

## Quantitative and qualitative overview and assessment of literature on animal health in organic farming between 1991 and 2011 – Part I: general and cattle

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### Abstract

On the subject of “animal health in organic farming” an evaluative review and assessment of publications has been conducted. This overview is intended to provide recommendations for future research to optimize the organic farming. The literature search covers the period from 1991 to 2011. Articles from international and national magazines, some with a peer-review process, other periodicals and reports have been collected. A total of recorded 569 publications (thereof 33 % reviewed) related to animal health in organic farming were found. This included articles on general topics (42 publications), on cattle (211), on pigs (181), on poultry (100), on small ruminants (25) and on other species (10). A majority of the studies deals with “status quo - representations” (n = 222). Particularly comparative studies within organic production systems are rare (n = 86). Less than half of the investigations carried out a comparison with the aid of a control group or cohort (n = 205). Of 417 studies which originated from organic or comparable farming systems only 103 were published reviewed. In addition, there is a lack of research to examine a practical approach (n = 124). In organic cattle farming frequently the subject of mastitis has been edited. Problems such as lameness, metabolic disorders or calves’ diseases were studied subordinately. The problems concerning animal health in organic as in conventional farming are comparable. In general, an implementation-oriented, but at the same time high-quality scientific research is needed to optimize the conditions for animal health and animal welfare in organic farming.

*Keywords: production animal, animal husbandry, animal welfare, ecological farming, organic livestock production, organic cattle, Cattle, organic agriculture, animal health*

### Zusammenfassung

#### Quantitative und qualitative Übersicht und Bewertung der Literatur über Tiergesundheit in der ökologischen Tierhaltung zwischen 1991 und 2011 – Teil 1: Allgemein und Rinder

Dazu ist eine bewertende Zusammenfassung und Einschätzung der Veröffentlichungen durchgeführt worden. Dieser Überblick soll Empfehlungen für die zukünftige Forschung zur Optimierung des ökologischen Landbaus aussprechen. Die Literaturrecherche umfasste den Zeitraum von 1991 bis 2011. Artikel aus internationalen und nationalen Zeitschriften, aus Berichten sowie Abschlussarbeiten wurden dafür zusammengetragen. Insgesamt wurden 569 Veröffentlichungen (davon 33 % reviewed) mit Bezug zur Tiergesundheit im ökologischen Landbau erfasst, davon zu allgemeinen Themen (42 Artikel), zu Rindern (211), Schweinen (181), Geflügel (100), Kleinen Wiederkäuern (25) und sonstigen Tierarten (10). Ein Großteil der Untersuchungen beschäftigen sich mit Status quo - Darstellungen (n = 222). Besonders vergleichende Studien innerhalb ökologischer Produktionssysteme sind eher selten (n = 86). Weniger als die Hälfte der Studien führte einen Vergleich mit Hilfe einer Kontrollgruppe oder Kohorte durch (n = 205). Von 417 Untersuchungen, die aus ökologischen oder vergleichbaren Haltungssystemen stammten, wurden nur 103 reviewed publiziert. Außerdem mangelt es an Forschungsprojekten, die praktische Lösungsansätze untersuchen (n = 124). Für die ökologische Rinderhaltung wurde gehäuft das Thema Mastitis bearbeitet. Probleme wie Lahmheit, Stoffwechselerkrankung oder Kälberkrankheit wurden eher nachrangig untersucht. Die Probleme bei der Gesundheit in der ökologischen wie in der konventionellen Tierhaltung sind vergleichbar. Eine umsetzungsorientierte, aber dabei anerkannt hochwertige wissenschaftliche Forschung ist notwendig, um die Bedingungen für Tiergesundheit und Tiergerechtigkeit auch im ökologischen Landbau zu optimieren.

*Schlüsselwörter: biologische Nutztierhaltung, ökologische Nutztierhaltung, Tiergesundheit, ökologische Rinderhaltung, Tierwohlbefinden, Rind, ökologischer Landbau*

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## Introduction

A major criterion for the quality of organic animal husbandry should be exemplary good animal health as part of animal welfare. This goal is one of the challenges of the future to demarcate organic from conventional animal husbandry and must be a response to increasingly critical consumer consciousness. At present a non-professional image of an idealized animal husbandry is still frequently used as a figurehead of organic agriculture. The allegedly greater animal well-being serves as an argument to purchase organic food of animal origin.

The valid European-wide regulations (see box) serve as the basis for animal husbandry oriented to the principles of animal fairness and the well-being of the domestic livestock. Animal health is to be assured by preventive measures.

Some authors doubt that animal health in organic farming is actually better than in conventional agriculture (Ruegg, 2009; Sundrum et al., 2004). Multiple studies on some aspects of organic animal husbandry and several overviews were undertaken in recent years, but generally accepted indications of better animal health could not be found.

Certain scopes of action, in accordance with organic guidelines, could promote animal health: e.g., increased movement could induce a longer life span and support easier births by ensuring a higher level of fitness of the cow; and increased well-being could cause a better fertility (intermediate calf times, culling rates, born farrows per sow and year) or could improve social behaviour (feather pecking, cannibalism).

### Council regularisation (EC) NO 834/2007 and Commission regularisation (EC) NO 889/2008

[Laying down detailed rules for the implementation of Council regularisation (EC) NO 834/2007] define the rules, which are European-wide binding for all organic animal husbandry. Some excerpts are represented here.

#### EC No. 834: (highlighting of words by authors)

Reasons:

(17) Organic stock farming should *respect high animal welfare standards ... animal-health management should be based on disease prevention. ...*

Article 3

Organic production shall pursue the following general objectives:

... aim at producing a wide variety of foods and other agricultural products that respond to consumers' demand for goods produced by the **use of processes that do not harm** the environment, human health, plant health or **animal health** and welfare.

Article 5:

... the *maintenance of animal health* by encouraging the natural immunological defense of the animal, as well as the selection of appropriate breeds and husbandry practices;

... the observance of a *high level of animal welfare* respecting species-specific needs;

Article 14

... husbandry practices, including stocking densities, and housing conditions shall ensure that the developmental, *physiological and ethological needs of animals are met*;

... *any suffering, including mutilation, shall be kept to a minimum* during the entire life of the animal, including at the time of slaughter

#### EC No. 889: (highlighting of words by authors):

Reasons:

(10) ... specific housing conditions should serve **a high level of animal welfare, which is a priority in organic livestock farming** ...

(16) *Animal-health management should mainly be based on prevention of disease. ...*

Articles 10 to 18:

... *minimum surface* for indoor and outdoor areas ...

... At least half of the indoor surface area ... shall be solid, that is, *not of slatted or of grid construction*.

... dry bedding strewn with *litter material* shall be provided

... Operations such as attaching *elastic bands to the tails of sheep, tail-docking, cutting of teeth, trimming of beaks and dehorning* shall not be carried out routinely in organic farming. ...

*Mutilation* such as clipping the wings of queen bees is prohibited.

Article 24:

... animals become sick or injured they shall be *treated immediately*, ...

Phytotherapeutic, homeopathic products, trace elements and products listed in Annex V, part 3 and in Annex VI, part 1.1. shall be *used in preference* to chemically-synthesized allopathic veterinary treatment or antibiotics, *provided that their therapeutic effect is effective* for the species of animal, and the condition for which the treatment is intended.

If the use of measures referred to in paragraph 1 and 2 is not effective in combating illness or injury, and if treatment is essential *to avoid suffering or distress of the animal*, chemically-synthesized allopathic veterinary medicinal products or antibiotics may be used under the responsibility of a veterinarian.

However, there are also questionable regulations which could hamper good animal health: e.g., the danger of injury and infection for the animal rises with the use of an outdoor run and pasture going. In this case, increased pain, suffering and unsatisfactory animal health can be connected to the regulations as well as less food security for the final product. This could result in the necessity for more veterinary medicinal products and more disinfectants. A second example is the restriction on the number of treatments [(EC) No 889, Article 24 (4)] to only one treatment during the whole life of fattening pigs and broiler. This could influence the therapeutic efforts of farmers, followed by a negative impact on health and welfare of livestock (Koopmann et al., 2011). The priority of complementary medicine could negatively affect the timely (and thus on the disease process adapted quantity of veterinary drugs) administration of effective, chemical-synthetic medicines.

For the advancement of organic animal husbandry a detailed and systematic review and evaluation of the available appropriate announcements and publications, both in the scientific and in the non-scientific range, are necessary. These review-data should promote some justified recommendations for future research, which should support the optimisation of organic animal husbandry. This overview will focus on general aspects and the health of cattle (Part I) and on the health of pigs, poultry and others (Part II).

## Methods

Firstly a literature search was done to investigate literature on animal health in organic farming. The priority laid on the main species cattle, pigs and poultry. After checking all the abstracts, on the second step, a subsample of papers was assessed completely. Selection criteria are described below.

The search included international and national journals with a peer review procedure, publications of other journals and literature of special databases on organic farming as well as diploma and doctoral theses. The literature search was conducted between July 2011 and December 2011 using the databases Medline (PubMed), ISI Web of Science and Organic Eprints. These are the major databases in the area of veterinary medicine and animal health. Access to PubMed and Organic Eprints, a database especially on organic farming, are free of charge and both are therefore usable regardless of this research project. Only articles published between January 1991 and December 2011 were included. Journal articles which were not published in English, German, French, Dutch or Danish were excluded.

Factor considered in the search on animal health in organic farming included the search terms: animal species (*cattle, dairy, swine, pig, pigs, sow, poultry, chicken, hens,*

*laying hens, fowl, and animal*); animal housing and health (*complementary therapies, animal husbandry, animal disease, animal welfare, housing, health, animal health and position*) and organic farming. Additionally special search terms were used: *organic agriculture, organic system, organic, biological, biologically, ecological, nonconventional, extensive, low input, sustainable, agriculture research, lameness, pasture, grazing, mortality, risk factors, productivity, outdoor and enrichment*. The literature review was not limited to only organic studies. Articles on alternative or extensive farming were added as well.

The so-called grey literature (master and doctoral thesis and similar) were determined, in addition, in cooperation with German universities and advanced technical colleges. The universities and institutes were selected on the basis of their focus on agriculture and animal health.

The literature was managed using EndNote® (version X4; Thomson Reuters). An MS-Access® – database (Microsoft Office Access; 2003) was created from these data.

To ease the search in the database it is possible to sort the results according to different selection criteria. Categories for assessment, containing qualitative and content aspects, were added into this database.

The qualitative assessment considers the scientific excellence of the study and the source given. Case reports and personal opinions which do not underpin their knowledge with scientific studies are of low quality. Scientific studies, particularly those which have been carried out using a control group, possess a higher level of evidence. Articles published in peer reviewed journals belong to the group with the best quality. After a short overview, we decided that it was not useful to implement criteria like impact factor of journal, quality of statistics and number of replicates additionally. Furthermore, it was determined whether the article contains a status quo analysis or a comparison study of the different management forms (e.g. conventional or ecological).

The content based assessment considers articles with selection criteria like "species", "production systems" (e.g. milk, eggs, meat) or "disease". Subcategories were classified for certain illnesses. E.g. the category "microbiology" included articles which examine bacterial, protozoal as well as viral illnesses. An additional indexing occurs in the ecological status of the study farm (Yes, No), whether a solution attempt is offered (Yes, No) and whether future research needs are found (Yes, No).

Finally, the articles were classified by their estimated importance for concrete realization in organic husbandry. Articles which major content focuses on animal health in organic farming were included into the first category. The second category provided articles which include relevant aspects on animal health in organic farming, but with small deficiencies (e.g. the article contains two research

aims and only one is relevant to animal health, animal health in alternative farming for example on pasture is described). Studies which describe only aspects of the animal health in farms similar to organic farming were sorted into the category three.

93 articles with focus on practical aspects of organic farming and/or declared research needs were read and evaluated. 53 of those have been published in peer-reviewed journals). Finally a small evaluation-text was added to the Access © – database as well.

## General Results

A total of 569 publications on animal health in organic farming were included in the Access© -database. The results provide an overview of the literature on animal health in organic farming. 423 articles care directly for farmer's practice, 127 are more concerning theoretical knowledge, 19 may interest the consumer. The number of articles on the specific species and on organic farming is shown in Table 1. Articles describing at least one organic farm were defined as an „organic“ article. Accordingly articles describing, e.g., comparative studies on conventional and organic farms are counted in this category. As the search was limited not only to organic studies, articles on alternative or extensive farming were added as well. Studies which were not classified as organic could still provide valuable knowledge for animal health in organic farming as well. These studies were, e.g., on the animal health at pasture, stables with outlet or housings with particular high level of animal welfare.

Table 1:  
Number of organic articles

Species	Number of articles	
	Total	Thereof „organic“
General	42	40 (95 %)
Cattle	211	156 (74 %)
Pig	181	117 (65 %)
Poultry	100	76 (76 %)
Small ruminants	25	21 (84 %)
Other	10	7 (70 %)
Total	569	417 (73 %)

The origin of the studies on only organic farming was included in Table 2. The database includes national and international literature for which the results could be relevant for German conditions. Nearly half of articles came from Germany (46 %), followed by Scandinavia (16 %) and 8 % from Switzerland and the Netherlands, respectively.

One reason could be a bias because „grey“ literature from German universities was included.

Regarding the relative importance of the German market for organic food, the small part of German research publications is interesting. Austrian research on organic husbandry is probably not smaller as the Swiss one, but generates nearly half of searchable papers.

Most articles are originally written in English (n = 287) or German (n = 271).

Table 2:  
Origin organic articles

Country	Organic articles	Percent
Germany	192	46 %
Denmark	43	10 %
Netherlands	32	8 %
Switzerland	28	7 %
United Kingdom	22	5 %
Schweden	20	5 %
Austria	17	4 %
more than one country	33	8 %
others	30	7 %
Total	417	100 %

However, not only the number of the studies is important, but also the quality of source (Table 3). Journals with a „peer review“ procedure should ensure high quality. 33 % of retrieved articles met that criterion. Only 18 % of the studies done on organic farms are published with high quality.

Table 3:  
Quality of the literature source

Source Quality	Number of articles (thereof „organic“)	Percent (thereof „organic“)
Peer-Review	186 (103)	33 % (18 %)
Scientific	375 (311)	66 % (55 %)
Other	8 (3)	1 % (0,5 %)
Total	569 (417)	100 % (73,5 %)

The second category „Scientific“ included scientific conference contributions (which could be sometimes a personal opinion), final reports and scientific works as for example theses. This category includes the greatest amount of literature. Conference contributions are often a short description of a study and therefore sometimes insufficient. Final works, like theses, are mostly accessible in libraries and less often found in online databases. Therefore, their propagation and knowledge transfer is more

difficult. The category "Other" contains publications in non-scientific technical journals.

This result indicates that more studies on organic farming should have a high scientific quality which allows to publish reviewed.

The procedures of the study itself were assessed as well. For our assessment it was important whether farming systems have been compared (Table 4). Possible differences were examined between alternative and conventional systems and between organic systems. Comparative studies in-between organic farms could be important to improve the animal health. However, this category was rare in the available literature (15 %). Most of studies describe the present state. Their results recognise problems, but no solutions or improvements can be examined.

Table 4:  
Type of the studies

Study procedure	Number of articles (thereof "organic")	Percent (thereof "organic")
Status quo analysis	222 (174)	39 % (30,5 %)
Comparison conventional x conventional (alternative)	69 (0)	12 % (0 %)
Comparison conventional x organic	75 (73)	13 % (13 %)
Comparison organic x organic	86 (86)	15 % (15 %)
no classification	117 (84)	21 % (15 %)
Total	569 (417)	100 % (73,5 %)

Table 5:  
Quality of Studies

Study quality	Number of articles (thereof "organic")	Percent (thereof "organic")
Meta-analysis	3 (2)	1 % (0,5 %)
Review	41 (26)	7 % (5 %)
study with control group	205 (139)	36 % (24 %)
study without control group	211 (153)	37 % (27 %)
Case report	14 (12)	2 % (2 %)
Personal opinion	21 (15)	4 % (3 %)
no classification	74 (70)	13 % (12 %)
Total	569 (417)	100 % (73,5 %)

The quality of study-design could be very different (Table 5). Studies which compare different groups with each other have a high likelihood of valid results. The groups can either based on given circumstances (farms with stable or pasture are compared) or be determined by the test protocol (two different strategies of treatment are exam-

ined on a farm). Only 24 % of studies on organic farms belong to this category. Sometimes case reports and personal opinions which are of low quality as they do not underpin their knowledge with scientific studies, are published as „Scientific“ – paper, e.g. in a conference report.

In the future it will be most important to have results from comparative studies of high quality, to clarify free of doubt the advantages of organic farming system and the best organic practice available for the farmer.

Some publications propose a way to resolve problems (n = 124). 74 out of those are done on organic farms.

59 articles describe a successful solution for the focussed problem. The main topics of these publications are specific illnesses and conditions of husbandry with 47 % (n = 28), respectively. Species in these articles are represented as pigs 41 % (n = 24), cattle 30 % (n = 18), and poultry 29 % (n = 17).

296 (52 %) of all articles may have a high relevance and importance, 149 (26 %) may have a good relevance for solutions in organic animal health problems.

A version of the created Access© -database will be accessibly free of charge at the website of the vTI.

## Results of literature search on health of cattle

78 (37 %) of the 211 publications concerning cattle were published in a scientifically reviewed journal. A predominant part of 81 % (n = 170) from all retrieved articles deals with health problems of dairy cows. Only 9 % of the articles concern with young cattle and 5 % with mother cows. Following the search order, the main focus of retrieved publications lay on the investigation of "illnesses" (62 %, n = 130). The remaining articles focus aspects of "housing" (26 %, n = 55), improvement of "performance" (9 %, n = 18) or "genetics" (3 %, n = 7).

Key aspects of publications on "illnesses" are presented in Table 6.

Table 6:  
Illnesses of cattle differentiated by main aspects

Main aspect	Number of publications (n)
udder health	56
disease of locomotive system	14
parasites	12
metabolism disorder	11
problems of reproduction	8
other infections	7
without classification	13
others	9
Total	130

## Review of selected articles on health of cattle

In the following section the main conclusions of the retrieved articles on health of bovine livestock are drawn.

The combination of an expanding organic dairy production and limited and inconsistent valuable publications on animal health means that additional studies are an urgent issue. The most important health issue in dairy cows in the western world is poor udder health, often expressed as mastitis (Fall et al., 2009). Many studies have been conducted on udder health in organic husbandry. Similar to conventional management, in organic herds most cows were culled due to poor udder health (Ahlmán et al., 2011). Still, studies clarify that the incidence of clinical mastitis treated by a veterinarian were lower in organic herds than in conventional herds (Bennedsgaard et al., 2003; Hamilton et al., 2006), but often organic farmers do not use the same criteria to detect and treat clinical mastitis (Ruegg, 2009). However, substantial variations exist both between and within farm types (Langford et al., 2009). On the other hand, one study indicates that the same udder health status was achieved in organic or conventional management types, which could imply that organic farmers perform a better udder health management as they achieved this status with restrictive antibiotic policy (Fall et al., 2009). But it could be as well the result of either a truly better udder health or lack of treatment and poor bookkeeping routines (Fall et al., 2009; Hamilton et al., 2006; Garmo et al., 2010). In general, the evaluation of veterinary treatments has been described as a questionable indicator of herd health, because of different treatment thresholds for different farmers and diseases (Bennedsgaard et al., 2003). No differences were found when investigating the time /number of veterinary-treated cases of mastitis between organically and conventionally managed cows (Fall et al., 2009).

In the future high quality studies should be performed, e.g., with a control group. They should focus as well on determining animal health with clinical and bacteriological examinations. Furthermore, the complete use of antibiotics and other medications should be monitored. Antibiotics were regularly used for dry-cow management in 65 % of all study farms, although the regulations for organic dairy production prohibit the application of these substances for other than curative reasons (Busato et al., 2000). This leads to the conclusion that especially investigations of wise dry cow management in organic farming without setting back animal health should be carried out.

More high quality research is needed to further elucidate the mechanisms and the associations between high levels of concentrates and udder disease in dairy cows (Hamilton et al., 2006).

Furthermore, little data is available supporting the clinical efficacy of alternative treatments (Ruegg, 2009). Or-

ganic farmers reported varied success rates for alternative treatments and many farmers were gathering the information on homeopathic remedies and other alternatives from sales representatives (Langford et al., 2009). On the other hand Klocke et al. (2010) indicate a way of implementing "Comparative Alternative Medicine" in routine treatment processes. Anyhow, there is no indication that a presumably lower use of antibiotics in organic dairy farms has resulted in frequency of antibiotic resistance considerably different from conventional farms (Busato et al., 2000a, Roesch et al., 2006). In addition, measures to postpone the spread of resistance against antimicrobials should be examined in organic farming as well.

No differences were found in general health and longevity between organically managed cows and conventionally managed cows (Fall et al., 2008). This similarity between organic and non-organic farms in most respects indicates that cow housing and health on organic dairy farms is neither compromised by the regulations, nor considerably better than on non-organic farms (Langford et al., 2009).

The available literature shows a low amount of studies about animal health of calves, young stock and of mother cows. Future studies in these areas would be important to recognise and avoid problems in these production systems. Sometimes housing of young stock in organic farming could be improved. Meantime inadequate equipment and barns could cause poor hygiene (Hamilton et al., 2002). Organic producers reported more frequently than conventional farmers that they had observed poor weight gain and/or diarrhoea in their calves in the first grazing season, probably due to parasite infections (Svensson et al., 2000). Furthermore, future research could lie as well in the problem of cross suckling of calves in relation to group housing (Georg et al., 2004).

Overall, the prevalence of hock lesions and hock swellings was less on organic as compared with nonorganic farms (Rutherford et al., 2008). Additionally, cows housed on straw and under organic management have the lowest chance of being lame (Rutherford et al., 2009; Barker et al., 2010). The studies showed substantial variation between the top performing and the poorest herds, within any farm type. This indicates that organic certification, although it has a beneficial impact, does not always necessarily ensure cow comfort (Rutherford et al., 2008). Further efforts are needed to develop new, and to optimize existing housing systems so that they meet the animal welfare requirements in organic dairy farms (Busato et al., 2000b). Additionally, breed can be a variable to reduce lameness, as pure HF-herds show higher lameness prevalence (Barker et al., 2010). Further studies to monitor breeds which may be better adapted on organic farming conditions could be interesting.

In organic farming parasites were common, even if not always clinically evident (Hamilton et al., 2002). Svensson

et al (2000) showed in a questionnaire study that there were no differences between organically and conventionally raised cattle, in terms of the presence of parasite-induced damages at slaughter. Better knowledge about the effects of strategic nutritional supplementation on the level of parasitism in young cattle needs to be attained through further experimentation (Höglund et al., 2001). Future studies should focus on pasture grazing from the perspective of the parasite load on cattle, including targeted treatment systems to reduce the amount of deworming drugs and to postpone the spread of anthelmintic resistant worm populations in organic farming (Höglund et al., 2009; Kleinschmidt et al., 2010)

Bidokhti et al. (2009) suggest that organic farm management may be effective in reducing virus infections relative to conventional farming methods. However, further studies will be required to substantiate this hypothesis. Furthermore, possible risk factors at organic farms, e.g., passenger traffic and less efficient disinfection should be analysed, as e.g., no disinfectant effective against *Coccidia* spp. oocysts is allowed in organic farming (Koopmann et al., 2011).

However, organic farming is to demonstrate an improved animal health and welfare compared to mean conventional farms. That's why research is needed about the possibilities of management or housing to improve animal health (e.g., mastitis, lameness) in organic farming. Additionally, necessary requirements should be available before a farm gets certified for organic production, where animal welfare is expected to be a top priority (Hamilton et al., 2002). However, the assessment of animal health is a difficult task in the absence of obvious standard health indicators (Fall et al., 2009). There is a lack of implementable and standardized methodology to measure animal welfare especially in larger populations (Busato et al., 2000b). To measure wellbeing by indicators the Welfare Quality®-project gives advises (Welfare Quality® consortium, 2009). It lacks until now the implementation of proposed indicators into the daily work of advice- and control bodies and the financial appreciation of animal welfare. Therefore, it is an important task for the future to develop high quality scientific studies which define objective indicators to perceive and quantify animal health in organic farming.

## Conclusion and Outlook

High-quality studies in organic husbandry are rare, mainly comparative studies with control groups within the organic system are essential to perform in the future.

To achieve no bias of the results, data should be raised increasingly on the basis of scientific investigations and in a scientifically controlled environment. Status quo analyses matter to receive actual data from farms and to recog-

nise the existing problems. Nevertheless, universally valid statements concerning the future improvement of animal health in organic husbandry are hard to be pulled out of these data because of the bias caused by a great amount of diversities between the different farms. Even as some of these differences may be measurable some are not e.g. the personal traits of the farmers. Studies to investigate solution attempts are lacking as well.

The research needed on health in organic cattle farming may arise from gaps of knowledge on:

- Improvement of management and housing
- Prevention and treatment of infections
- Parasite's prevention and treatment
- Lameness and respiratory illness
- Studies on young stock and feeder cattle as well as mother cows
- Studies on hornless cattle

In general, similar problems on animal health exist for both organic farming and conventional farming. Beside the high influence of individual management skills of the owners, organic husbandry has to have an outstanding good status of animal health as a basic goal. The realization of that goal would exclude all possibilities of doubts and meet the consumer's perceptions. Finally, objective indicators especially on good animal health and welfare are needed to implement quantitative criteria which could help all those farmers who realise completely an outstanding good status of animal health, in example by financial support.

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## Conflict of interest

The authors have no financial or personal relationships with other people or institutions that could have influenced or biased the content of this review.

Even as a large amount of research need could be determined, the authors can give no guarantee of completeness.

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