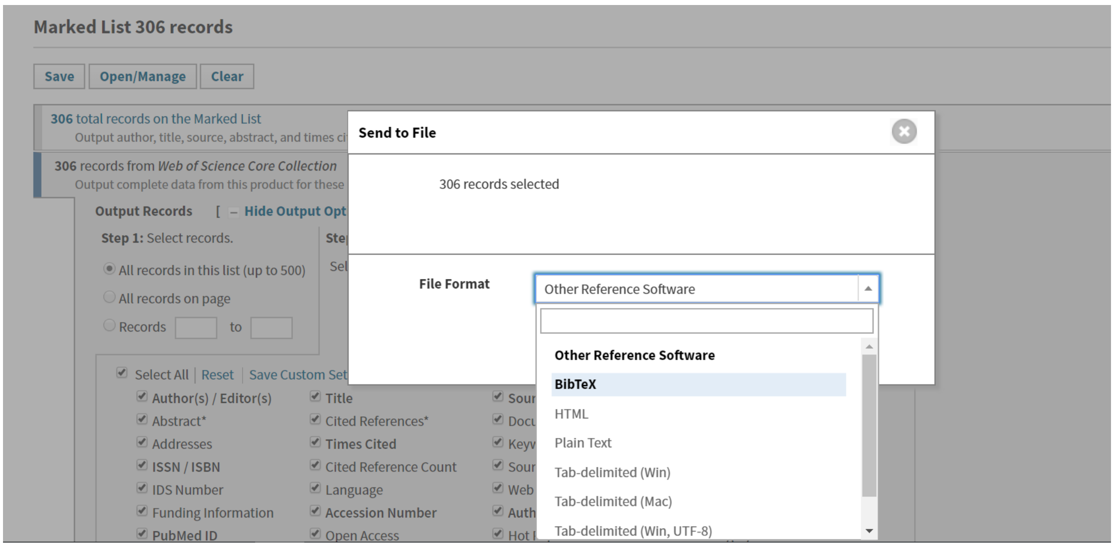
8. Annex I Bibliometric and literature review methodology

The following screen-shots show the literature search for the bibliometric analysis and how to obtain the dataset for the R analysis:







The following screen-shot shows the script used in R for the bibliometric analysis:

```
install.packages("bibliometrix")
install.packages("stringr")
install.packages("qdap")
install.packages("qdapTools")
install.packages("splitstackshape")
install.packages("ngram")

library(bibliometrix)
library(stringr)
library(qdapTools)
library(qdap)
library(splitstackshape)
library(ngram)

isiweb_2 <- readFiles("F:\\Investigacion\\Italia\\Organic_Plus_Project\\bibliometrix_organic\\savedrecs.bib")

I2 <- convert2df(isiweb_2, dbsource = "isi", format = "bibtex")
results <- biblioAnalysis(I2,sep = ";")
plot(results, pause = FALSE )

resumen <- summary(object = results, k = 10, pause = FALSE)

> histResults <- histNetwork(I2, n = 20, sep = ";")

> histPlot (histResults, remove.isolates = FALSE, size = F, labelsize = 0.8, label
= TRUE, arrowsize = 0.1)

> keywordAssoc(I2, sep = ";", n = 10, excludeKW = NA)

# TAG = keyword extractions ==> function termExtraction
```

The following are preliminary summaries for the literature review on alternatives to synthetic vitamins, antibiotics and antiparasitics:

DRAFT (SUMMARY)

ALTERNATIVES TO SINTHETIC VITAMINS IN ORGANIC FARMING

INTRODUCTION

Across the last 50 years, an extraordinary food crop productivity growth has occurred, despite increasing land scarcity and rising land values (World Bank 2008, FAO 2009, Pingali, 2012). Overall, in order to guarantee sustainable food security, the production of high yields is crucial, especially because land availability is finite and global populations grows dramatically (Godfray et al., 2010; Foley et al., 2011)…

1. AN ALTERNATIVE APPROACH TO PRODUCE ANIMAL PRODUCTS: ORGANIC FARMING

In Europe, consumers are increasingly concerned about some concerns related to the consume of animal food origin, even if their knowledge and understanding about animal food production systems is poor (Cornish, Raubenheimer and McGreevy, 2016). In fact, according to the last serve commission by European Union, concerning to public opinion about agriculture activities and policies, in 24 European countries, providing health food of high quality should be the main objective of the EU in terms of agriculture and rural policy (Eurobarometer 2018)…

2. LEGISLATIVE BACKBONE OF FEEDING ORGANIC LIVESTOCK

The legislative backbone of Organic Farming is the Commission Regulation (EC) No 889/2008 of 5 September 2008. In this regulation, the rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control are laid down detailed. In the Title II, Section 3, (arts. 19-20-21-22) of this regulation, feed nutritional requirements are described. Specifically, the article 22 reports that…

Water-soluble	Fat-soluble

DRAFT:

ALTERNATIVES TO ANTIBIOTICS IN ORGANIC FARMING

SUMMARY

INTRODUCTION

- Characteristics of alternative to antibiotics
- Phytochemicals

PLANT-DERIVED COMPOUNDS AS ANTIMICROBIALS

- Phenolic compounds
- Terpenes
- Plant byproducts

USE IN SWINE

- Minimum inhibitory concentration of essential oils
- Effects of essential oils on intestinal inflammation
- Effects of essential oils on pig oxidative stress
- Effects of essential oils on quorum sensing
- Effects of essential oils on intestinal microbiota and microbiome

USE IN POULTRY

- Botanical alternatives to antibiotics for use in organic poultry production
- Antimicrobial properties

USE IN DAIRY CATTLE

- Pharmacokinetics of plant-based molecules used for mastitis treatments
- Antimicrobial properties of plant-based products against mastitis pathogen agents

PREVIOUS PROJECTS DEVELOPED ON THE TOPIC

……………………………………………………………………………………………

INTRODUCTION

Optimal characteristics of alternative to antibiotics:

Cheap, available, secure, safe, bioavailable, effective, metabolizable, biodegradable.

……………………………………………………………………………………………

Phytochemicals

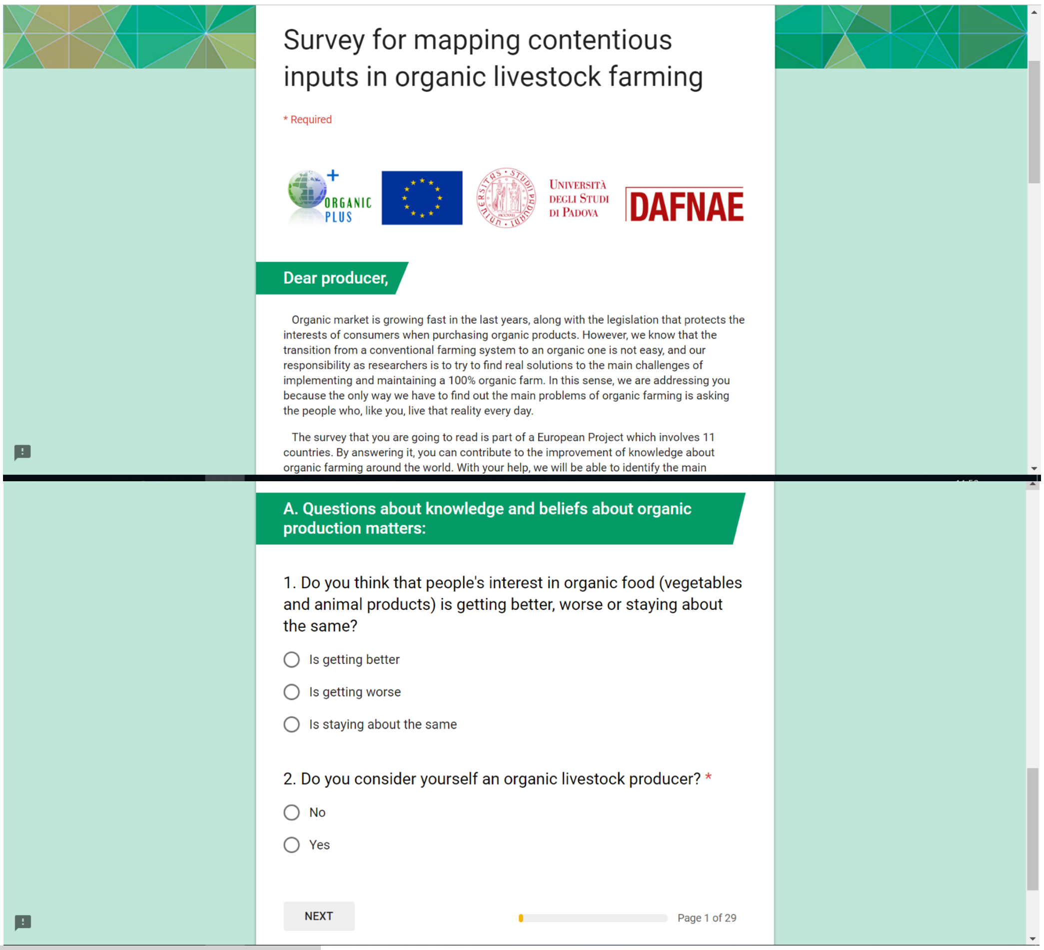
Phytochemicals are plant-derived compounds, such as essential oils or tannins that may have antibacterial and growth promoting effects.85 Different essential oils vary in antibacterial mode of action, which is often not well characterized.86 Phytochemicals are used on commercial poultry

9. Annex II Questionnaire for the survey study

The online questionnaire link in English, Italian and Spanish is available upon request to the WP4 leader.

The following screen-shoot shows the cover letter and the first questions for each of the three languages.

- English version:



- Italian version


Indagine per la mappatura di input controversi nell'allevamento biologico

* Required

Caro produttore,

Negli ultimi anni il mercato delle produzioni biologiche sta crescendo velocemente, insieme alla legislazione garante degli interessi dei consumatori dei prodotti di origine biologica. Tuttavia, sappiamo che la transizione dal sistema convenzionale a quello biologico non è semplice, e come ricercatori è nostra responsabilità lavorare per ricercare soluzioni reali alle principali sfide per lo sviluppo ed il sostegno di un'azienda 100% biologica. A tale scopo, ci rivolgiamo a Lei perché riteniamo che l'unico modo per cogliere le principali difficoltà dell'agricoltura biologica sia chiedere alle persone, che come Lei, vivono quotidianamente tale realtà.

Il questionario che andrà a leggere è parte di un Progetto Europeo che coinvolge 11 Paesi. Rispondendo al questionario, può contribuire concretamente allo sviluppo di una

A. Domande riguardo la conoscenza del settore delle produzioni biologiche:

1. Pensa che l'interesse delle persone nei confronti delle produzioni biologiche (vegetali o animali) stia aumentando, peggiorando o rimanendo stabile?

- È in aumento
- È in diminuzione
- È stabile

2. La Sua è un'azienda produttrice di prodotti biologici di origine animale? *

- No
- Sì

NEXT

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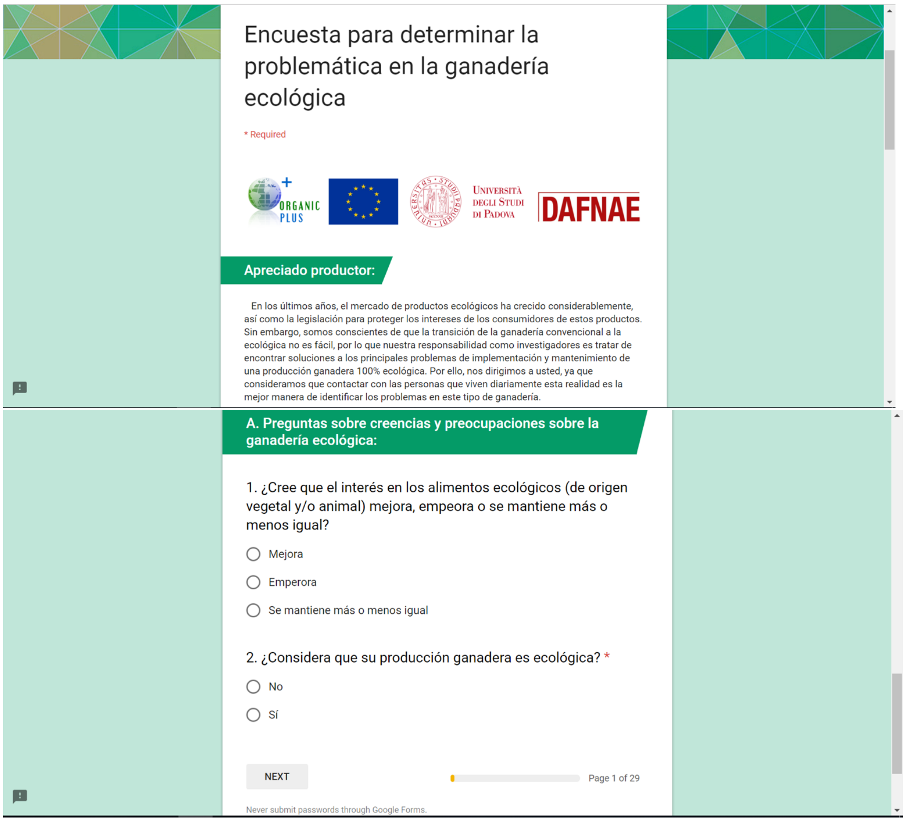
- Spanish version


Encuesta para determinar la problemática en la ganadería ecológica

* Required

Apreciado productor:

En los últimos años, el mercado de productos ecológicos ha crecido considerablemente, así como la legislación para proteger los intereses de los consumidores de estos productos. Sin embargo, somos conscientes de que la transición de la ganadería convencional a la ecológica no es fácil, por lo que nuestra responsabilidad como investigadores es tratar de encontrar soluciones a los principales problemas de implementación y mantenimiento de una producción ganadera 100% ecológica. Por ello, nos dirigimos a usted, ya que consideramos que contactar con las personas que viven diariamente esta realidad es la mejor manera de identificar los problemas en este tipo de ganadería.

A. Preguntas sobre creencias y preocupaciones sobre la ganadería ecológica:

1. ¿Cree que el interés en los alimentos ecológicos (de origen vegetal y/o animal) mejora, empeora o se mantiene más o menos igual?

- Mejora
- Emperora
- Se mantiene más o menos igual

2. ¿Considera que su producción ganadera es ecológica? *

- No
- Sí

NEXT

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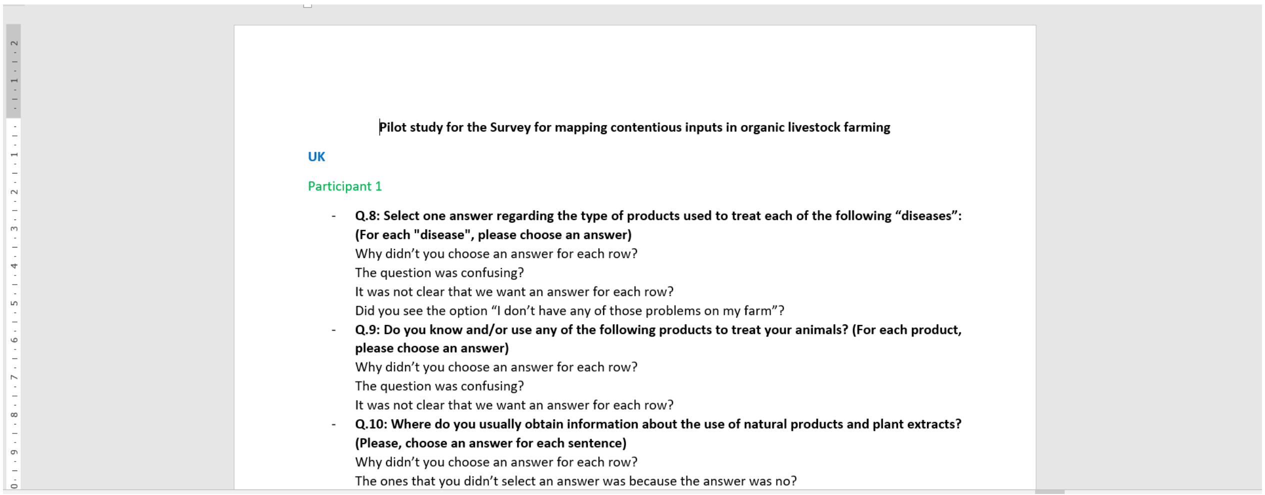
Never submit passwords through Google Forms.

For the pilot study, each answered questionnaire was analysed and specific questions were made to the farmer as it can be observed in the following screen-shot:



Pilot study for the Survey for mapping contentious inputs in organic livestock farming

UK

Participant 1

- **Q.8: Select one answer regarding the type of products used to treat each of the following "diseases": (For each "disease", please choose an answer)**
  Why didn't you choose an answer for each row?
  The question was confusing?
  It was not clear that we want an answer for each row?
  Did you see the option "I don't have any of those problems on my farm"?
- **Q.9: Do you know and/or use any of the following products to treat your animals? (For each product, please choose an answer)**
  Why didn't you choose an answer for each row?
  The question was confusing?
  It was not clear that we want an answer for each row?
- **Q.10: Where do you usually obtain information about the use of natural products and plant extracts? (Please, choose an answer for each sentence)**
  Why didn't you choose an answer for each row?
  The ones that you didn't select an answer was because the answer was no?

10. Annex III Additional information from Norway

Contentious inputs in organic livestock in Norway

Figure 1 shows disease treatments for dairy cows in total number of treatments per cow per year, figure 2 shows occasions of clinical mastitis per 100 cows per year and figure 3 shows occasions of ketosis and milk fever per 100 cows per year. These figures are for all dairy cows, regardless of whether they are organic or conventional.

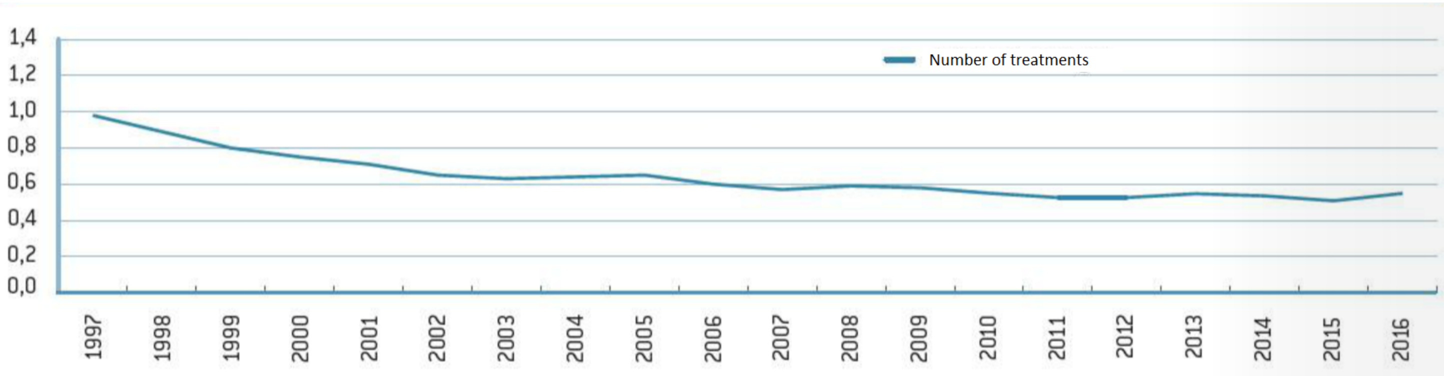


Figure 1: Disease treatments for dairy cows, total number of treatments per cow per year. Reference: Tine Rådgivning /

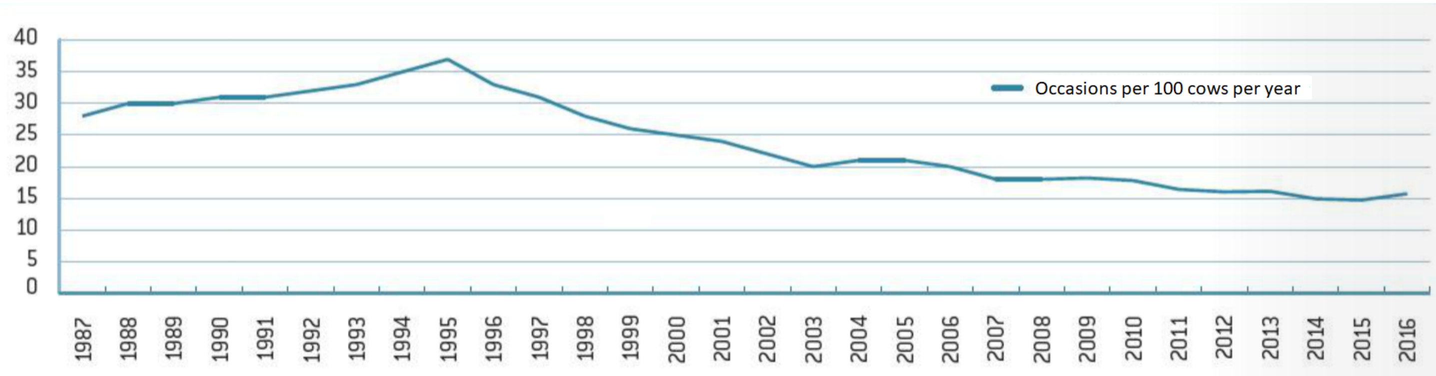


Figure 2: Occasions of clinical mastitis (inflammation of the udder) per 100 cows per year. Reference: Tine Rådgivning / Helsetjenesten for storfe, årsrapport Helsekortordningen 2016.

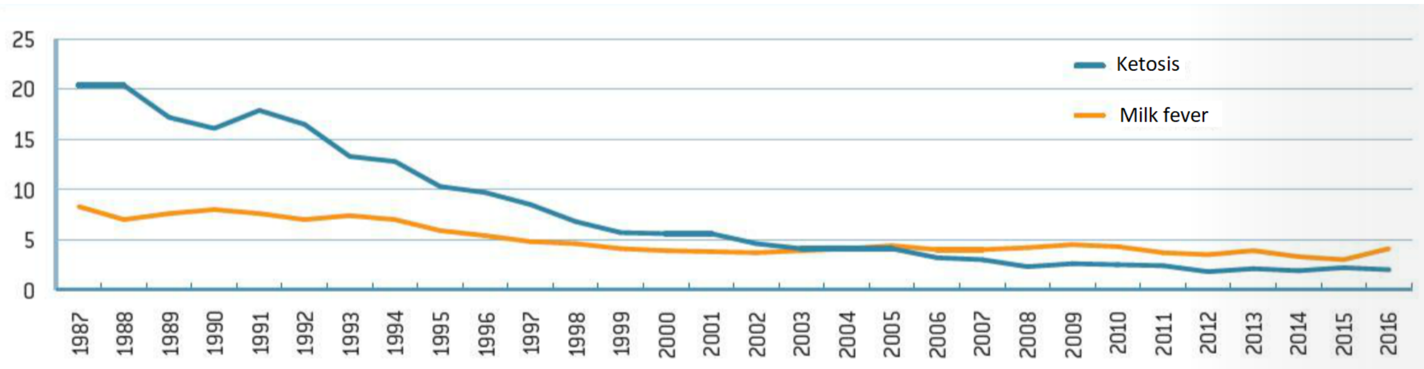


Figure 3: Occasions of ketosis and milk fever per 100 cows per year. Reference: Tine Rådgivning / Helsetjenesten for storfe, årsrapport Helsekortordningen 2016.

Figure 4 shows sales of different antibiotics in kg for food producing animals in Norway from 1993 till 2016, and figure 5 shows sales of antibiotics in mg per population correction unit in Norway from 2010 till 2016.

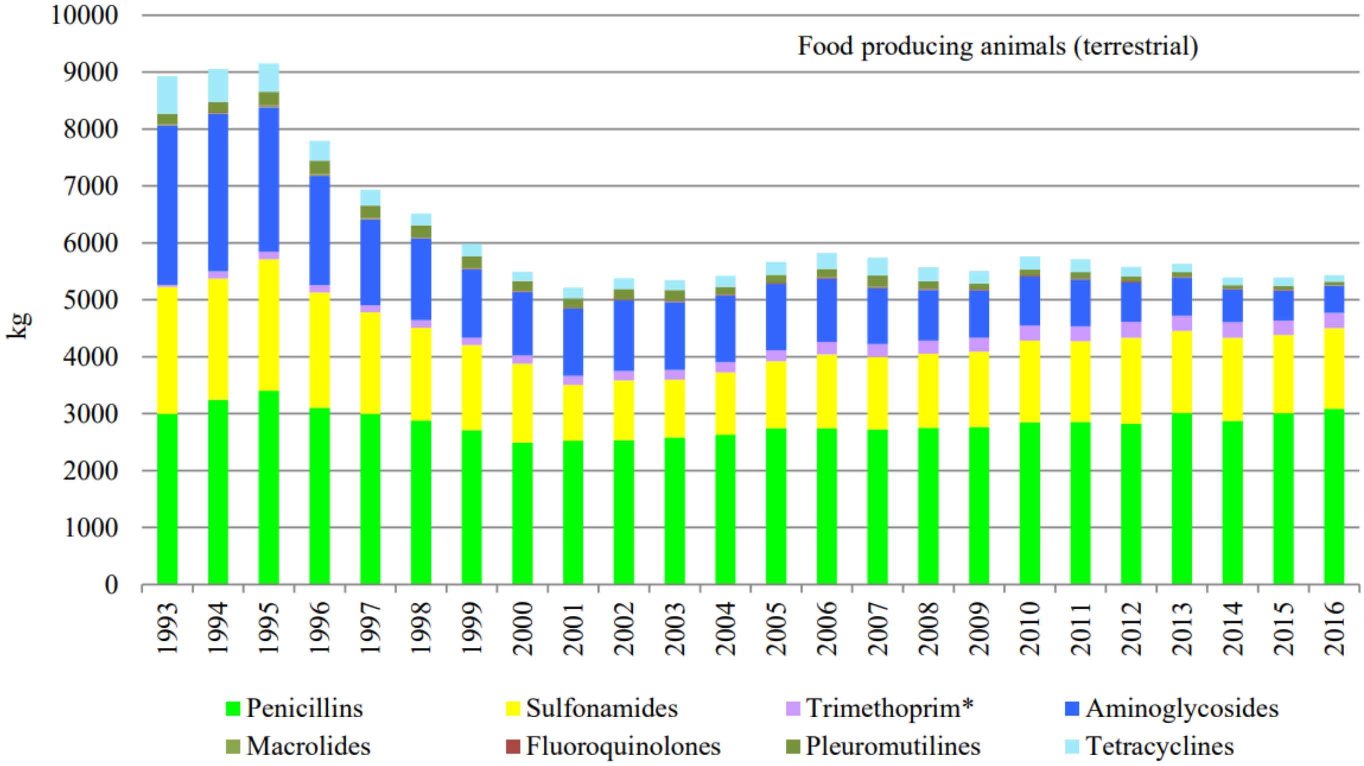


*Figure 4: Sales, in kilograms active substance, of antibacterial veterinary medicinal products (VMPs) for therapeutic use in terrestrial food producing animals (including horses) in Norway, for the years 1993-2016. In addition, minor amounts of amphenocols (range 17-27 kg) were sold in 2008-2016). There were minor sales (< 0.05 kg) of a third generation cephalosporin VMP for the years 2012-2016. *Includes minor amounts of baquiloprim 1994-2000.*
Reference: NORM/NORM-VET 2016. Usage of Antimicrobial Agents and Occurence of Antimicrobial Resistance in Norway. Tromsø / Oslo 2016.

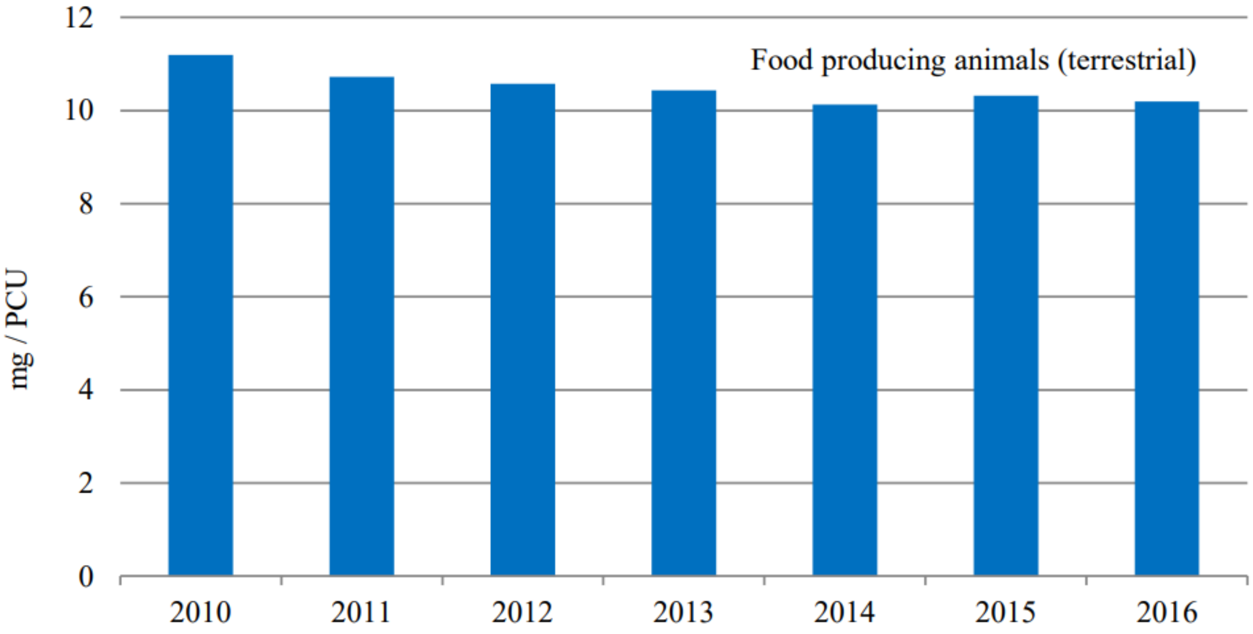


Figure 5: Sales (mg/PCU) in Norway, in mg active substance of antibacterial veterinary medicinal products for therapeutic used in terrestrial food producing animals (including horses) normalised by the population correction unit (PCU) for the years 2010-2016. Reference: NORM/NORM-VET 2016. Usage of Antimicrobial Agents and Occurence of Antimicrobial Resistance in Norway. Tromsø / Oslo 2016.

Figure 6 shows antibiotics sold and used for livestock in the Scandinavian countries from 2002 till 2016.

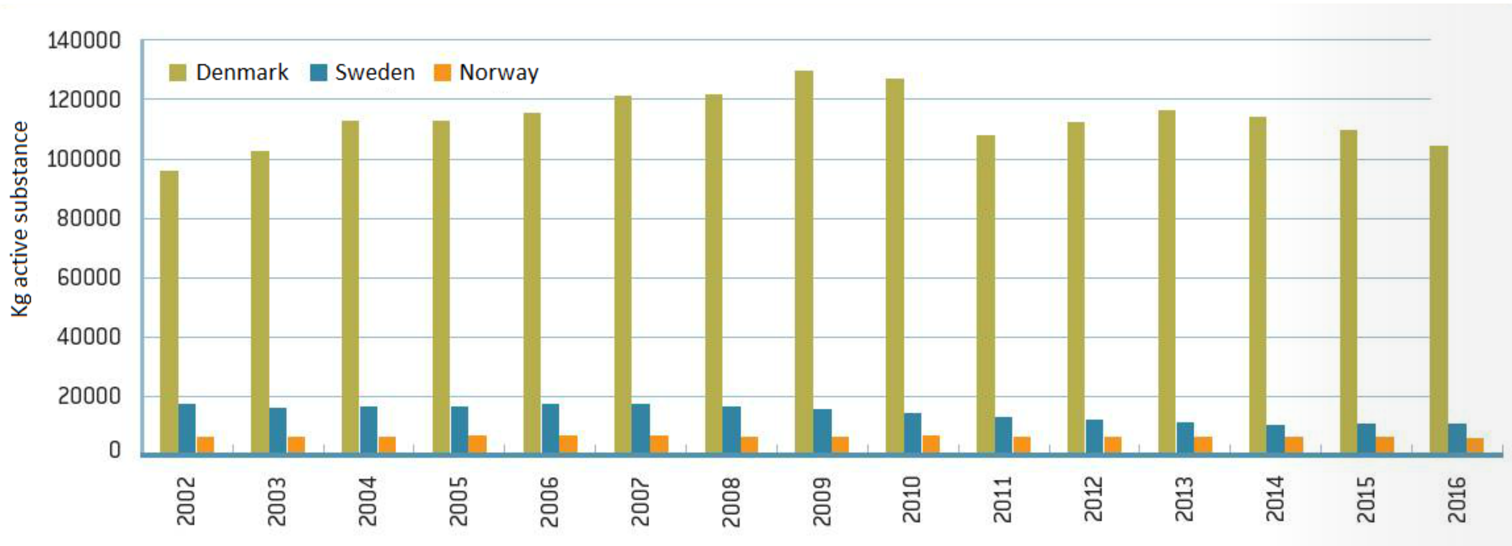


Figure 6: Number of kg active substance of antibiotics sold in the Scandinavian countries. Changes in the number of animals may affect trends in statistics on the use of antibiotics. The Norwegian figures are updated with preparations registeres for fish but used for livestock. References: VetStat, Miljø- og Fødevareministeriet, Fødevarestyrelsen.
Swedres-Swarm 2016. Consumption of antibiotics and occurrence of antibiotic resistance in Sweden. Solna / Uppsala.
NORM/NORM-VET 2016. Usage of Antimicrobial Agents and Occurence of Antimicrobial Resistance in Norway. Tromsø / Oslo 2016.

Figure 7 shows sale of antibiotics for food producing animals, including horse, in 29 European countries in 2014.

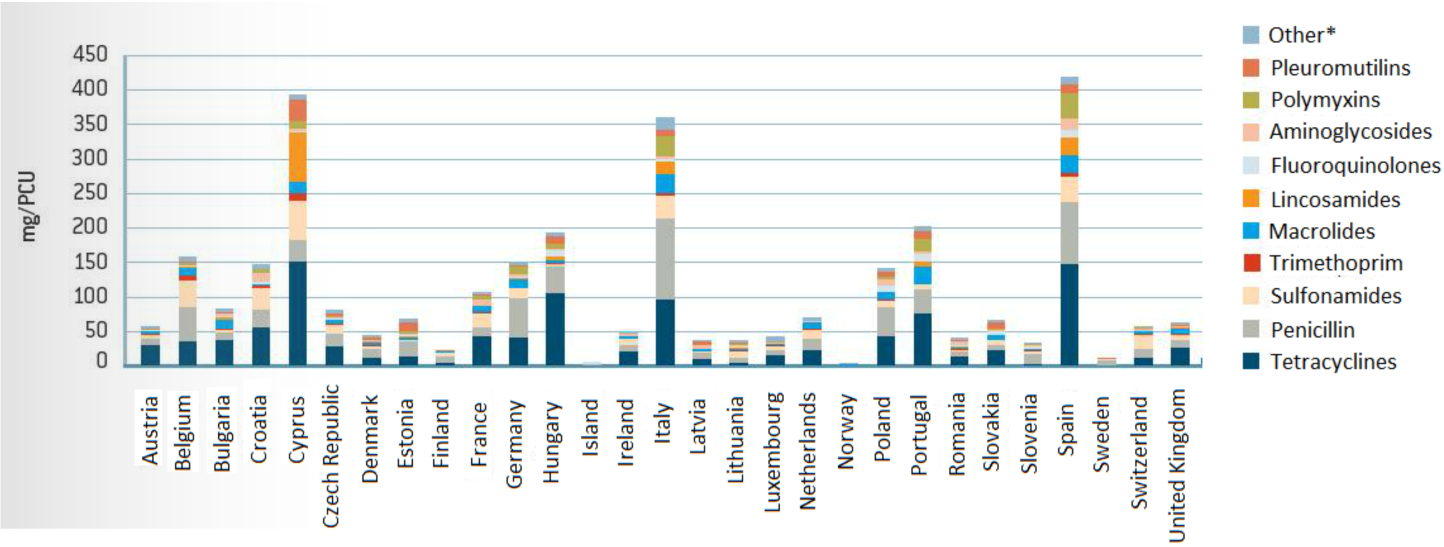


*Figure 7: Sale of antibiotics to food producing animals, including horses, in 29 European countries in 2014. *Other includes amphenicols, cephalosporins, other quinolones and other antibiotics (classified as in the ATC Vet System). Obtained from European Medicines Agency, European Surveillance of Veterinary Antimicrobial Consumption, 2016 "Sales of veterinary antimicrobial agents in 29 European countries in 2014".*

Picture 1: In organic broiler production in Norway just one of four producers used antibiotics one time between 2012 and 2017. This picture is from Hovelsrud farm where the organic chickens have lots of environmental enrichment, roughage, a porch and access to an outdoor area when the weather allows it. Taken by: Peggy Haugnes

Use of anthelmintic for organic livestock in Norway:

There are no registrations on the use of anthelmintic that is specific for organic livestock in Norway. It is usual to use anthelmintic to prevent parasites in production with sheep and cattle on pasture in Norway. The anthelmintic are used mostly for young animals. Maybe they use a little less of this in organic versus conventional production, but since we do not have any registrations about this, we cannot say this for sure.

Table 2 shows the 8 most reported preventive treatments for cattle in 2016, and table 3 shows the 7 most reported preventive treatments for sheep in 2016.

Table 1: The 8 most reported preventive treatments for cattle in 2016. Reference: Dyrehelseportalen.

Rank	Code	Preventive treatment	Quantity
1	780	Dehorning	118 652
2	766	**Preventive treatment multicellular parasites**	29 108
3	888	Preventive treatment of vitamin and mineral deficiency	7 990
4	746	Preventive treatment infectious respiratory infections	6 337
5	743	Preventive treatment anthrax emphysema	4 091
6	751	Preventive treatment respiratory diseases – nonspesific	3 587
7	797	**Preventive treatment external parasites in general**	419
8	776	**Prevventive treatment single-cell parasites (ex. Coccidia)**	385

Table 2: The 7 most reported preventiv treatments for sheep in 2016. Reference: Dyrehelseportalen.

Rank	Code	Preventive treatment	Quantity
1	710	Vaccination against clostridial infections	320 258
2	774	Vaccination against pasteurella/clostridial infections	242 505
3	888	Preventive treatment of vitamin and mineral deficiency	25 714
4	766	**Preventive treatment multicellular parasites**	12 446
5	764/765	Preventive treatment stomach/intestinal inflammation	7 832
6	728	**Preventive treatment toxoplasmosis**	7 486
7	776	**Preventive treatment single-cell parasites (ex. coccidia)**	7 275

Picture 2: It is usual to do treatments with anthelmintic in sheep production in Norway. This picture is of sheep on a cultivated pasture. Taken by: Peggy Haugnes

Use of conventional bedding material (straw) for organic livestock in Norway:

There are no registered amounts/numbers on the use of conventional bedding materials, as straw, that are used for organic livestock in Norway. But we know the amounts of produced grains in Norway, and the proportion of the grains that is produced organic.

Only 3,0 % of the area in Norway is cultivated land, and around 30 % of this is suitable to grow food grains (KILDE). In practice, we use around 90 % to grow animal feed which is being converted into meat, milk and eggs. Most of the grains in Norway are cultivated in the east, especially in Østfold, Akerhus and Hedmark, there are almost no grains cultivated in the west and the north of Norway. In 2016, it was harvested 1 326 000 tons of grains in Norway, the amount of organic grains, included peas and oil seed was 14 7000 tons. This means that 1,2 % of the total Norwegian grain production in 2016 was organic (SSB 2017).

Probably most of the organic farmers that use straw as bedding for animals have to use mostly conventional straw, because there is very little production of organic grains in Norway and therefor very little access to organic straw from organic grain production.

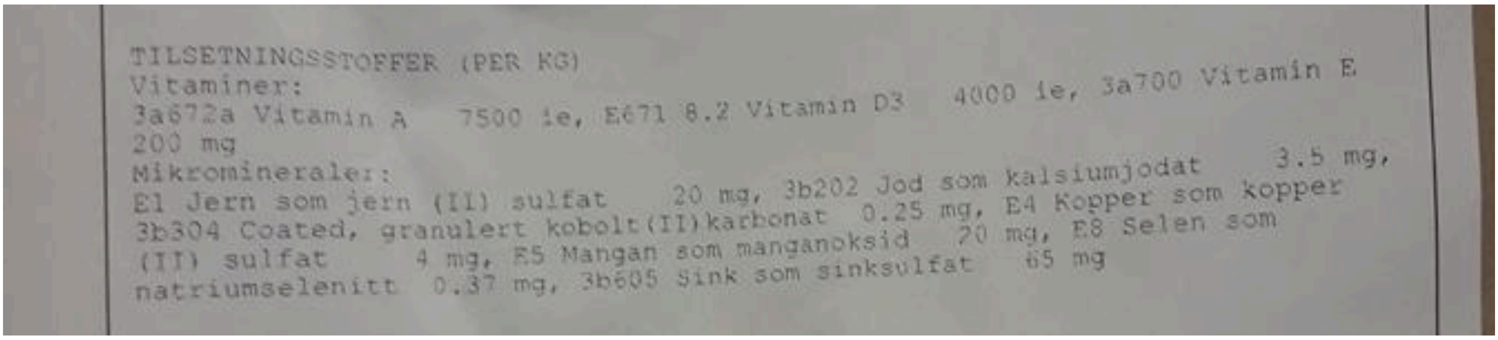
Picture 3: Most of straw used in organic production in Norway are used for cattle and sheep. But the few farmers who have organic pigs outside with cabins also uses alot of straw so that the pigs can lie down on a soft and dry bedding. This picture is from Holm Søndre who produces organic pig meat for Grøstad Gris. Taken by: Peggy Haugnes

Use of synthetic vitamins for organic livestock in Norway:

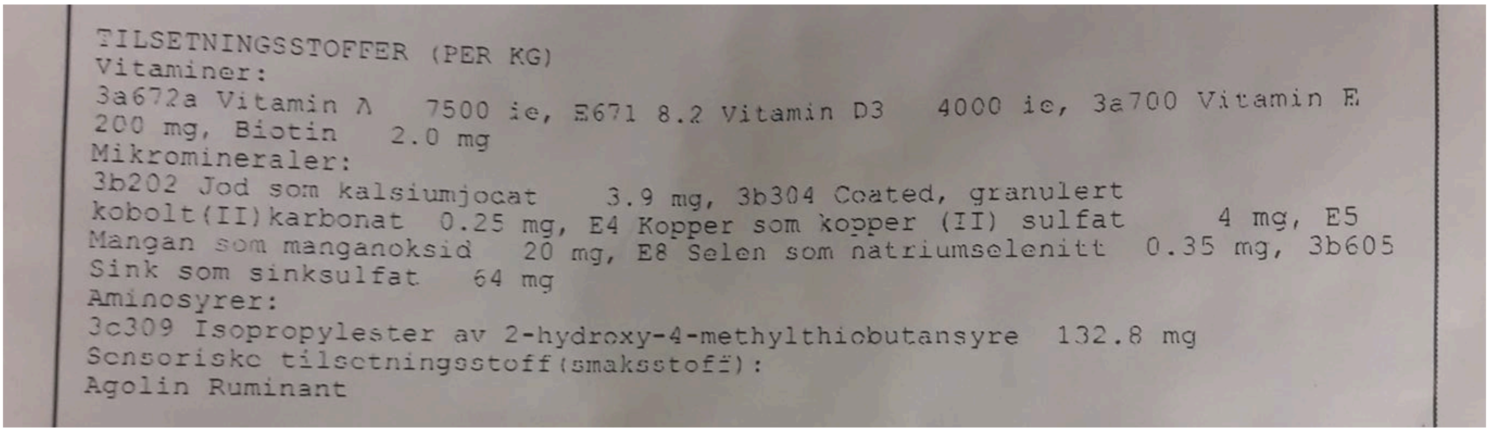
In Norway there are only Felleskjøpet (FK) who produces organic concentrates for cattle, sheep, pigs and poultry. Organic farmers in Norway who buy and use organic concentrates buys this from FK.

When we asked FK about synthetic vitamins in organic concentrate for livestock they answered that this is a question that is simple to answer because they use the same types and amounts of synthetic vitamins in organic concentrates as they use in conventional concentrates. They don't add "natural vitamins" since this is known to be exposed to oxidation by mixing with minerals and heat treatment (as is the case for the concentrate). Everything they use is non-GMO.

The contain of synthetic vitamins in concentrate for dairy cows, both the organic and the conventional, per kg concentrate is vitamin A: 5000 IE, vitamin D: 2000 IE, and vitamin E: 80 mg.


TILSETNINGSSTOFFER (PER KG)
Vitaminer:
3a672a Vitamin A 7500 ie, E671 8.2 Vitamin D3 4000 ie, 3a700 Vitamin E
200 mg
Mikromineraler:
E1 Jern som jern (II) sulfat 20 mg, 3b202 Jod som kalsiumjodat 3.5 mg,
3b304 Coated, granulert kobolt(II)karbonat 0.25 mg, E4 Kopper som kopper
(II) sulfat 4 mg, E5 Mangan som manganoksid 20 mg, E8 Selen som
natriumselenitt 0.37 mg, 3b605 Sink som sinksulfat 65 mg

Picture: This picture shows feed additives included the content of synthetic vitamins in Natura Sau, organic concentrate for sheep from Felleskjøpet in Norway. This concentrate contains synthetic vitamin A: 7500 IE, synthetic vitamin D3: 4000 IE, and synthetic vitamin E: 200 mg.


TILSETNINGSSTOFFER (PER KG)
Vitaminer:
3a672a Vitamin A 7500 ie, E671 8.2 Vitamin D3 4000 ie, 3a700 Vitamin E
200 mg, Biotin 2.0 mg
Mikromineraler:
3b202 Jod som kalsiumjodat 3.9 mg, 3b304 Coated, granulert
kobolt(II)karbonat 0.25 mg, E4 Kopper som kopper (II) sulfat 4 mg, E5
Mangan som manganoksid 20 mg, E8 Selen som natriumselenitt 0.35 mg, 3b605
Sink som sinksulfat 64 mg
Aminosyrer:
3c309 Isopropylester av 2-hydroxy-4-methylthiobutansyre 132.8 mg
Sensoriske tilsetningsstoff(smaksstoff):
Agolin Ruminant

Picture: This picture shows feed additives included the content of synthetic vitamins in Formel Sau, conventional concentrate for sheep from Felleskjøpet in Norway. This concentrate contents the same amounts of synthetic vitamins as the organic concentrate for sheep.

Other than concentrates, there are several supplementary feed or vitamin- and mineral mixtures that are allowed to use for organic livestock in Norway. These mixtures also usually contain synthetic vitamins. For example, Felleskjøpet have a supplementary feed for all livestock species called Natura E-konsentrat which contains 15 000 mg of synthetic vitamin E per kg. This is meant to be given when needed for extra vitamin E. They also for example have mineral feed for use in full feed called Natura Fullfôr Total, which contains synthetic vitamin A, D3 and E. And they have different kinds of mineral stones with vitamins, for example one called Natura Storfe VM-block with synthetic vitamin A, D3 and E. This mineral stone is meant to be given after appetite for animals that receive less than 25 % of their ration (dry matter basis) as concentrates.