

# Hog Farms and Their Impact on the Quality of Life of Rural Populations

**A SYSTEMATIC REVIEW OF THE LITERATURE**

Direction des risques biologiques,  
environnementaux Et occupationnels

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### EXTERNAL REVIEW

This systematic review was submitted by the National Collaborating Centre for Environmental Health to a scientific peer review committee comprised of two external reviewers whose identity was not disclosed to the authors of the document. We thank them for their thoughtful comments.

Our thanks go to Ms Katia Raby, administrative officer in the INSPQ Health and Environment Unit, for her excellent work in revising the text and formatting the document.

### CONFLICT OF INTEREST

The authors and partners hereby declare that they have no conflict of interest or appearance thereof with respect to the present research.

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## EXECUTIVE SUMMARY

Hog farms generate controversy and conflict in rural communities because of concerns relating to health and the environment. Moreover, these concerns may affect the health of communities exposed to the farms. As a result, public health professionals are interested in the psychosocial dimensions of this issue, particularly in Quebec, where they act as resource persons during the public consultations required by the government before a hog farm can be developed.

### Approach

This systematic review of the literature documents the impacts of hog farms on the quality of life of rural populations, in terms of mental and social well-being, under conditions comparable to those existing in Quebec. The research strategy is based on the approach taken by the National Institute for Health and Clinical Excellence in the United Kingdom (NICE), while integrating other recognized approaches in order to take into account both qualitative and quantitative studies. Throughout this process, the writing team was assisted by a scientific committee and an advisory committee comprised of potential users of the systematic review.

The research strategy chosen (Figure 1) involved consulting eight scientific literature databases and three databases specializing in grey literature. This research was supplemented by reviewing the bibliographies of the articles selected and consulting the members of the advisory committee. This work produced a list of over 27,000 articles identified by means of key words describing the relevant types of exposure, populations and psychosocial outcomes. These articles were written from 1992 onward, in English or French. As a result of an initial selection process based on the relevance of the titles and summaries, 36 documents were chosen for quality analysis based on NICE standards. This process was accomplished through parallel evaluations by two members of the scientific committee. The evaluations resulted in the exclusion of 15 documents: 4 etiologically-oriented studies, 4 qualitative studies and 7 literature reviews. The reasons for their disqualification included methodological weaknesses, biases in recruitment or analysis, and deficiencies in the internal or external validity of the studies. Finally, this corpus of literature was supplemented with suggestions from the advisory committee and the external scientific reviewers.

### Studies selected

The corpus of studies selected for this systematic review is comprised of twenty-two documents: one experimental study (group 1), two etiologically-oriented studies (group 2), six descriptive studies (group 3), three qualitative studies (group 4) and nine literature reviews and reports by expert groups (group 5). Most of the texts are articles published in scientific journals; in addition, there are two doctoral theses and two reports. Moreover, the majority of these texts examine outcomes connected with both the psychological and the social dimensions of quality of life.

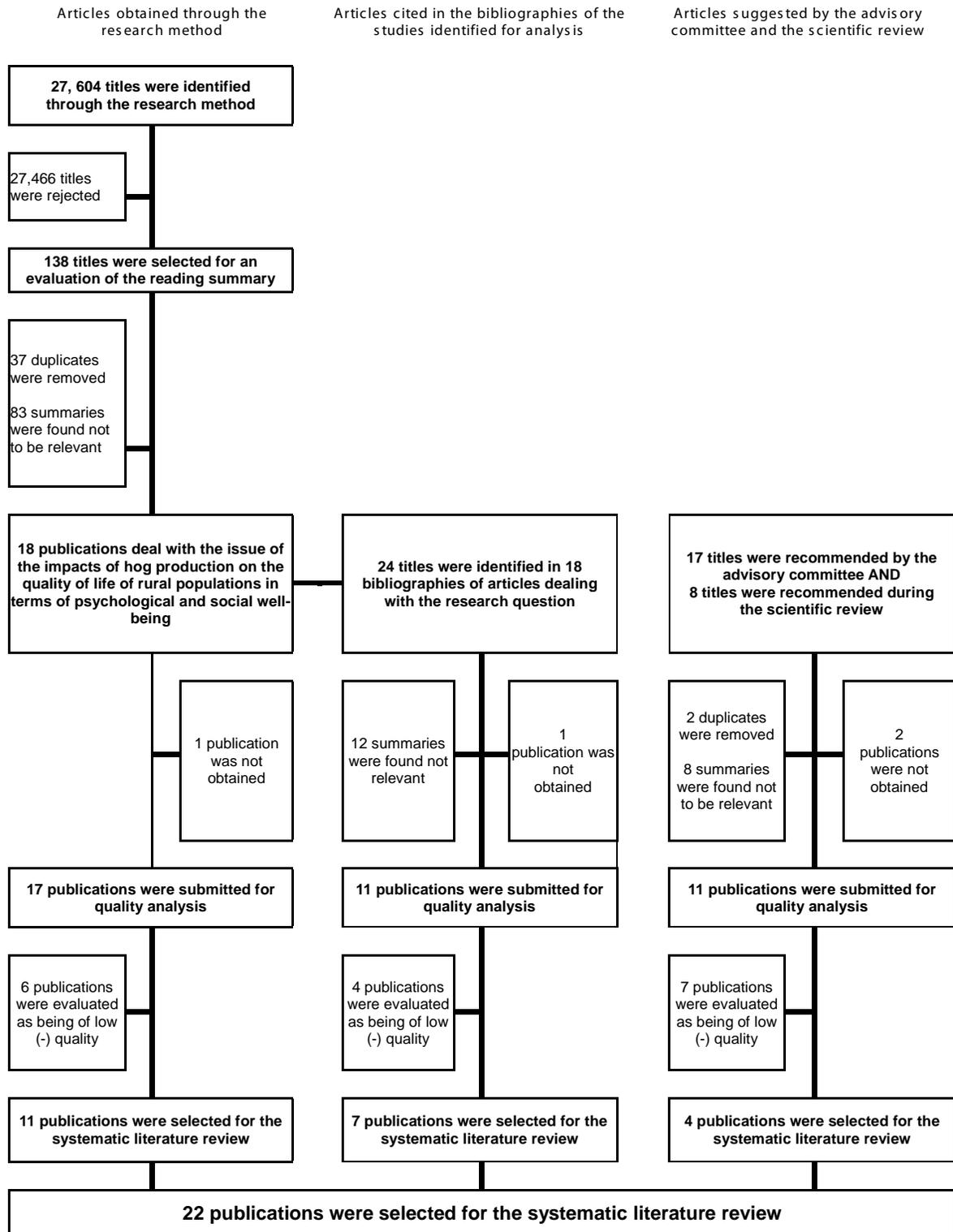


Figure 1: Process for selecting publications to be included in the systematic review

Because the sources are so diverse, the synthesis of the results of the 22 scientific studies chosen is presented in the form of a descriptive analysis of the content. These sources must be considered while keeping in mind the limits of each of the studies selected—and of all the studies taken as a whole—and the potential or documented differences among the fine context-specific variables. However, the body of literature reviewed is consistent as to the broad contextual parameters, i.e., that the source of exposure includes a hog farm, the exposed population is rural and located in the vicinity of the farm, and the sociopolitical context is similar to that of Quebec.

## Results

The analysis of the various results of research on hog and livestock farms provides answers to the question posed by this systematic review of the literature: What are the impacts of hog farms on the quality of life of rural populations, in terms of mental and social well-being, under conditions comparable to those in Quebec?

Livestock farms (including hog farms), and intensive operations in particular, can have impacts on the social well-being of rural populations. Although the available data do not allow us to make absolute generalizations, it is possible to identify certain effects:

- The presence or installation of intensive livestock farms, including hog operations, is associated with conflict and appears to heighten opposition and social tensions. This opposition can polarize social relations and contribute to the development of negative feelings within the community, which persist over time, while a relationship of trust between the farmer and the citizens appears to alleviate these feelings.
- The acceptability of a hog farm depends on a number of factors and on the relationships between them. Planned farms seem to have a lower level of acceptance than existing ones. Proximity appears to be an important factor, particularly in the case of hog farms. Moreover, the role of the producer within the community targeted for the development may be crucial to the social acceptability of a project.
- Citizens from exposed rural communities experienced a greater sense of inequality in the distribution of harms and risks, including those connected with health, the environment, and quality of life.
- Overall, when they are imposed on citizens, livestock farms appear to produce a decrease in trust in government institutions at all levels and to have a negative influence on public respect for existing standards.

Thus, livestock farms, including hog farms, can have a negative impact on the perceived quality of life in surrounding populations. Odours are the exposure source most frequently noted in connection with this impact, but they are not the only one. The magnitude of the impact is also influenced by proximity to the facilities and age, with the impact being greater on younger members of the population.

The results are divergent with respect to the possible impacts on the psychological or mental health status of people exposed to odours produced by a hog farm, and as a result, no conclusions can be drawn in this regard. Nonetheless, it is important to keep the conclusions

regarding the mental dimension in perspective, as they are necessarily linked with the social well-being dimension revealed by the studies.

### Conclusions

The studies identified for this systematic review of the literature point to numerous avenues of research. Quality of life and the social implications associated with hog farms are the variables to be documented if harmonious relationships between residents and producers are to be fostered. Research should also be aimed at gaining a more thorough understanding of the impacts these farms have on human health and on the exposure environment. Finally, this research provides some guidance on increasing social acceptability through public policy and political choices.

While the results of the systematic review do reveal possible impacts on the quality of life of rural populations exposed to hog production units, they also reveal gaps in our knowledge in this area. These gaps may have a considerable influence on the reading of the social and psychological impacts in this review. The authors emphasize the need for better documentation of the social/community and geographic variables as well as those related to the technical/administrative aspects of the farms studied. Moreover, it is apparent that more precise definitions of the concepts and related variables used, particularly the concept of quality of life, need to be formulated.

### Implications for policy and practices

In the light of the results, it is clear that livestock farms generate conflict, controversy and concerns within the populations studied. Their real or perceived quality of life is affected by these operations. Hence, the need arises to manage these perceptions and concerns. The results presented in this systematic review of the literature suggest that communication, the social integration of projects, and issues around location are all relevant solutions.

Similarly, greater consideration must be given to the analysis of impacts on quality of life, beginning with the social dimension, not only in research projects but also when establishing criteria and processes for the development of hog farms. It is therefore recommended that the social integration of hog and other livestock production units be enhanced by creating and maintaining a variety of links between the producer and the rural community.

## TABLE OF CONTENTS

<b>TABLES AND FIGURES .....</b>	<b>VI</b>
<b>ACRONYMS .....</b>	<b>VII</b>
<b>1 INTRODUCTION .....</b>	<b>1</b>
1.1 Background .....	1
1.2 Hog farms in Quebec .....	2
<b>2 OBJECTIVES AND ISSUES .....</b>	<b>4</b>
<b>3 SEARCH STRATEGY AND PROCESS .....</b>	<b>7</b>
3.1 Search terms .....	7
3.2 Article selection criteria .....	8
3.2.1 Formal selection criteria .....	8
3.2.2 Relevance criteria .....	8
3.3 Document search .....	9
3.3.1 Process .....	9
3.3.2 Databases .....	9
3.3.3 Bibliographies of the selected articles .....	10
3.3.4 Consultation with the advisory committee and reviewers .....	11
<b>4 QUALITY ASSESSMENT OF THE PUBLICATIONS .....</b>	<b>13</b>
4.1 Quality criteria and evaluation .....	13
4.2 Characteristics of the excluded studies .....	13
4.3 Studies selected .....	17
4.3.1 Characteristics of the selected studies .....	17
4.3.2 Limitations of the studies selected .....	19
<b>5 RESULTS .....</b>	<b>26</b>
5.1 Overview .....	26
5.2 Impact on mental well-being .....	29
5.3 Impact on social well-being .....	30
5.3.1 Changes to social capital .....	30
5.3.2 Variation in the social acceptability of farms .....	32
5.3.3 Inequitable distribution of impacts .....	33
5.3.4 Reduced confidence in democracy .....	34
5.4 Impact on overall quality of life .....	35
<b>6 CONCLUSION REGARDING THE RESEARCH QUESTION .....</b>	<b>37</b>
<b>7 SUGGESTED AVENUES OF RESEARCH .....</b>	<b>38</b>
<b>8 CONCLUSION OF THE SCIENTIFIC AND ADVISORY COMMITTEES .....</b>	<b>40</b>
<b>9 REFERENCES .....</b>	<b>42</b>

## TABLES AND FIGURES

Table 1:	Definitions of terms used in the research question.....	4
Table 2:	Keywords and search strategy for the systematic review.....	7
Table 3:	Formal document search criteria .....	8
Table 4:	Relevance evaluation criteria for the abstracts.....	9
Table 5:	Databases selected for the systematic review.....	10
Table 6:	Breakdown of studies rejected as a result of the quality evaluation .....	14
Table 7:	Breakdown of studies selected during the quality evaluation process .....	20
Table 8:	Limitations found in the studies selected during the quality evaluation process .....	22
Table 9:	Breakdown of results of the systematic review.....	27
Figure 1:	Process for selecting publications to be included in the systematic review.....	12

## ACRONYMS

<b>BAPE</b>	Bureau d'audiences publiques sur l'environnement
<b>CAFO</b>	<i>Cattle and Feeding Operations</i>
<b>INSPQ</b>	Institut national de santé publique du Québec
<b>POMS</b>	<i>Profile of Mood States Questionnaires</i>
<b>RCT</b>	<i>Randomized Controlled Trial</i>



# 1 INTRODUCTION

## 1.1 BACKGROUND

Hog farms are currently the subject of debate in many forums, involving a wide range of stakeholders, where they are portrayed as a source of conflict and tension within the community or, at the very least, as a topic on which there is no consensus. The limited social acceptability of swine production projects is attributed to the environmental, health and other concerns they raise. These concerns and tensions may themselves have harmful effects on the health of surrounding communities and farm workers, to the extent that health is defined as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” (WHO, 1946, p. 1).

In Quebec, the paragonovernmental Bureau d'audiences publiques sur l'environnement (BAPE – Office for Public Hearings on the Environment) recently noted that the issue of swine production has been a source of controversy in the province for over 30 years (BAPE, 2003b). By 2002, the situation was deemed urgent enough for the government to impose a moratorium on new industrial-scale hog operations, during which time a series of public hearings was held on the subject. In the course of this process, stakeholders expressed concerns for their physical health and for psychological aspects of their health (BAPE 2003a). Moreover, the hearings revealed public concerns about other social and personal health-related issues, including quality of life, equity, the division of powers, and the harmonious development of agricultural and rural areas for a variety of uses.

The opinions expressed by public health experts at the hearings raised the possibility of psychosocial impacts in connection with hog farms, based on a review of available literature (Gingras et al., 2003; Jacques, Masson and Tardif, 2003; Martin, Gingras, Lainesse, Vigneault and Lessard, 2003). There have also been conflicts in a number of Quebec municipalities, which are documented in press reviews (Transfert Environnement, 2003) and case studies (Aubin and Forget, 2001). As a result of these considerations, in their final report, the BAPE commissioners determined that the presence, development or expansion of swine production facilities could lead to situations that would have social and psychological impacts on the population. Consequently, the BAPE believes public policies should be put in place to counter these risks, and it has made a number of recommendations in this regard.

Since the BAPE's report was released in 2003, political decisions have been taken on the issue of swine production, notably in the form of amendments to a number of laws and regulations. Some measures directly address the social acceptability aspect of production units, such as the requirement that the surrounding population be consulted on measures to mitigate certain nuisances associated with swine production. Since the moratorium on hog farms developments was lifted in December 2005, 75 public consultations have been held. They have shown that the population still has health concerns in connection with swine production projects, and that social tensions around the issue persist, although at varying levels, depending on the location of the facilities. A research project is currently underway to document the subject further<sup>1</sup>.

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1 This project is funded by the Ministère de la Santé et des Services sociaux (Ministry of Health and Social Services) and is directed by Geneviève Brisson, LL. B., Ph. D., a researcher with INSPQ. It deals with public concerns and the response of decision-makers to these concerns, in the context of the recently-introduced public consultations on the construction or modification of hog farms in Quebec. The results of this study will be available at a later date.

The law requires that the expert opinions of public health professionals be included in the public consultations. Despite the limitations of this forum, it does allow professionals to be solicited to provide decision-makers and citizens with information on the health impacts of hog farms. More importantly, these public consultations represent an ideal opportunity to analyze the health of the communities involved. Indeed, a number of participating public health professionals have reported worrying signs of adverse effects on the psychological and social health of the affected populations. These observations prompted requests to the Institut national de santé publique du Québec (INSPQ) for better documentation of the psychosocial impacts of swine production projects. Moreover, the reported concerns were instrumental in initiating this knowledge synthesis.

In Quebec, as elsewhere in Canada, it is essential that existing data be made available to inform public health work related to hog farms. The BAPE noted that “[...] from the outset, it is important to recognize the considerable margin of uncertainty regarding the health effects [of hog farms], either because the direct effects on health are not sufficiently known, or because the diffuse nature of the pollution makes it difficult to determine the degree of responsibility attributable to each participant” (BAPE, 2003b). This idea forms the backdrop for this literature review. Far from invalidating the review, it highlights its inherent challenges, including that of properly applying the principles of prudence and caution. The INSPQ has therefore produced the review of the literature on the psychosocial impacts of swine production facilities with a view to providing public health professionals with more effective tools to carry out their work, conduct their analyses and inform their positions on hog farms. This work supplements another synthesis currently being produced by the INSPQ that looks at the impacts of swine production operations on the physical health of surrounding populations<sup>2</sup>. Currently, research projects dealing with the health of workers in the hog industry have also included syntheses of knowledge targeting that specific population<sup>3</sup>. Those issues will therefore not be dealt within this review.

## 1.2 HOG FARMS IN QUEBEC

Agricultural businesses play an important role in the culture and history of Quebec. As in other industrialized countries, they have expanded and become more specialized over the past 50 years. The number of farms fell from 95,777 in 1961 to 30,675 in 2006 — the latter figure corresponding to 56,000 direct jobs and sales of over 5 billion dollars (CAAQ, 2008). Livestock production alone accounts for nearly 73% of this revenue. The province’s main commodities in this sector are dairy cattle (35%), hogs (16%), and poultry, including eggs and turkeys (11%). Beef cattle, sheep and lamb make up the remaining 11% of the province’s livestock production.

In 2005, 2,060 farms in Quebec declared that they earned revenue from hog production, and of these, 84% (1,860 farms) were specialized in swine. During the same period, an average farm had 200 sows and 1,230 grower-finisher pigs. This production amounts to a total of nearly 7 million pigs slaughtered in 2005 (Ministère de l’Agriculture, des Pêcheries et de l’Alimentation [MAPAQ – Ministry of Agriculture, Fisheries and Food], 2007). According to the Fédération des producteurs de porcs du Québec (FPPQ – Quebec Federation of Hog Producers), hog production

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2 This work is being conducted by the INSPQ’s Health and Agriculture group.

3 These projects, funded by the MSSS (Ministry of Health and Social Services) and other agencies, deal with the physical adaptation of hog farm workers (Dr Yvon Cormier’s working group) and the perception of risks by hog farm workers (Dr Alice Turcot’s working group).

in Quebec produces economic benefits of 3.1 billion dollars per year and 28,200 direct and indirect jobs depend on it (FPPQ, 2008).

Since the 1970s, hog production has undergone significant changes, resulting in a reduction of the number of producers and an increase in production. Hog production systems are now specialized and governed by various parameters such as sanitation, disease control, profitability and the organization of work. Moreover, today systems are divided according to the structure and requirements of production, which has favoured the emergence of different types of producers (FPPQ, 2005).

- Breeders produce animals for breeding (purebreds and hybrids).
- Farrowing operators maintain a herd of breeding sows producing piglets for growing and finishing.
- Grower-finishers grow the piglets until they reach the desired market weight.

Many producers are both farrowing operators and grower-finishers. Some producers also operate nurseries: they raise weaned piglets for around 50 days before transferring them to a grower-finisher. In 2006, breeders accounted for 3% of hog farms; farrowers, 19%; finishers, 28%, and farrow-to-finish, 50%.

Finally, over the years, the hog industry has not grown uniformly throughout Quebec, and areas of concentration have developed. Thus, over 80% of businesses in this sector are concentrated in three regions of the province: Chaudière-Appalaches (35%), Montérégie (30%) and Mauricie – Bois-Francs (15%) (FPPQ, 2005; Gilbert, Pigeon and Morisset, 1998).

## 2 OBJECTIVES AND ISSUES

The purpose of this knowledge review is to provide public health professionals in Quebec and Canada with tools they can use when dealing with hog farms where psychological and social health issues have been raised<sup>4</sup>.

The review has three objectives:

1. to determine the impacts of exposure to hog farms on the psychosocial dimensions of quality of life for the surrounding population, in contexts comparable to the situation in Quebec;
2. to provide a review of current research dealing with the psychosocial impacts of swine production units;
3. to determine the most promising avenues for further research in this area.

The review of the literature will address the following research question: What are the impacts of hog farms on the quality of life of rural populations, in terms of mental and social well-being, under conditions comparable to those in Quebec? The terms used in this research question are to be understood according to specific definitions (Table 1).

Table 1: Definitions of terms used in the research question

Term	Definition
Quality of life	<p>This concept is related to the definition of health proposed by the WHO, highlighting the fact that health is a condition of physical, mental and social well-being. Health-related quality of life is the most relevant definition for this systematic review. It may include general health; physical and psychological functions and symptoms; emotional, cognitive, identity-related, social, sexual and spiritual functions; well-being; and satisfaction. Since this is a broad definition, most studies choose to deal with one or more of these dimensions and to describe them (Fayers and Machin, 2000).</p> <p>This study focuses on the mental and social aspects of well-being. The emotional, cognitive and social dimensions and satisfaction will be the central elements considered.</p> <p>Mental well-being refers to emotions, cognitive functions, psychological states, and affects related to mood and to individual behaviours. Social well-being is connected with congruity between the members of a community and the underlying characteristics of the group's social structure (Renne, 1974). It is also called social capital. It refers to trust, reciprocity, sharing, and the ability to work from a common perspective for the good of the community (Wright et al., 2001).</p>

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4 Thus, the aim is to understand these impacts and not to determine, for example, what characterizes the social acceptability of this industry.

Term	Definition
Rural population	<p>A rural population is comprised of individuals who may feel the direct effects of hog farms: both those who live in the immediate vicinity of the facilities (including the immediate family of the producer) and the citizens belonging to the same local administrative unit (e.g. municipality, MRC [regional county municipality]).</p> <p>It should be noted that research on hog industry workers is currently underway and this includes knowledge syntheses on the subject. Consequently, the category of workers was excluded from this review of the literature. However, documents dealing with both surrounding populations and workers were retained.</p>
Hog farm	<p>Hog farm refers to any facility exclusively or primarily devoted to one or more of the stages of swine production. Three stages are generally considered to be specializations, and these may or may not be combined in a single operation; they are farrowing, nursery, and growing/finishing. Consequently, this review of the literature includes buildings containing hogs as well as related facilities such as waste storage lagoons. The other operations directly connected with swine production, particularly those involving manuring, are taken into account.</p> <p>Various terms are used to refer to hog farms. The publications selected for this review deal with industrial production as opposed to family-scale production. Like the terms mega-hog farm and CAFO, these terms have no special technical meaning, and may take on a negative connotation in everyday language. The terms intensive livestock operation and large-scale livestock operation will be preferred.</p> <p>The size of the hog farms is mentioned where this information is available.</p>
Quebec context	<p>The Quebec context in relation to hog production and the settings where this activity takes place is defined in terms of comparable conditions, identified according to three criteria:</p> <ol style="list-style-type: none"><li data-bbox="667 1304 1398 1539">1. The method of livestock production currently practised in Quebec, i.e. the type that applies the same management methods used in other economic sectors, including the use of technology, least-cost production and adaptability to market demands. The integration of a number of production components and their specialization are also features of this method. The existence of prescribed production standards at national, regional or local levels is another criterion that is taken into account.</li><li data-bbox="667 1549 1398 1602">2. The society, which must be industrialized and have an open-market economy.</li><li data-bbox="667 1612 1398 1665">3. The government, which must provide a legislative framework for livestock production units including hog farms.</li></ol> <p>In Quebec, producers may be independent or part of a larger group of producers. Both these production methods are considered. Similarly, operations both with and without manure spreading sites were considered.</p>

To answer the research question, this review of the literature was planned. It is the result of work conducted using a systematic review method that draws on the approach developed by the National Institute for Health and Clinical Excellence in the United Kingdom (NICE, 2007). This approach was chosen in order to increase the validity of the review by eliminating chance associations, results that cannot be widely generalized, and methodological biases. Other systematic review approaches were also taken into account (Thomas and Harden, 2007; Mays, Pope and Popay, 2005; Weightman, Ellis, Cullum, Sander and Turley, 2005; Popay, 2005; Atassi et al., 2000; Coren and Fisher, 2006; Kitchenham, 2004), particularly as to the manner of dealing with both qualitative and quantitative studies in the same project. Indeed, given the question posed for this knowledge synthesis and the exploratory nature of the approach used, it was not possible to restrict the types of scientific studies considered.

A scientific committee was charged with developing and applying the method selected for this systematic review. The researchers were also assisted by an advisory committee comprised of potential users of the results of the review. This committee provided validation and support to the authors' work through the various stages of the systematic review, and ensured that the review accounted for the concerns expressed by the professionals and their experiences in the field.

This report begins by explaining the research strategy adopted and the document search process. Next, the corpus of publications chosen is introduced, showing first which studies were included and which were excluded from the process, and then highlighting the characteristics of the studies that were selected. The main results obtained from the systematic review process are then discussed. The review also outlines the implications of this approach for further research on the subject.

### 3 SEARCH STRATEGY AND PROCESS

#### 3.1 SEARCH TERMS

The search terms were first chosen based on the literature review conducted by BAPE on the psychosocial impacts of hog farms (BAPE, 2003a), and the terms contained in the public health reports filed during the public hearings (Gingras et al., 2003; Jacques et al., 2003; Martin et al., 2003). The meanings of each term were then standardized, where possible, using the thesaurus of the United States National Library of Medicine (Medical Subject Headings – MeSH). Finally, the search terms were submitted to the advisory committee for their comments and annotations.

The terms selected fall into four broad categories related to results, exposure and population (Table 2). Terms relating to the impacts on mental and social well-being were distinguished to facilitate the search and the formulation of results. During the document search, the terms related to results, exposure and population were combined using the Boolean operator “AND”, whereas within a given group, some terms were combined using the Boolean operator “OR”.

Table 2: Keywords and search strategy for the systematic review

<b>Results Impact on quality of life</b>	<b>Exposure</b>	<b>Population</b>
<b>Mental well-being</b>	<b>Hog farm</b>	<b>Surrounding population</b>
<ul style="list-style-type: none"> <li>• Mood, OR Emotion, OR Stress, OR Mental health</li> <li>• Quality of life, OR Well-being</li> <li>• Damage, OR Prejudice, OR Annoyance, OR Affect</li> <li>• Behaviour, OR Attitude, OR Motivation, OR Perception</li> <li>• Psycho*</li> </ul>	Swine, OR Pig, OR Hog, OR Livestock, OR CAFO Odour, OR Manure	Rural
<p style="text-align: center;"><b>Social well-being</b></p> <ol style="list-style-type: none"> <li>1. Community health</li> <li>2. Social</li> <li>3. Conflict, Acceptability, Land use, Cohabitation</li> <li>4. Socioeconomic</li> <li>5. Human health, Health effects</li> </ol>	<b>A</b> <b>N</b> <b>D</b>	<b>A</b> <b>N</b> <b>D</b>

## 3.2 ARTICLE SELECTION CRITERIA

### 3.2.1 Formal selection criteria

Criteria regarding the form of the documents were considered when selecting publications from the documentary resources described in section 3.3. Table 3 shows the formal criteria used. All the documents had to meet the criteria set out in this table. Where possible, these criteria were used when consulting the documentary databases.

Table 3: Formal document search criteria

Criterion	Description	Comments
Type of study	Systematic reviews, randomized controlled studies, etiologically-oriented studies, descriptive studies, qualitative analyses, theses <sup>1</sup> , literature reviews <sup>2</sup> and reports by panels of experts.	All these types of studies are selected because of the subject and the marginal position it occupies in the public health literature, and because this topic can be addressed using both qualitative and quantitative approaches. Letters, editorials and essays were not considered.
Form of document	Includes an abstract or summary.	
Title	Is related to the research question.	Excludes articles on the use of hogs in laboratory research, for example.
Language of publication	English and French.	
Date of publication	Between 1992 and 2007.	

<sup>1</sup> The inclusion of doctoral dissertations was discussed with the scientific and advisory committees, which decided to take them into consideration because of the original data they offer.

<sup>2</sup> Literature reviews and panels of experts were considered due to their critical perspective and the research proposals presented, but they were taken into account only to provide additional information for the analysis.

### 3.2.2 Relevance criteria

The titles and abstracts selected during the document search process were also evaluated for relevance. This process was guided by the research question for this systematic review. The analysis was based on criteria related to population, exposure and effects (Table 4). The title and abstract of each article were used as a basis for selection. These two elements served to validate the fact that the article could answer the research question with a score of Excellent (++) or Acceptable (+). Titles and abstracts that received one or more Unacceptable (-) scores were eliminated. Lack of information on a criterion resulted in a lower score.

Table 4: Relevance evaluation criteria for the abstracts

Criterion	Description	Excellent (+ +)	Acceptable (+)	Unacceptable (-)
Participants	The study must look at a population that is exposed to a hog farm at the time of the research.	Family, neighbourhood, town village, community	Region (broad), sub-group defined within a specified territorial unit (e.g. women, children)	Not defined
Exposure	The source of exposure studied must have the characteristics of a hog farm.	Hog farm	Livestock farms in general; other livestock farms excluding hog farms	Other types of farms
	The conditions of exposure must be comparable to the Quebec context <sup>2</sup> .	Study conducted in Quebec	Study conducted outside Quebec but in a fully or partially comparable context	No similar variable for the context
Measurement of effects	The publication must address changes in quality of life in the exposed population, in terms of mental or social well-being.	Measurement of direct effects on the criteria	Measurement of indirect and socioeconomic effects	Other effects on physical health measured, but not psychosocial effects

<sup>1</sup> Defined in Table 1 (point 2.2).

<sup>2</sup> Defined in Table 1 (point 2.4).

### 3.3 DOCUMENT SEARCH

#### 3.3.1 Process

During the search process, various documentary sources were considered: databases of scientific literature and grey literature, the bibliographies of the selected articles, and documents suggested by members of the advisory committee. This process was conducted between August 13 and October 10, 2007. Two people took part and simultaneously completed the process of searching for and selecting articles from the databases and additional bibliographic lists.

First, the databases were consulted using keywords and formal selection criteria. Then, the titles yielded by this operation were assessed based on the formal and relevance criteria. Next, the abstracts of the titles selected were evaluated a second time using the same relevance criteria. This evaluation process was also adopted for the documents added as a result of the supplementary searches (consulting the advisory committee and extracting titles manually from the bibliographies of the articles selected). The available publications could then move on to the next step, quality analysis (described in chapter 4).

#### 3.3.2 Databases

To produce this literature review, eight scientific literature databases were chosen due to their potential for addressing the topics considered (Table 3). For each database, a professional selected the keywords used for the search, entering pairs of sub-entries in the search engine.

This process yielded 27,604 different articles. The results of this search are shown in Appendix 1 (Table 1).

The titles obtained were examined based on the formal and relevance criteria. The majority of the 27,604 documents were rejected because these articles dealt with the use of Suidae in clinical and biomedical research, the neurophysiological effects of odours in general, biological plausibility, and the health and well-being of livestock. Other articles dealing with the health of agricultural workers, animal husbandry in developing countries and the biochemical aspect of the effects of hog farms were also rejected. 138 titles of articles were found suitable to move on to the next stage in the process.

From the 138 articles selected during the search, 37 duplicates were eliminated. The abstracts of the remaining 101 articles were again analyzed for relevance. At this stage, 83 references were identified as not relevant to the research question, including 13 that were given this status following a more thorough evaluation. The search method thus yielded 18 articles eligible to move to the next stage in the search process (Table 2, Appendix 1). However, one of the articles selected (Schaffer, n. d.) could not be obtained. As a result, 17 articles were selected for quality analysis.

The search was now expanded to include the available grey literature. A search was therefore conducted in the relevant databases (Table 5) using a similar approach to that used for the scientific databases. No documents were selected during this stage of the search.

Table 5: Databases selected for the systematic review

<b>Scientific literature</b>	<b>Grey literature</b>
<ul style="list-style-type: none"><li>• Ebsco (ASP, IPISA, Medline, CINAHL, Communication &amp; Mass media)</li><li>• PubMed</li><li>• CSA (AEBA, BioOne, EconLit, Francis, Pollution, PsychInfo, SSA, Sociological Abstracts)</li><li>• Ovid (Biosis, SWA, CAB Abstracts)</li><li>• Current Contents Only the following 3 sections:<ol style="list-style-type: none"><li>1. Agriculture, Biology &amp; Environmental Sciences</li><li>2. Arts &amp; Humanities</li><li>3. Social &amp; Behavioural Sciences</li></ol></li><li>• Compendex</li><li>• Campbell Collaboration</li><li>• Cochrane Collaboration</li></ul>	<ul style="list-style-type: none"><li>SIGLE</li><li>Canadian Evaluation Society Grey Literature Database</li><li>REBJ (jurisprudence)</li></ul>

### 3.3.3 Bibliographies of the selected articles

A second phase of the document search involved reading the bibliographies of the 18 articles selected for any further titles that met the established relevance criteria. This process produced 24 new titles for possible inclusion in the literature review (Appendix 1, Table 3).

Of these 24 titles, one (Steinheider, 1999) could not be obtained, and 12 were rejected after their abstracts were evaluated for relevance. Thus, 11 articles were selected for quality analysis.

#### 3.3.4 Consultation with the advisory committee and reviewers

The bibliographic list containing the results of the various steps in the document search described above was submitted to the advisory committee. The committee members recommended that the researchers consult the BAPE documents filed during the public consultation on the sustainable development of hog production in Quebec, held in 2003. They also suggested publications as references. As a result, 17 new titles were added to the bibliographic list (Appendix 1, Table 3). Of the 17 titles proposed by the advisory committee, one could not be obtained (Center for Disease Control and Prevention [CDC], 1998), and eight abstracts were found to lack sufficient relevance to continue to the next stage of the process. As a result, eight articles were selected for a quality analysis of their content.

Finally, during the external scientific review of this report, one of the evaluators suggested that new documents be included (Appendix 1, Table 4). Of the documents rejected, two had already been selected during the search process and excluded when analyzed for relevance. Other proposed references were also set aside for the same reasons: either because livestock production was not directly addressed in these publications or because their content was not sufficiently germane to the research subject. Another (Torre et al., 2006) could not be obtained in time to be included in the final version of this literature review. Consequently, three documents were evaluated for quality.

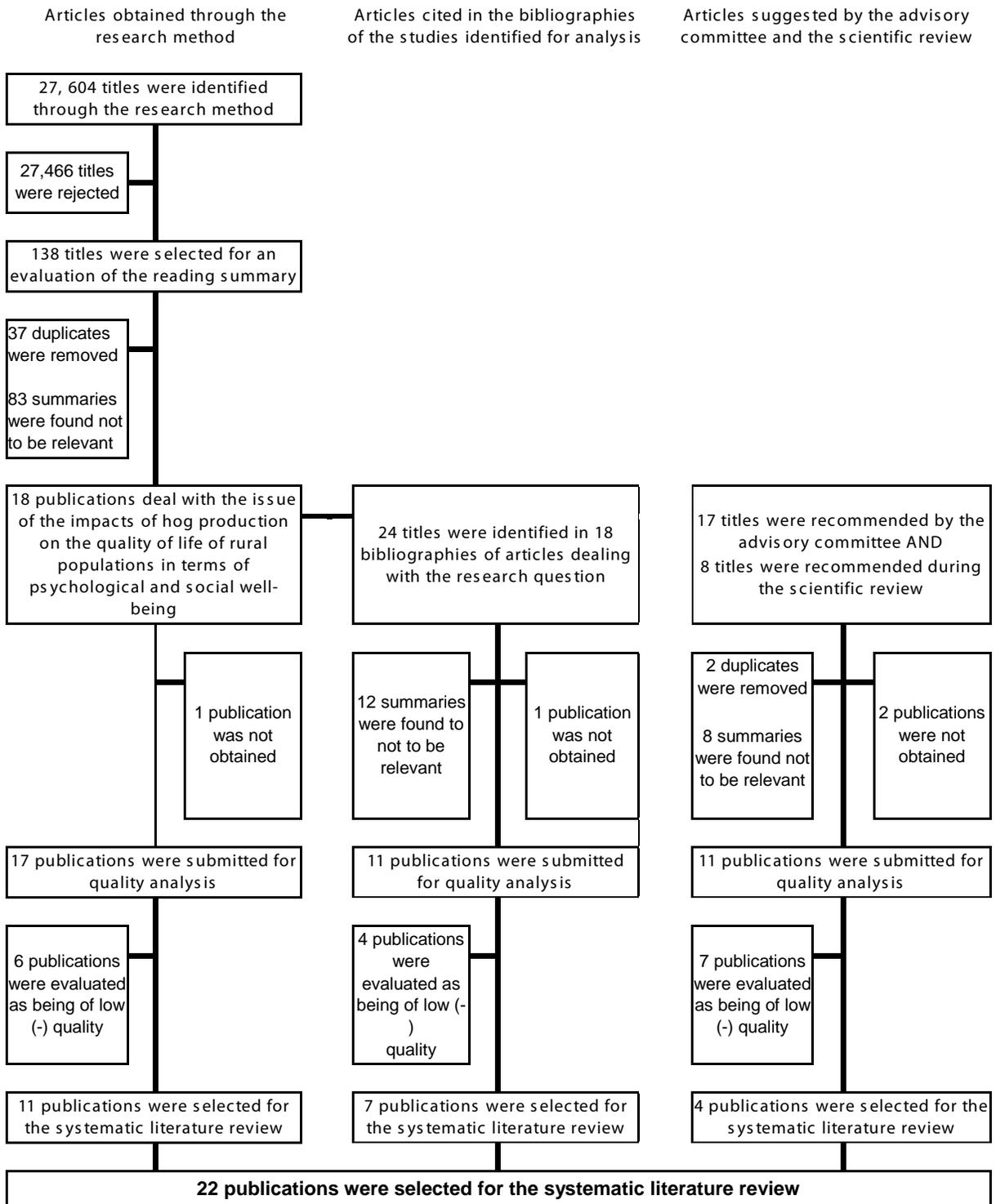


Figure 1: Process for selecting publications to be included in the systematic review

## 4 QUALITY ASSESSMENT OF THE PUBLICATIONS

### 4.1 QUALITY CRITERIA AND EVALUATION

Through the application of formal and relevance criteria, 36 documents that address the question posed by the systematic review were selected. Once chosen, these publications were assessed for scientific quality using a standardized methodology, applying the principles and tools in the methodological guide for producing systematic reviews developed by NICE (2007). The grids used are shown in Appendix 2. Grids 2, 3, 4 and 5 were used—and adapted where necessary—to evaluate the documents expressing the results in order to represent three of the groups of studies analyzed: randomized controlled trial (RCT) studies (Group 1), etiologically-oriented studies (Group 2) and descriptive studies (Group 3). Next, the authors of this report used the grid from the NICE guide, unmodified (Appendix 2, Grid 1), to examine Group 4, which is comprised of the qualitative studies. Since Group 5 contains all the literature reviews published in the form of reports or in scientific journals and reports by task forces and panels of experts, the grid for systematic reviews was adapted to be used for all these documents.

A study was accepted for the systematic review of the literature if it was given a positive evaluation (++ or +) by a team of two evaluators, including at least one member of the project's scientific committee. In cases of uncertainty or disagreement, a consensus was reached through a discussion between the evaluators, who were able to resolve all their differences of opinion. Consequently, it was not necessary to solicit the opinion of the full scientific committee<sup>5</sup>. Five studies received an overall score of “excellent” (++) , 16 received a score of “acceptable” (+) and 15 were rated as “weak” (–).

### 4.2 CHARACTERISTICS OF THE EXCLUDED STUDIES

The quality evaluation process led to the elimination of 17 studies from the literature surveyed as part of the systematic review (Table 6). The 17 studies eliminated can be broken down as follows: four etiologically-oriented studies (Group 2) (Bullers, 2005; Lohr, 1996; Pampalon and Légaré, 1997; Thu et al., 1997), five qualitative studies (Group 4) (DeLind, 1998; Ikerd, n. d.; Novek, 2003a and 2003b; Nicourt, Girault and Bourliaud, 2000) and eight reviews of the literature and papers/reports by panels of experts (Group 5) (Martin et al., 2003; Aubin and Forget, 2001; Abbozzo, Boggia and Brunetti, 1996; Durrenberger and Thu, 1996; Hogberg et al., 2005; Thu, 1998; Heederik et al., 2007; Ministère de l'Environnement du Québec [MENVQ], 2003). Eleven of these studies were published in scientific journals, one was published in a book (DeLind, 1998), one is a Master's thesis (Aubin and Forget, 2001) and three are academic papers produced by the government of Quebec (Martin et al., 2003; Pampalon and Légaré, 1997; MENVQ, 2003).

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5 According to the study design, if a difference of opinion cannot be resolved, the entire scientific committee must decide, with the majority ruling if no consensus is reached. In this case, the need to consult the whole scientific committee did not arise.

Table 6: Breakdown of studies rejected as a result of the quality evaluation

Study	Type of limitation						
	Method not specified, absent or weak	Recruitment	Limitations in measurement or data collection tools	Incomplete analysis	Internal validity	External validity (context)	Lack of information
Group 1: RCT							
-	-	-	-	-	-	-	-
Group 2: Etiologically-oriented studies							
1. Bullers, 2005		X		X		X	
2. Lohr, 1996				X	X	X	X
3. Pampalon et Légaré, 1997							X
4. Thu et al., 1997		X	X				
TOTAL Group 2	0	2	1	2	1	2	2
Group 3: Descriptive studies							
-	-	-	-	-	-	-	-
Group 4: Qualitative studies							
1. DeLind, 1998	X		X			X	
2. Ikerd, n. d.	X				X	X	X
3. Novek, 2003a	X	X	X		X		
4. Novek, 2003b	X	X	X		X		
5. Nicourt et al., 2000				X	X		
TOTAL Group 4	4	2	3	1	4	2	1

Study	Type of limitation						
	Method not specified, absent or weak	Recruitment	Limitations in measurement or data collection tools	Incomplete analysis	Internal validity	External validity (context)	Lack of information
Group 5: Reviews							
1. Abbozzo et al., 1996	X		X	X	X	X	X
2. Durrenberger and Thu, 1996	X					X	
3. Hogberg et al., 2005	X				X		
4. Thu, 1998	X				X		
5. Aubin and Forget, 2001				X	X		
6. Heederik et al., 2007	X				X	X	X
7. Martin et al., 2003	X			X			
8. MENVQ, 2003	X				X		
TOTAL Group 5	7	0	1	3	6	3	2
TOTAL: 17 studies	11	4	5	6	11	7	5

No Group 1 study received a weak (–) quality evaluation.

Four of the Group 2 studies received a weak evaluation score and were eliminated. Pampalon and Légaré (1997) is an academic paper produced by the government of Quebec, filed during the public consultations on hog production held by BAPE in 2003. While this analysis does offer relevant results, the lack of information, mainly regarding the method and analysis, makes the study's findings difficult to generalize to the entire population. The articles by Bullers (2005) and Lohr (1996) were rejected for reasons of bias in the analysis, recruitment, internal and external validity, and lack of information. The study by Bullars (2005) uses tests dating back over 20 years to evaluate perceived control and psychological distress, without mentioning more recent developments. Moreover, the author of the document states that the analysis cannot easily be generalized. The study by Lohr (1996) is in fact a pilot study based on a small sample of livestock production units, which limits its internal and external validity. Furthermore, the analysis is not very discriminating: the evaluation of the results is identical regardless of the level of exposure. Finally, the study by Thu et al. (1997), often quoted in the literature on the issue of the psychological and social impacts of swine production, was rejected on the basis of inadequate recruitment and bias in the use of measurement tools. This study does not include any exposure indicators and it uses a small sample ( $n = 18$ ) without detailing how it was constituted. Moreover, the questionnaire is not validated, and bases the evaluation of the constructs of depression on a scale developed in 1965.

None of the Group 3 studies received a weak (–) quality evaluation.

Five of the qualitative studies in Group 4 were rejected: four original studies and one research paper presented during the BAPE public consultations on hog production. Weaknesses in the method, or the absence of method, created biases affecting the internal or external validity of the five publications that were excluded. More specifically, the article by DeLind (1998) was excluded for reasons related to its external validity, since the author addresses the impacts of hog farms in a journalistic style, without outlining the method or the measurement and data collection tools used. The paper by Ikerd (n.d.) is also silent as to the method used and fails to provide any references in support of its line of argument. This lack of information casts serious doubt on the document's internal and external validity. Although the two articles by Novek (2003a and 2003b) appear under two different titles, they contain the same information. Both were rejected for the following reasons: weak methodology, recruitment biases, biases in the measurement and data collection tools, and a bias in internal validity. This article (published twice as separate articles) has numerous methodological shortcomings: it mentions neither the period covered by the analysis, nor the inclusion criteria for the body of literature or the interview respondents ( $n = 30$ ), nor the basis on which the questionnaire was standardized. As a result, the study's internal validity is suspect. The study by Nicourt et al. (2000) also suffers from weaknesses regarding analysis and external validity, particularly in terms of relating the data to the theoretical framework.

Group 5 includes four papers produced by panels of experts and four reviews of the literature, for a total of eight documents. Three papers by panels of experts were obtained from the grey literature filed on behalf of the government of Quebec during the public consultations on hog production (BAPE). One of these reports was excluded because its purpose was to argue a particular point rather than generate research results (Martin et al., 2003). The authors of the

document produced by the Ministry of the Environment (MENVQ, 2003) admit its major methodological limitations from the outset. The thesis written by Aubin and Forget (2001) had similar shortcomings. Finally, the fourth document, Heederik et al. (2007), is the experts' summary of seminars; as a result, it does not include a method. However, the primary reason for its elimination was that it identifies impacts of hog farms without contextualizing the points raised. This calls into question the internal and external validity of this publication. The four reviews of the literature were eliminated from the corpus because they present results without identifying the methodology, and they suffer from biases affecting their internal and external validity. Durrenberger and Thu (1996) is a contemporary application of the classic study by Goldschmidt published in 1978. The evidence is scantily referenced, and the related discussion is taken from previously published material. Thu (1998) resembles a science magazine article: it presents results without putting them in context. Hogberg et al. (2005) is based on a compilation of data which is sometimes contextualized, but often incompletely. Moreover, the authors cite very few sources to support the points raised. For these reasons, the study's internal validity is questionable. Finally, the content of the literature review produced by the team of Abbozzo et al. (1996) is incomplete (lacking in information) and at times incoherent, and its analysis is open to criticism.

#### 4.3 STUDIES SELECTED

##### 4.3.1 Characteristics of the selected studies

The quality evaluation process yielded 22 documents for the review of the literature conducted as part of the systematic review. Each one provides relevant quality information related to the research question: What are the impacts of hog farms on the quality of life of rural populations, in terms of mental and social well-being, under conditions comparable to those in Quebec? Grids were produced to extract and present the information from each of the papers selected.

The corpus of studies selected is comprised of 22 documents: one experimental study (Group 1): Schiffman et al. (2005); three etiologically-oriented studies (Group 2): Wing and Wolf (2000), Schiffman, Miller, Suggs and Graham (1995), and Merchant and Ross (2002); six descriptive studies (Group 3): Radon et al. (2004), Mann and Kögl (2003), Kleiner (2004), Asmus (1998), Sharp and Tucker (2005), and Reisner and Taheripour (2007); three qualitative studies (Group 4): Williams (2006), DeLind (2004), and Wright et al. (2001); and nine reviews of the literature and reports by panels of experts (Group 5): Kirkhorn (2002), Merchant and Ross (2002), Thu (2002), Thu (1995), Von Essen and Auvermann (2005), Donham et al. (2007), McBride (1998), Brodeur, Goulet and D'Allaire (1999), and Cole, Todd and Wing (2000). Most of the texts are articles published in scientific journals. In addition to these, there are two doctoral dissertations (Kleiner, 2004; Asmus, 1998) and a few scientific reports (Merchant and Ross, 2002; Brodeur et al., 1999; Thu, 1995; McBride, 1998) (Table 8).

Group 1 is comprised of one experimental study by Schiffman, Studwell, Landerman, Berman and Sundy (2005). In the course of the study, 48 volunteer subjects were exposed to diluted odours from a hog production unit in a confined area (experimental condition) to evaluate changes in their psychological and physiological states. The researchers measured participants' physiological status four times during the study by taking their vital signs, and evaluated their psychological health using three standardized questionnaires.

Group 2 is comprised of three etiologically-oriented studies: one cohort study (Wing and Wolf, 2000) and two case-control studies (Schiffman et al., 1995; Merchant and Ross, 2002). These three studies use questionnaires completed by professionals or by respondents. Just one of the studies extended its research to an analysis of medical records and in situ measurements. All three studies use the comparative method; however, the sample sizes vary. In Schiffman et al. (1995), two groups of 44 subjects (n = 88) are exposed to a hog farm environment. Wing and Wolf (2000) compare subjects from three communities (n = 155): the first centred around hog production (n = 55) and the second around cattle production (n = 50); the third community has no livestock farms within its territory (n = 50). Finally, Merchant and Ross (2002) compares the results from 1,004 rural respondents. Its research objectives are to evaluate and objectively present the risks posed by exposure to odours from hog farms, and to describe the risk factors associated with agricultural production.

Group 3 is made up of descriptive studies. It includes six original studies (Radon et al., 2004; Mann and Kögl, 2003; Kleiner, 2004; Asmus, 1998; Sharp and Tucker, 2005; Reisner and Taheripour, 2007). Mail and telephone questionnaires, validated or designed by the researchers, were used as the basis for these articles. One study also used semi-directed face-to-face interviews. The research conducted for these studies was population-oriented. At a micro or meso level, the studies used samples of 2,776 (Mann and Kögl, 2003), 771 (Kleiner, 2004), 719 (Asmus, 1998) and 106 respondents (Reisner et Taheripour, 2007). At a macro level, some studies considered one U.S. state (n = 4,030) (Sharp and Tucker, 2005) and several regions in Germany (n = 2,748) (Radon et al., 2004). All the Group 3 studies analyze hog production units, with three of them focusing solely on this type of production (Mann and Kögl; Kleiner; and Reisner and Taheripour). Finally, their research objective is to evaluate the effects associated with the farms or, more specifically, the repercussions associated with the odours produced by livestock production units.

Group 4 comprises three qualitative studies (Williams, 2006; DeLind, 2004; Wright et al., 2001). The methods employed vary: face-to-face interviews; case studies based on documentary sources and face-to-face interviews; and focus groups, local newspapers and grey literature. All three studies are population-oriented, but their scales of analysis differ. One study analyzes data on populations from three American states (Williams, 2006); the second is based on data from six U.S. counties (n = 8,423 to 133,166) (Wright et al., 2001); and the third looks at a single town in the United States (n = 2,715) (DeLind, 2004). Two studies deal exclusively with hog production units; they are aimed at evaluating their social repercussions, such as conflicts and opposition groups associated with the presence or introduction of livestock production, primarily hog farms.

Finally, Group 5 comprises all the literature reviews identified during the document search. It includes nine reviews from two work reports (Merchant and Ross, 2002; Brodeur et al., 1999) and seven reviews of the literature (Kirkhorn, 2002; Thu, 2002; Thu, 1995; Von Essen and Auvermann, 2005; Donham et al., 2007; McBride, 1998; Cole et al., 2000). Only two of the publications partially describe how the method for conducting the reviews was obtained (Thu, 1995; Brodeur et al., 1999). The reviews of the literature include a large number of sources, but only one of the reviews — Brodeur et al. — gives an exact count of this corpus. Five of the reviews limit their research to hog farms and four include additional types of livestock production units, particularly cattle operations. The objective of these reviews is to document

the effects of hog and other livestock production on the population living near the production sites. Some were conducted in response to specific requests from government (Merchant and Ross, 2002; McBride, 1998) or interest groups (Brodeur et al., 1999).

#### **4.3.2 Limitations of the studies selected**

The 22 studies selected for the literature review have certain limitations that affect the presentation of the results (Table 8). All these limitations were noted by the authors of the articles and were confirmed when the texts were analyzed as part of this review of the literature. Some of these limitations concern the method; others, the tools used for measurement or data collection and analysis; and yet others, the recruitment plans and internal and external validity.

Table 7: Breakdown of studies selected during the quality evaluation process

Study	Data collection method	Sample size (n =)	Type of livestock production unit or exposure	Impacts measured			Quality score	
				Well-being	Mental health	Social health	++	+
Group 1: RCT								
1. Schiffman et al., 2005 – U.S.	Standardized questionnaire filled out after exposure in a confined area	48	Air; hog production		X	X		X
<b>TOTAL Group 1</b>					1	1		1
Group 2: Etiologically-oriented studies								
1. Wing and Wolf, 2000 – U.S.	Questionnaire filled out by the participants	155	Large-scale livestock production (n = ?)	X				X
2. Schiffman et al., 1995 – U.S.	Questionnaire filled out by the participants	88 (2 X 44)	Odours; hog production		X			X
3. Merchant and Ross, 2002 – U.S.	Questionnaire Medical records In situ measurements	1 004	Rural areas with and without livestock production		X		X	
<b>TOTAL Group 2</b>				1	2	0	1	2
Group 3: Descriptive studies								
1. Mann and Kögl, 2003 – Germany	Mail questionnaire filled out by the participants Interviews	2 776	Hog production			X		X
2. Radon et al., 2004 – Germany	Mail questionnaire filled out by the participants	2 748	Odours; livestock production	X				X
3. Kleiner, 2004 – U.S.	Telephone questionnaire	711	Large-scale hog production (n = ?)	X	X	X	X	
4. Asmus, 1998 – U.S.	Telephone questionnaire	719	Odours; livestock production	X	X		X	
5. Sharp and Tucker, 2005 – U.S.	Mail questionnaire filled out by the participants	4 030	Large-scale livestock production (n = ?)		X	X		X
6. Reisner and Taheripour, 2007 – U.S.	Mail questionnaire filled out by the participants	106	Large-scale hog production (n = ?)			X	X	
<b>TOTAL Group 3</b>				3	3	4	3	3

Study	Data collection method	Sample size (n =)	Type of livestock production unit or exposure	Impacts measured			Quality score	
				Well-being	Mental health	Social health	++	+
Group 4: Qualitative studies								
1. Williams, 2006 – U.S.	Face-to-face interviews	Not mentioned	Corporate hog production (n = ?)			X		X
2. DeLind, 2004 – U.S.	Case study using documentary sources	1 rural community	Large-scale hog production (n = ?)		X	X		X
3. Wright et al., 2001 – U.S.	Face-to-face interviews and focus groups Local newspapers and grey literature	122 indiv. 4,680 newspaper issues	Livestock production	X	X	X	X	
TOTAL Group 4				1	2	3	1	2
Group 5: Reviews								
1. Kirkhorn, 2002	Not mentioned	Not mentioned	Large-scale livestock production (n = ?)		X			X
2. Merchant and Ross, 2002	Not mentioned	Not mentioned	Large-scale livestock production (n = ?)	X	X	X		X
3. Thu, 2002	Not mentioned	Not mentioned	Large-scale livestock production (n = ?)	X	X			X
4. Thu, 1995	Citizen's forum	5 experts	Large-scale hog production (n = ?)	X		X		X
5. Von Essen and Auvermann, 2005	Not mentioned	Not mentioned	Odours; livestock production	X	X			X
6. Donham et al., 2007	Panel of experts	Not mentioned	Large-scale livestock production (n = ?)		X	X		X
7. McBride, 1998	Not mentioned	Not mentioned	Odours; hog production		X	X		X
8. Brodeur et al., 1999	Specific terms in 5 databases and grey literature from the government of Quebec	393 articles	Odours; hog production		X		X	
9. Cole et al., 2000	Not mentioned	Not mentioned	Large-scale hog production (n = ?)	X	X			X
TOTAL Group 5				5	8	4	1	8
TOTAL: 22 studies				10	16	12	6	16

Table 8: Limitations found in the studies selected during the quality evaluation process

Study	Type of limitation						
	Method	Recruitment	Measurement or collection tools	Incomplete analysis	Internal validity	External validity	Lack of information
Group 1: RCT							
1. Schiffman et al., 2005		X				X	
TOTAL Group 1	0	1	0	0	0	1	0
Group 2: Etiologically-oriented studies							
1. Wing and Wolf, 2000	X		X		X		
2. Schiffman et al., 1995	X		X	X			
3. Merchant et al., 2002	-	-	-	-	-	-	-
TOTAL Group 2	2	0	2	1	1	0	0
Group 3: Descriptive studies							
1. Mann and Kögl, 2003	X		X				
2. Radon et al., 2004		X		X			
3. Kleiner, 2004	X						
4. Asmus, 1998	X					X	
5. Sharp and Tucker, 2005	X		X				
6. Reisner and Taheripour, 2007		X				X	
TOTAL Group 3	4	2	2	1	0	2	0
Group 4: Qualitative studies							
1. Williams, 2006	X	X	X				
2. DeLind, 2004	X		X	X			
3. Wright et al., 2001	X			X			
TOTAL Group 4	3	1	2	2	0	0	0

Study	Type of limitation						
	Method	Recruitment	Measurement or collection tools	Incomplete analysis	Internal validity	External validity	Lack of information
Group 5: Reviews							
1. Brodeur et al., 1999				X			
2. Cole et al., 2000	X			X			
3. Donham et al., 2007	X						
4. Kirkhorn, 2002	X						
5. McBride, 1998	X			X			
6. Merchant and Ross, 2002	X						
7. Thu, 2002	X						
8. Thu, 1995	X			X			
9. Von Essen and Auvermann, 2005	X			X			
TOTAL Group 5	8	0	0	5	0	0	0
TOTAL: 22 studies	17	4	6	9	1	3	0

Group 1 is comprised of one experimental study conducted by Schiffman et al. (2005). The limitations of the study are connected with external validity and recruitment. Given the experimental nature of this study and its small sample size, its findings cannot be generalized to the entire population. The control exercised by the researchers during the data collection process did not allow them to reproduce the natural conditions under which odours are perceived. Moreover, the authors believe their results may have been skewed by the fact that the subjects were healthy volunteers who knew they were being exposed to odours under controlled conditions.

Limitations were also found in the three etiologically-oriented Group 2 studies. These limitations fall under the following categories: method, measurement and collection tools, analysis, and internal validity. Merchant et al. (2002) mention three limitations in their study that may influence the results obtained: a lower than expected participation rate, farmers younger and healthier than expected, and a low number of smokers among the farmers in the area targeted by the research. The limitations of Schiffman et al. (1995) are related to the method, the measurement tool used, and analysis of results. In her methodology, the author specifies that the subjects had to respond to the questionnaire (POMS: Profile of Mood Status) when they perceived an unpleasant odour associated with a hog farm. However, no measures were taken to ensure that hog farms were the only source of the odours reported in the questionnaire, and no exposure level was specified. The analysis of the results is limited and discussion is based on hypotheses according to which unpleasant odours bring about a deterioration in mood. Moreover, the results obtained are not detailed. Nonetheless, the study was selected because of its strong relevance to the evaluation of quality of life. The limitations of Wing and Wolf (2000) concern the method, the measurement tool and the study's internal validity. The concept of quality of life is not defined by the research, but by the variables measured. Nor is there any discussion of the sources of the measurement tool or of the relative importance given to the topics addressed. Also, some respondents may have misinterpreted some of the items measured. Finally, according to the authors, it is possible that individuals living near hog farms reported more symptoms than others as a result of known negative connotations.

The studies in Group 3 have limitations related to method, recruitment, external validity, and the tools used for data measurement or collection and analysis. Asmus (1998) does not indicate any measurement of exposure or the type of livestock production in the area studied. The unique characteristics of the area make the results difficult to generalize. Kleiner (2004) uses the concept of quality of life without defining it, and Mann and Kögl (2003) provide no details on the development and validation of their questionnaire. Moreover, their theoretical framework does not include any modelling of the constructs used, or the implications of the cognitive, behavioural and emotional variables used. Radon et al. (2004) do not indicate the inclusion criteria for their population, and the variables they chose explain only 6% of the variance. Sharp and Tucker (2005) provide no information on their questionnaire, either about its validity or the items included in it. In addition, although the number of individuals assessed is indicated, it is impossible to know whether it is sufficient to satisfy the statistical criteria for the scale of analysis. Finally, despite the high level of methodological detail provided by Reisner and Taheripour (2007) in their study, the number of people consulted was low

(n = 106), and there may be cultural differences between these people and those in the Quebec context.

Limitations were also found in the Group 4 qualitative studies. They concern method, recruitment, data measurement or collection tools, and analysis. All three studies in this category have limitations with regard to the method used. DeLind (2004) provides little information on method and no details regarding the analysis grid used. Moreover, the themes (effects on conflicts, anger, polarization, long-term losses) are not documented. Williams (2006) indicates that hog industry data were obtained but does not provide the sources or the length of the documents. Finally, Wright et al. (2001) contains a structural defect: the review of the recent literature is addressed after the analysis. The final section is not analyzed, resulting in a loss of information.

The Group 5 literature reviews also have a number of limitations. These publications are not systematic reviews, but classic narrative reviews. Also, they do not indicate a search method and they suffer from deficiencies in the analysis. The only study that includes a methodology is the one produced by the team of Brodeur et al. (1999), which describes the databases consulted and the search terms; however, this group did not conduct a quality analysis of the studies in their survey, which means it cannot be classified as a systematic review, despite its title. None of the other studies present a research question or inclusion or exclusion criteria for the articles selected. Additional biases in the analysis were noted: a discussion on the negative aspects of hog farms (Cole et al., 2000), an analysis presenting arguments on the biological plausibility of the impacts of hog odours on health and cognitive processes (Brodeur et al., 1999), weak analyses that repeat the content of the original articles (Von Essen and Auvermann, 2005; Brodeur et al., 1999) and an analysis based on poorly documented information (Von Essen and Auvermann, 2005). It should also be noted that the text of Brodeur et al. (1999) was produced in response to a request from a hog industry interest group and that despite the methodologically rigorous approach; such a context may skew the results. These publications were retained for the present review of the literature only for the discussion of the findings of the original studies selected.

## 5 RESULTS

### 5.1 OVERVIEW

The synthesis of these scientific documents is presented in the form of a descriptive analysis of the content, due to the diverse sources of results. Thus, a caveat applies: when reading and interpreting the findings, the individual and general limitations of the studies must be taken into account (see point 4.2.2). It must also be borne in mind that the results come from studies with differences (possible or documented) in the finer contextual variables, namely those relating to the size and method of management of the production units, the socio-geographical and historical criteria used to determine the populations studied, the sizes of the populations and samples measured, and the public actions taken and the instruments used for this purpose. However, this review presents a coherent corpus with regard to the broad contextual parameters, i.e. in so far as the source of exposure is hog farms (exclusively or otherwise), the exposed population is rural and lives in proximity to the farms, and the sociopolitical context is similar to that of Quebec. Above all, the impacts are consistent in terms of the descriptions and measurement approaches, and can therefore be combined.

The following sections present the results taken from the 22 selected articles, presented in Table 9. The first part sets out current knowledge as to impacts on mental health, and the second part, the impacts on social health. A final section deals with overall measurement of quality of life. As was indicated in Table 3 above, the reviews of the literature and the expert reports were considered in order to qualify these results.

Table 9: Breakdown of results of the systematic review

Study	Impacts on quality of life					
	Impact on quality of life (overall)	Impact on mental well-being	Impact on social well-being			
			Modification of social capital	Inequitable distribution of impacts	Variation in the social acceptability of farms	Declining confidence in democracy
<b>Group 1: RCT</b>						
1. Shiffman, 2005 – U.S.		X				
<b>TOTAL Group 1</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Group 2: Etiologically-oriented studies</b>						
1. Wing and Wolf, 2000 – U.S.	X			X		
2. Shiffman, 1995 – U.S.		X				
3. Merchant et al., 2002 – U.S.		X				
<b>TOTAL Group 2</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>
<b>Group 3: Descriptive studies</b>						
1. Mann and Kögl, 2003 – Germany					X	
2. Radon et al., 2004 – Germany	X					
3. Kleiner, 2004 – U.S.	X			X		
4. Asmus, 1998 – Germany	X	X				
5. Sharp and Tucker, 2005 – U.S.		X	X			
6. Reisner and Taheripour, 2007 – U.S.			X		X	
<b>TOTAL Group 3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>2</b>	<b>0</b>

Study	Impacts on quality of life					
	Impact on quality of life (overall)	Impact on mental well-being	Impact on social well-being			
			Modification of social capital	Inequitable distribution of impacts	Variation in the social acceptability of farms	Declining confidence in democracy
<b>Group 4: Qualitative studies</b>						
1. Williams, 2006 – U.S.			X			X
2. DeLind, 2004 – U.S.		X	X			X
3. Wright et al., 2001 – U.S.	X		X	X		X
<b>TOTAL Group 4</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>3</b>
<b>Group 5: Reviews</b>						
1. Kirkhorn, 2002		X				
2. Merchant and Ross, 2002	X	X	X			
3. Thu, 2002		X				
4. Thu, 1995	X		X			X
5. Von Essen and Auvermann, 2005	X	X				
6. Donham et al., 2007		X	X			
7. McBride, 1998		X	X			
8. Brodeur et al., 1999		X				
9. Cole et al., 2000	X	X				
<b>TOTAL Group 5</b>	<b>4</b>	<b>8</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>1</b>
<b>TOTAL 22 studies</b>	<b>9</b>	<b>14</b>	<b>9</b>	<b>3</b>	<b>3</b>	<b>4</b>

## 5.2 IMPACT ON MENTAL WELL-BEING

A number of the publications selected for this review deal with perceptions of states of mental well-being and other factors that influence people's emotional, cognitive and social functioning and the satisfaction they derive from life. Symptoms and affects of mood and even of mental health were also identified in the various articles.

First of all, the Group 1 (RCT) study (Shiffman et al., 2005) does not demonstrate any significant impact from hog farm odours on the components of mental health in the standardized test (mood: p value = 0.55, attention and memory: p value = 0.35). According to the author, the sudden and involuntary nature of exposure in a natural environment could not be reproduced, and the subjects tested may have been biased.

The results of the Group 2 studies relate to impacts on mental health. Schiffman et al. (1995) shows that people exposed to hog farm odours are significantly more tense, depressed and irritable; they have less energy and experience greater fatigue and confusion; and they are more emotionally fragile than people who are not exposed. According to the authors, the difference between the control group and the experimental group is significant ( $p < 0.0001$ ) for all items measured by the test (POMS). However, the cohort study by Merchant et al. (2002) is not conclusive as to any impact resulting from livestock production units, as the results obtained are similar in rural areas exposed to livestock farms and areas that are not exposed. In rural areas, women more frequently report that they suffer from depression than men (OR = 0.55) and they are more frequently treated for this problem (OR = 0.46).

In Group 3, Asmus (1998) was unable to show that the rise in feelings of apathy resulted from the odours generated by livestock production units, or to isolate one or more variables that were predictive in this regard. The only individual variable that contributed significantly to the feeling of apathy was the subject's youth ( $\beta = -0.30$ ;  $R^2 = 0.19$ ). Moreover, Sharp and Tucker (2005) established that there are statistically significant associations ( $p \leq 0.05$ ) between the anxiety created by livestock production and living in the city, being aware of the livestock facilities in the area, and supporting small-scale (or pastoral) agriculture. On the other hand, the less anxious subjects appear to be those who have a positive view of the economic contribution of livestock production and express trust in farmers. There is a consistent and relatively strong association between living far from exposure sources and being aware of the issues associated with livestock production. However, the tendency for people who live further from farms to be less anxious is not so pronounced.

The qualitative research (Group 4) reported in DeLind (2004) looks at the case of a community where a large-scale hog production operation is a source of social conflict giving rise to negative feelings: anger, loss of self-control, helplessness, insecurity and exclusion.

Finally, the Group 5 publications show two types of results. The report on a consultation meeting on the issue of swine production (Thu, 1995) advances the hypothesis that the feelings of loss of control reported by the residents who attended the meeting, are a major contributing factor in the development of psychological problems such as depression, anger and stress. The document also highlights the fact that the types of malaise experienced by the

residents are often dismissed because they do not always correspond to widespread or scientifically plausible symptoms.

In the reviews of the literature considered, there are very few conclusive findings of impacts of hog farms on mental well-being. However, Donham et al. (2007) point to what they consider to be significant results from epidemiological studies showing that people living near intensive farming operations are more likely to develop psychological symptoms. This group also believes that a significant result may be inferred from the fact that the emotional and psychological states that arise in people living near large-scale operations, have an influence on their quality of life. Von Essen and Auvermann (2005) argue that although there are few studies on the subject, symptoms of a psychological nature seem to be more prevalent in the vicinity of large-scale livestock farms, and this seems to have a negative impact on quality of life. In his review of the literature, Kirkhorn (2002) is more nuanced, saying that the symptoms are non-specific, and these results cannot be extrapolated due to the small sample size and the lack of an established exposure-response relationship. However, the other reviews do not draw any conclusions regarding the same studies. Merchant and Ross (2002) and McBride (1998) are unable to conclude that there is an impact caused by large-scale hog farms. Although observed or self-reported symptoms and emotional disturbances are more common in some studies, another study reports no significant clinical difference. More importantly, all the symptoms identified by the studies reviewed are similar to those found in the population and among hog farm workers, and it is difficult to establish an exposure-response relationship. In their articles, Cole et al. (2000) and Thu (2002) come to a similar conclusion and assert that the evaluation of exposure is problematic or non-existent in the studies reviewed. Brodeur et al. (1999) believe that no direct link between health and hog production has been identified (Brodeur et al., 1999, p. 19) and that the risks to psychological health may have been overestimated, since the studies or reviews they considered do not show associations, but rather hypotheses. This unequivocal result must, however, be interpreted with caution, given the context in which the report was produced.

The studies selected present divergent results with respect to the impacts of exposure to odours from hog farms on psychological well-being or mental health, and as a result, we cannot draw any definite conclusion on the subject.

### 5.3 IMPACT ON SOCIAL WELL-BEING

#### 5.3.1 **Changes to social capital**

The studies discussed in this section address the concept of social capital. Only one supplies a definition of the term: “the social and familial fabric within a community; refers to mutual trust and reciprocity in the sense of sharing between the individuals in a community, the ability to work with a shared perspective for the good of the community” (Wright, 2006, p. 95). Another article refers to it directly (Sharp and Tucker, 2005). Others mention factors related to this concept (Kleiner, 2004; Williams, 2006; DeLind, 2004).

None of the studies in Groups 1 or 2 deals with social capital. The results of the Group 3 study by Sharp and Tucker (2005) demonstrate a relatively strong negative association between trust in farmers and concerns regarding the environmental impacts of livestock production

units (standardized coefficient of 0.28 with a significance level of 95%). For these authors, then, trust may constitute a social capital resource that can help reduce or moderate civic concerns or conflicts. Further results, taken from Kleiner (2004), prove that changes in behaviour occur and that bonds are formed in communities where hog farms are located. Indeed, the F values associated with behavioural changes within communities where there are large-scale hog production units are 6.420 ( $p \leq 0.05$ ) and 17.320 ( $p \leq 0.001$ ) compared to 0.60 where there are no units of this type. Reisner and Taheripour (2007) suggest that a rift may occur in communities where large-scale hog farms are built, and may even persist after the facility has been operating for many years; these findings were measured by the differences in discourse between producers and residents. Moreover, 48% of the producers questioned and 42% of the residents mentioned the presence of social conflict that had lasted over a number of years, beginning with the construction or expansion of large-scale hog production facilities. There was a positive correlation between the size of the farms and the magnitude of the controversy. Although the issue of odours is raised during these controversies, they seem to be indicative of other problems. The authors note that these conflicts are not fed by “outsiders”, “people without any connection to agriculture” (Reisner and Taheripour, 2007, p. 1593). Rather, they continue to exist between people with similar social and demographic backgrounds who share the same longstanding experience of rural life. Finally, although these results are not so clear, the analysis suggests that people in the vicinity of these operations have greater tolerance toward producers who have closer ties with the local community and have been living there for a long time.

The Group 4 studies focus more on social capital. DeLind (2004) notes conflict and increased social tensions in a community that has an intensive hog production facility. Civil opposition and the need to exercise civil rights tend to entrench community polarization, reduce sociability and create an atmosphere of paranoia about physical safety. However, these actions also strengthen the in-group and feelings of belonging to the community (DeLind, 2004, p. 82-83). The results of Williams (2006) are similar. When large-scale hog production facilities are built, opposition groups may arise, and they tend to polarize relationships. However, the research shows that the emergence of opposition to swine projects is not systematic or constant. It appears to be influenced primarily by the size of the community (greater population = greater opposition). Moreover, there are citizens who reject this opposition: some support this form of production; others mention family reasons or the notion of freedom, while yet others believe that the economic and social disadvantages of the opposition outweigh any gains to be derived from it. When opposition arises in a community, it is mobilized by a number of fears. These are related to health and safety, the local economy, property values, community ties and the principles of justice and the free market. Finally, the study by Wright et al. (2001) demonstrates that intensive livestock units can have a negative impact on the economic vitality and social fabric of the local community. This method of production appears to modify social dynamics, and the author observes that conflicts are more common and openly expressed in host communities, increasing hostility and local tensions. Issues raised include nuisances associated with this type of production unit (odour, muddy streets, noise, etc.), environmental and health risks, and changes to lifestyle.

The publications considered in Group 5 include observations on social capital originating from a consultation meeting conducted by a panel of experts (Thu, 1995). Firstly, in the document

authored by the panel, residents stress the fact that communities where large-scale hog farms are sited experience degradation and a loss of collective identity and community values, such as sharing, respect and honesty. They base these perceptions on the words and actions of the producers. This report also describes the emergence of local resistance in communities with intensive livestock production facilities. This resistance appears to be caused by a perception that individual rights are being violated (full enjoyment of property rights, for example), and by skepticism regarding the authorities' efforts to deal with the problems in their communities. The conflicts have a negative impact on the social fabric: they lead to the polarization among the various players and tensions within families and among friends. As a result, the community becomes a war zone. According to the experts, these controversies could have a greater impact on quality of life than the hog farms themselves (Thu, 1995, chap.16, p. 95).

Merchant and Ross (2002) argue that intensive hog production projects are harmful to community values and bonds because they engender conflict, polarization and violence, and weaken trust, community engagement and social networks. McBride (1998) describes an impact involving social and class division within communities where there are hog production units. The work of experts, described by Donham et al. (2007) shows that the impacts identified in the studies consulted, suggest a decrease or erosion of social capital within communities where there are large-scale hog farms, in the form of a decline in the sense of belonging and social identity, a reduction in the ability to communicate, increased conflict, and social division. The latter may take a long time to be resolved.

In summary, the presence or introduction of intensive livestock production farms, including hog farms, appears to be associated with the presence of conflict and increased opposition and social tension. Such opposition polarizes relationships and contributes to the emergence of negative feelings within the community, which tend to persist over time. This opposition is sustained by a number of factors, but a relationship of trust between the farmer and the citizens appears to reduce it.

### 5.3.2 Variation in the social acceptability of farms

As the social acceptability of livestock production units is not considered per se in this literature review, there is little mention of it in the studies selected. Social conflicts and the factors contributing to them are mentioned frequently; however, as these are dealt with in section 5.2.1, they will not be addressed here.

Among all the studies selected, two from Group 3 deal with the social acceptability of hog farms and the impacts it may have on rural populations. The results of Mann and Kögl (2003) concern the factors that contribute to the social acceptability of existing and proposed swine production facilities. Existing livestock farms are better accepted than proposed ones as their advantages are tangible, and the status quo is always more easily accepted. The following factors appear to exert a positive influence that is statistically significant: obtaining information about the expected result through discussions on the project ( $t = 4.06$ ;  $p < 1\%$ ), having local economic benefits (associated  $t$  values are: source of income 3.3372 and creating jobs 6.54;  $p < 1\%$ ) and, with regard to the developer, being personally engaged in the community ( $t = 4.68$ ;  $p < 0.05\%$ ; this was confirmed through qualitative interviews conducted by the authors (Mann and Kögl, 2003, p. 248). Other findings suggest that the modernness of the

facilities and their distance from the population have a positive impact, with distance varying directly with acceptability, particularly for proposed hog farms ( $t = 3.62$ ;  $p < 1\%$ ). Methods of production (organic, intensive, animal-friendly), the type of property and the size of the operation (over 600 hogs) do not seem to influence acceptability, particularly with proposed developments. However, some factors do appear to have a negative impact, and this has been demonstrated statistically in regions where hog production farms have been introduced within communities. These factors are: the perception of noxious odours ( $t = 3.33$ ;  $p < 1\%$ ); the perception of potential health risks ( $t = 2.99$ ;  $p < 1\%$ ); the exclusion of the community from the decision-making process and the top-down approach (Mann and Kögl, 2003, p. 249). People between the ages of 40 and 60 are less accepting of hog farm proposals (ibid.). These results are qualified, however, by Reisner and Taheripour (2007). Although the role of hog producers in the community is important in promoting the long-term acceptability of their farms, the size of the farms seems to have an impact on acceptance: the larger the operation, the stronger the opposition. The cited study also highlights the perception of producers in relation to the influence of the media on the community's acceptance of hog farms.

In short, the acceptability of hog production units is a class of impact involving a range of different factors; however, it highlights some important points: proposed projects seem to be less well accepted than existing farms; distance can have a major influence, especially in the case of hog farms; and the role of the producer within the community targeted for the development is crucial. The size of the hog operations is a more ambiguous factor, since the results of the two studies analyzed are contradictory in this regard.

### 5.3.3 Inequitable distribution of impacts

Two studies consider the concept of health equity. According to their authors, people feel this kind of equity when the chances of being healthy and enjoying the living environment are equitably distributed among the members of a community (Kleiner 2004, p. 60).

No Group 1 study deals with equity in the distribution of risks and quality of life. However, one of the Group 2 studies, Wing and Wolf (2000), takes the view that people living near hog facilities are at significantly greater risk than others with regard to all the physical and psychological symptoms evaluated in the course of the research, including quality of life (Wing and Wolf, 2000, p. 236, Table 4). These results can be explained by a negative association between health and hog production units.

One of the Group 3 studies shows that the psychosocial and environmental impacts are not equitably distributed within the communities, and that residents living near hog farms are more severely affected by these impacts (Kleiner, 2004, p. 314-315). The perceived inequalities are associated with health (measured by quality of life), the quality of drinking water and streams, and nuisances caused by odours from hog facilities.

Finally, the publications in Groups 4 and 5 do not deal with social inequalities, with the exception of the consultation meeting conducted by Thu (1995). According to that paper, citizens who perceive the nuisances created by hog farms have the impression that they are responsible for proving their problems, which is an additional burden for them (Thu, 1995, p. 87).

Therefore, the information taken from the studies seems to show that social justice is inequitably distributed among members of rural communities exposed to livestock production units.

#### 5.3.4 Reduced confidence in democracy

Impacts with political connotations were noted in the studies consulted. These are centred around the confidence felt by people living near hog operations in the democratic institutions and principles of the countries targeted by the studies.

The studies in Groups 1, 2 and 3 do not address this social dimension.

The studies in Group 4 identify these kinds of impact. Wright et al. (2001) specifically looked at the impact of the presence of a livestock farm on empowerment and local governance. They found that the most marked impact after the construction of a livestock production unit is a decline in confidence in government and local institutions. The team of Wright et al. considered other findings to be contradictory. On the one hand, the presence of farms could have a positive effect on empowerment, creating a local movement to guide strategic decisions. On the other hand, “some individuals have adopted a fatalist perspective, viewing themselves as condemned to live with what they term the ‘stench’ and the undemocratic control by those with local power” (Wright et al., 2001, p. 24). DeLind’s results reveal a possible loss of trust in the government and public administration (DeLind, 2004, p. 83). Citizens feel that the territory is no longer being managed with integrity and that their environment is being ravaged without any response from the authorities. This is echoed in the results of Williams (2006). In his findings on opposition to hog farms, he notes that this opposition may arise when the community has the impression that the responsible authorities have violated the principles of justice and the free market (Williams, 2006, p. 382).

Among the publications in Group 5, a work report by Thu (1995) reports that large-scale hog production units have an impact on some aspects of democracy. People feel a loss of political control and perceive that democratic principles and their means to take control of their environment are being violated (Thu, 1995, p. 74). They also appear to have lost confidence in the legal or political channels for resolving their problems. These two feelings seem to contribute strongly to the emergence of local resistance. Merchant and Ross (2002) and Donham et al. (2007) note that livestock production units contribute to civic resentment toward the authorities and a decline in democratic values.

In general, when the presence of livestock farms is imposed on citizens, confidence in the state’s political institutions appears to decline. The three studies cited report a loss of confidence in public institutions at all levels of government among people living near hog production facilities (Williams, 2006; Wright et al., 2001). Moreover, this results in an impression that the principles of social justice and the free market are being violated (Williams, 2006) and that territorial integrity has been breached (DeLind, 2004).

#### 5.4 IMPACT ON OVERALL QUALITY OF LIFE

Quality of life is the category of impact that receives the greatest share of attention in the analysis of the psychosocial impacts of hog production units on rural populations. The majority of the studies selected evaluate this category or refer to it. However, the term quality of life is not defined in these studies. Only Kleiner (2004) provides evaluation criteria: quality of life is related to people's perceptions regarding the choices available to them in their daily lives and the feeling of respect from important family members and the members of their community. In addition to the variables mentioned above, feelings of well-being, the full enjoyment of the living environment and the absence of annoyances or nuisances, are important factors for evaluating quality of life in the studies selected.

No Group 1 study addresses quality of life in general. However, the results of one Group 2 study are statistically significant with regard to quality of life. Wing and Wolf (2000) show that perceived quality of life is notably diminished when individuals live near a large-scale hog production unit. They are more frequently unable to open their windows ( $\beta = 14.74$ ;  $t$  value = 5.26) or go outdoors in good weather ( $\beta = 14.73$ ;  $t$  value = 5.47). This perceived impact is specific to hog farms, and it is not significant in the case of cattle farms ( $\beta = 1.33$ ;  $t$  value = 0.46 and  $\beta = 0.79$ ;  $t$  value = 0.33). However, the authors qualify their results, stating firstly that the population living near hog production facilities may report more symptoms due to a negative perception of these facilities, and secondly, that this study does not present long-term effects on quality of life.

Among the Group 3 studies, Kleiner (2004) found that quality of life appears to be influenced by the industrialization of hog production farms. In her thesis, Kleiner also notes that there is a very marked decline in residents' quality of life within a radius of 4.83 kilometres (3 miles) from an intensive hog production farm. However, Kleiner shows that the choice of scale of analysis strongly influences her results. Radon et al. (2004) show a strong association between the perceived degree of nuisance with regard to livestock farm odours and reported quality of life (Radon et al., 2004, p 61). However, the study establishes that there is one factor that can improve this perception. Living or working on a farm is strongly associated with a lower level of annoyance caused by odours: 52.4% of respondents living on a farm stated that they were not at all bothered by the odours compared to 38.3% in the general population. Although no causal link is established, a possible impact is perceived between effective communication of the risks and an improvement in residents' perception of their quality of life (ibid.). Finally, in her doctoral dissertation, Asmus (1998) demonstrates that age is a determining factor in the perception of the nuisance generated by odours ( $\beta = 0.30$ ;  $p = 0.00$ ;  $R^2 = 0.19$ ), with people aged 55 and older being significantly less bothered ( $\bar{x} = 0.51$ ;  $SD = 3.42$ ) than people 55 and younger ( $\bar{x} = 2.39$ ;  $SD = 3.47$ ) by odours produced by livestock production units (Asmus, 1998, p. 55, 58 and 63). The results also suggest that the impression of having little control over these odours increases the perceived degree of nuisance (Asmus, 1998, p. 64, 65, 71) and that it is impossible to adapt to the odours (Asmus, 1998, p. 71). However, the author concludes that the nuisance associated with odours is difficult to evaluate because of the number of factors involved (Asmus, 1998, p. 72).

Among the Group 4 studies, the work by Wright et al. (2001) describes a marked decline in the quality of life in communities that have livestock production farms, particularly those producing hogs and chickens (Wright et al., 2001, p. 21). These farms appear to have a considerable impact on the perceived quality of life by increasing health problems, reducing the quality of drinking water, and impinging on the enjoyment of property and public spaces, and daily activities. Odours are highlighted in particular, but other sources of exposure related to livestock production (noise, traffic, increased conflict) appear to increase the severity of these impacts. Individuals living within 1.61 kilometres (1 mile) of the facilities seem to be the most affected. The informants themselves perceive livestock production farms as a negative phenomenon that is liable to reduce their quality of life and devalue their property.

The documents in Group 5 focus more on quality of life. The report on the consultation meeting on hog production by Thu (1995) notes a widespread perception that odour is responsible for a reduction in quality of life. A significant linear relationship has been established between this reduction and separating distance from hog production facilities (Thu, 1995, p. 76-77). Among other things, people report that odours reduce the number of outdoor family activities they engage in. Reduced quality of life is not only due to odours; other nuisances associated with hog farms (traffic and social conflict) also play a role, as well as economic impacts (the devaluation of property).

The reviews of the literature by Von Essen and Auverman (2005) and McBride (1998) conclude that odours from hog and cattle farms may be perceived as offensive by those in the vicinity and as a possible health risk. They also argue that quality of life appears to be affected by the presence of these odours, which are considered to be unpleasant. Merchant and Ross (2002) demonstrate that, of all the types of livestock farms, hog farms are considered to be the most detrimental (Merchant and Ross, 2002, p. 150). People report more periods during which they cannot go outdoors or open their windows. They also report that it is difficult for them to invite friends to their home, which diminishes their social relations. In addition, quality of life appears to be most strongly affected in the case of intensive farms (*ibid.*). In the studies selected, there is an inverse relationship between quality of life and the unpleasant odours produced by the facilities. Although the nuisances caused by odours from livestock production diminish with distance, this reduction appears to be less pronounced in the case of hog farms (*ibid.*). However, the authors believe this conclusion is debatable due to the narrow scope of the studies consulted, their limited number and small sample sizes, and the fact that the symptoms they discuss are similar to those found in the general population. The team of Cole et al. (2000) makes similar observations while establishing that quality of life can be affected by the presence of unpleasant odours associated with hog farms. This group adds another caveat with regard to the findings: personal or community values, opinions and experiences may influence the perception of odours and the nuisance they represent. Finally, Donham et al. (2007) presents the following relationship, with no discussion: the social and economic well-being of rural communities increases with an increase in the number of farmers but decreases with increased production capacity.

Thus, livestock production units, including hog farms, appear to have a negative impact on perceived quality of life of the surrounding population. Odours are the exposure source most often cited in connection with this impact. Finally, proximity and age are factors that reinforce the impact on quality of life.

## 6 CONCLUSION REGARDING THE RESEARCH QUESTION

Our analysis of the various research findings on hog and livestock production units provides answers to the question posed in this systematic review of the literature: What are the impacts of hog farms on the quality of life of rural populations, in terms of mental and social well-being, under conditions comparable to those in Quebec?

Livestock production farms (including hog farms), particularly large-scale farms, can have an impact on the social well-being of rural populations. Although the available data do not allow us to make absolute generalizations, it is possible to identify a number of impacts:

- The presence or introduction of large-scale livestock production facilities, including hog farms, is associated with conflict and can heighten opposition and social tensions. This opposition arises from within the community, can polarize relationships and contribute to the development of negative feelings, which seem to persist over time. Various factors may reinforce this opposition, while a relationship of trust between farmer and citizens appears to alleviate it.
- The acceptability of a hog farm depends on a number of factors and the relationships between them. Proposed farms seem to have a lower level of acceptance than existing ones. Proximity appears to be an important factor, particularly in the case of hog farms. Moreover, the role of the producer within the community targeted for the development may be crucial for the social acceptability of a project. However, results were ambiguous with regard to the influence of the size of the operation.
- Citizens from exposed rural communities can experience a greater sense of inequality in the distribution of harms and risks, including those connected with health, the environment, and quality of life.
- Overall, when they are imposed on citizens, livestock farms appear to produce an erosion of trust in public institutions at all levels of government and in the capacity for complying with existing standards.

Impacts on overall quality of life also appear to be clear: livestock production farms, including hog farms, can have a negative impact on the quality of life perceived by the surrounding population. Odours are the exposure source most frequently cited in connection with this impact, but they are not the only one. The magnitude of the impact is also influenced by proximity and age.

No trend was identified with regard to the dimension of mental health. The results are divergent when it comes to possible impacts on the psychological or mental health status of people exposed to odours from hog farms, and as a result, no conclusions can be drawn in this regard. Nonetheless, it is important to keep the conclusions regarding the mental dimension in perspective, as they are necessarily linked with the social well-being dimension revealed by the studies. Conflicts surrounding livestock farms in a community may give rise to personal fears and a sense of insecurity, as well as feelings of anger or tension. Moreover, psychological perceptions of loss or lack of control can have an impact on the perception of democracy and lead to the formation of civil groups and a rise in public demands.

## 7 SUGGESTED AVENUES OF RESEARCH

A comparison of the results of the review of the literature on hog production shows probable impacts on overall quality of life and its social dimension. These impacts must however be interpreted in light of the intrinsic limitations of the studies selected. These limitations are representative of the current state of research on hog farms. Moreover, caution must be exercised when combining results from a variety of sources.

It would be wrong to believe that all aspects of hog farms and their impacts on quality of life, including the psychological and social well-being of rural populations, have been adequately addressed to allow us to understand and prevent any foreseeable problems connected with the development of this sector. Indeed, according to Brodeur et al.: “the problems associated with odours generated by hog production are complex and real” (Brodeur et al., 1999, p. 19). New research is needed in order to better reflect the concerns of residents of areas exposed to this type of production. The studies on swine production selected for this systematic review of the literature suggest several avenues of research. According to a number of authors (Asmus, 1998; Merchant and Ross, 2002; Thu, 1995; Brodeur et al., 1999; Wing and Wolf, 2000; Thu, 2002; Donham et al., 2007; Cole et al., 2000), quality of life and the social implications of hog farms are the variables to be documented with a view to fostering harmonious relationships between residents and producers. Research should also be aimed at gaining a more thorough understanding of the impacts these farms have on human health and on the exposure environment (Von Essen and Auvermann, 2005; Wing and Wolf, 2000; Kirkhorn, 2002; Cole et al., 2000; Schiffman et al., 2005) and at establishing a definition of the political frameworks needed to promote the social acceptability of hog farms (Kleiner, 2004; Sharp and Tucker, 2005; Wright et al., 2001; Thu, 1995). The following topics of research are recommended based on the different areas identified:

- Quality of life and the social dimension:
  - establish a better definition of the concept and measurement of quality of life, particularly in a rural setting (Fayers and Machin, 2000);
  - document personal, social and cultural values in rural communities (Thu, 1995);
  - evaluate residents' level of satisfaction as to their quality of life (Asmus, 1998);
  - study the long-term impacts of reduced quality of life (Cole et al., 2000);
  - give priority to research on community health and the study of the psychophysiological impacts of bad odours on mental health, quality of life, and the behavioural modifications associated with this exposure (Brodeur et al., 1999; Wing and Wolf, 2000; Donham et al., 2007; Cole et al., 2000);
  - further document the influence of variables associated with production structures: mode of production, type of property and facility size (Mann and Kögl, 2003; Reisner and Taheripour, 2007);
  - conduct a population analysis to determine whether residents in communities where hog production is practised experience more discomfort or health problems than those in other communities (Brodeur et al., 1999).

- Psychological well-being, human health and exposure environment:
  - define their environmental parameters (Cole et al., 2000; Kirkhorn, 2002);
  - standardize clinical assessment of physical and psychological health (Wing and Wolf, 2000);
  - compare the prevalence of symptoms within currently accepted exposure limits or standards (Von Essen and Auvermann, 2005);
  - determine whether an exposure-response relationship can be identified (Kirkhorn, 2002);
  - document the health status of people living near hog and cattle farms and make a comparison with the only differentiated variable being exposure to livestock production farms (Von Essen and Auvermann, 2005).
- Political framework and social acceptability:
  - conduct research on policy and legal processes to understand the conditions to which rural communities must adapt (Thu, 1995);
  - compare the various management policies for intensive livestock production and their respective impacts (Kleiner 2004);
  - evaluate the impact of negative perceptions of large-scale production facilities on the level of acceptability in agricultural communities (Sharp and Tucker, 2005);
  - evaluate how the population's trust in farmers develops (idem);
  - comprehensively document the variables that influence the long-term process of establishing the social acceptability of hog farms, including the influence of the media and communications (Reisner and Taheripour, 2007) and the production method and facility size (idem; Mann and Kögl, 2003);
  - emphasize the transfer of scientific knowledge in order to improve public policy and practices (BAPE, 2003a; Donham et al., 2007).

## 8 CONCLUSION OF THE SCIENTIFIC AND ADVISORY COMMITTEES

The authors of this systematic review — the scientific committee and the advisory committee — believe the results available reveal not only potential impacts but also gaps in the knowledge on the quality of life of rural populations exposed to hog farms. These gaps may have a considerable effect on the reading of the social and psychological impacts and on the perception of hog farms in a given community. Moreover, during this process, the large number of articles excluded due to their poor quality – including papers by recognized authors – underscores the importance of viewing with a critical eye the information disseminated. The various stakeholders in the hog sector should exercise caution with respect to the data they use in support of their actions. This caution is especially important as the interpretation and use of scientific results may add fuel to certain conflicts connected with the issue.

The authors note that the following specific factors limit the interpretation of the results:

- Social, community and geographic variables are not documented; these include representations of the environment and feelings of belonging to the community, the context, local and regional history, origin of the producer, local and regional economy, etc.
- The size of the livestock production farms studied, the type of property on which the facilities are located, production structures and manure spreading activities are not mentioned, or scarcely so, despite the fact that in the Quebec context, these factors may play an important role.
- The studies consulted contain many terms and concepts that are not defined, including quality of life, which remains a vague concept that is defined and documented in a variety of ways, depending on the factors taken into account in each study. Very few results are based on a coherent definition and construct of quality of life, and no definition addresses it as a complex, multi-factor phenomenon. This observation is in line with the general concept of quality of life of Fayers and Machin (2000). In our view, quality of life remains an area for further and more systematic exploration, including documentation of the relationships between the various impacts identified through this process.

In general, quality of life associated with hog farms needs to be better documented. Nevertheless, it is possible to conclude that livestock farms are a source of conflict, debate and concern within all the populations studied and quality of life — whether actual or perceived — is affected as a result. Therefore, these perceptions and concerns need to be taken into account. However, in examining the results of this systematic review of the literature, the members of the scientific and advisory committees did note a number of possible solutions: these involve communication with the public and the social integration of farms, the involvement of the developer, and the siting and size of facilities.

Consequently, despite the limitations of the studies reviewed, an analysis of the impacts on quality of life, beginning with its social dimension, needs greater consideration. Indeed, although exposure standards currently exist, they are limited by the current state of knowledge and the types of exposure analyzed. As a result, they do not provide protection against all

possible impacts. Also, even if existing exposure standards are adhered to, a strong perception of nuisance associated with hog farms persists. The findings indicate that this perception cannot be attributed solely to the hog industry's bad reputation. It appears to be due primarily to the scant attention currently paid to the social dimensions of production facilities. For example, impacts on the political dimension may reflect a lack of community empowerment and a weak sense of control over the living environment. The authors believe these social effects can affect the psychological well-being of individuals.

In this regard, the social aspects of hog farms deserve further examination, not only through research but also in practice, in terms of the criteria and processes used in developing farms and the social technologies employed in consulting the community. These are very sensitive issues that have a strong impact on community dynamics. In line with earlier recommendations from the BAPE, the authors of this review propose that a social impact analysis be included in the planning process for hog production facilities, in order to identify the most promising ways of ensuring the social integration of each project. Moreover, authorities and decision-makers at all levels, including the national level, are urged to consult the community and determine the societal choices that should be given priority with regard to livestock farms, particularly in the hog sector, in light of the possible impacts of the various farm types, sizes and activities on the social fabric of the region where they are to be located, and on the territory. Great care should be taken when choosing the ways in which to implement these consultations. Similarly, beyond the wide range of local and regional adaptations that might be envisaged, it would be desirable to arrive at a national consensus on the social choices to be made regarding hog farms. Minimum separating distances through zoning and processes for settling land use conflicts should also be considered. In short, the various factors that will contribute to greater harmony in rural communities and improved well-being among individuals exposed to livestock production facilities cannot be determined without a more effective dialogue among the actors involved, a search for collective solutions, and better coordination on the part of government institutions.

We can deduce, from the results brought to light by this systematic review, that increased social engagement by producers reduces the risk of a diminished quality of life in their communities. Accordingly, better social integration of hog and other livestock operations is recommended. To this end, pilot projects that include the community in integrated management approaches should also be advocated.

Finally, these results allow us to draw conclusions only with regard to the psychosocial impacts of hog farms on rural populations, since the study did not address impacts of hog facilities on the physical health of rural populations or their effects on the health of workers in the hog industry.

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APPENDIX 1

TABLES OF DOCUMENT SEARCH RESULTS

Table 1: Breakdown of documents obtained by consulting scientific databases – August and September 2007

Database	Date of consultation	Number of articles obtained using keywords			Number of articles retained after evaluation for relevance <sup>1</sup>	
		Psychological well-being	Social well-being	Total	Summary	With duplicates eliminated
Campbell Collaboration	10/09/2007	0	0	0	0	0
Cochrane Collaboration	07/09/2007	36	34	70	0	0
Compendex	07/09/2007	120	122	242	10	8
CSA	27/08/2007 to 04/09/2007	10 498	6 252	16 750	30	25
Current Contents	10/09/2007	21	39	60	11	8
EBSCO	21/08/2007 to 23/08/2007	1 955	2 986	4 941	34	29
OVID	05/09/2007 to 06/09/2007	794	1 039	1 833	29	18
PubMed	13/08/2007 to 20/08/2007	955	2 753	3 708	24	13
<b>TOTAL</b>		<b>14 379</b>	<b>13 225</b>	<b>27 604</b>	<b>138</b>	<b>101</b>

<sup>1</sup> Articles retained after the evaluation of the summaries for relevance, based on the grid developed for this purpose.

Table 2: Articles evaluated as relevant, taken from the scientific databases<sup>1</sup> – August and September 2007

Article	Score of ++ or +	Score of–	Not relevant
1. Asmus, 1998	X		
2. Coppin, D. M., 2003			X
3. Curran, 2001			X
4. DeLind, 2004	X		
5. Donham et al., 2007	X		
6. Durrenberger and Thu, 1996		X	
7. Edelstein, 2002			X
8. Evans and Yarwood, 1995			X
9. Furuseth, 1997			X
10. Hogberg et al., 2005		X	
11. Kirkhorn, 2002	X		
12. Kleiner, 2004	X		
13. Lohr, 1996		X	
14. Mann and Kögl, 2003	X		
15. Mayda, 2001			X
16. Merchant et al., 2002	X		
17. Nicourt et al., 2000			X
18. Nimmermark, 2004			X
19. Novek, 2003a		X	
20. Novek, 2003b		X	
21. Radon et al., 2004	X		
22. Ramsey et al., 2005			X
23. Schaffer, n. d. (not obtained)	-	-	-
24. Sharp and Tucker, 2005	X		
25. Stretesky et al., 2003			X
26. Thu et al., 1997		X	
27. Vuitton, 2003			X
28. Williams, 2006	X		
29. Wilson et al., 2002			X
30. Wing et al., 2000			X
31. Wing and Wolf, 2000	X		
<b>TOTAL</b>	<b>11</b>	<b>6</b>	<b>13</b>

<sup>1</sup> Ebsco, Pubmed, CSA, Ovid, Current Contents, Compendex, Campbell Collaboration et Cochrane Collaboration.

Table 3: Articles from the bibliographies of the scientific articles<sup>1</sup> and the recommendations\* from the advisory committee evaluated as relevant, and their quality based on the NICE (2007) grids

Article	Score of ++ or +	Score of –	Not relevant
<b>1. Aubin and Forget, 2001</b>		X	
2. Abbozzo et al., 1996		X	
<b>3. Auvermann and Rogers, 2004</b>			X
4. Avery, 2004			X
<b>5. Brodeur et al., 1999</b>	X		
6. Bullers, 2005		X	
7. CDC, 1998 (not obtained)	-	-	-
8. Cole et al., 2000	X		
9. Common-Singh, 1999			X
10. Cormier, 1997			X
11. Delind, 1998		X	
12. Donham, 1998			X
<b>13. Gingras, 2003</b>			X
<b>14. Gingras et al., 2003</b>			X
15. Havenstein, 2002			X
16. Heederik et al., 2007		X	
<b>17. Ikerd, n. d.</b>		X	
<b>18. Jacques et al., 2003</b>			X
<b>19. Labbé, 2001</b>			X
20. Ladd and Edward, 2002			X
21. Lloyd, Spencer and Guan, 2004			X
<b>22. Martin et al., 2003</b>		X	
<b>23. McBride, 1998</b>	X		
<b>24. Merchant and Ross, 2002</b>	X		
25. Nimmermark, 2004 <sup>107</sup>			X
26. Okun, 1999			X
<b>27. Pampalon and Légaré, 1997</b>		X	
<b>28. Région laboratoire du développement durable, 2000</b>			X

\* The articles in bold type were evaluated following the recommendations of the advisory committee.

Table 3: Articles from the bibliographies of the scientific articles<sup>1</sup> and the recommendations\* from the advisory committee evaluated as relevant, and their quality based on the NICE (2007) grids (continued)

Article	Score of ++ or +	Score of -	Not relevant
29. Schiffman et al., 2005	X		
30. Schiffman, 1995	X		
31. Schiffman, 1995			X
32. Schiffman, 1998			X
33. Schiffman, 1998			X
34. Schiffman, 2000			X
35. Steinheider, 1999 (not obtained)	-	-	-
36. Swinker, 1998			X
37. Thorne, 2007			X
38. Thu, 1995	X		
39. Thu, 1998 <sup>52</sup>		X	
40. Thu, 2002	X		
41. Transfert Environnement, 2003			X
42. Von Essen and Auvermann, 2005	X		
43. Wing and Wolf, 1999			X
44. Wright et al., 2001	X		
<b>TOTAL</b>	<b>10</b>	<b>9</b>	<b>23</b>

\* The articles in bold type were evaluated following the recommendations of the advisory committee.

Table 4: Articles suggested during the outside review of the report, and the results of the evaluation of their quality (NICE, 2007)

Article	Score of ++ or +	Score of –	Not relevant and therefore not evaluated
1. Reisner and Taheripour, 2007	X		
2. Ministère de l'Environnement, 2003		X	
3. Boutin, 2000			X
4. Bonnano and Constance, 2000 <sup>1</sup>			
5. Caron and Torre, 2006			X
6. Nicourt et al., 2000			
7. Torre and Caron, 2005 (not obtained)			
8. Torre et al., 2006			X
TOTAL	1	1	3

<sup>1</sup> Document already identified and rejected during an earlier phase of the search process.

APPENDIX 2  
EVALUATION GRIDS

Grid 1: Qualitative studies

Source: National Institute for Health and Clinical Excellence. (2007). The guidelines manual (2<sup>nd</sup> ed.). London: author. Appendix H, p. 145.

Study identification (Include author, title, reference, year of publication)			
Checklist completed by:			
Guideline topic:		Key question no.:	
Criteria:		How well is this criterion addressed? (Circle one option for each question)	
1 Aims of the Research			
1.1	Are the aims and objectives of the research clearly stated?	Clearly described Unclear Not reported	Comments
1.2	Is a qualitative approach appropriate?	Appropriate Unclear Not appropriate	Comments
2 Study Design			
2.1	Is (are) the research question(s) clearly defined and focused?	Clearly defined and focused Unclear Not focused Not defined	Comments
2.2	Are the methods used appropriate to the research question(s)?	Appropriate Unclear Inappropriate	Comments
3 Recruitment and Data Collection			
3.1	Is the recruitment or sampling strategy appropriate to the aims of the research?		Appropriate Unclear Not appropriate
3.2	Are methods of data collection adequate to answer the research question?	Adequate Not adequate Not reported	Comments
3.3	Are the roles of researchers clearly described?	Clear Unclear Not reported	Comments

3.4	Have ethical issues been addressed adequately?	Adequate Unclear Not adequate	Comments
4 Data Analysis			
4.1	Is the data analysis sufficiently rigorous?	Rigorous Not rigorous	Comments
5 Findings/Interpretation			
5.1.	Are the findings internally coherent, credible (valid)?	Valid Unclear Potential bias	Comments
5.2	Are the findings relevant?	Relevant Unclear Limited relevance	Comments
6 Implications of Research			
6.1	Are the implications of the study clearly reported?	Clearly reported Unclear	Comments
6.2	Is there adequate discussion of the study limitations?	Adequate Inadequate Not reported	Comments
OVERALL ASSESSMENT OF THE STUDY			
How well was the study conducted? Code ++, + or -			
Are the results of this study directly applicable to the patient group targeted by this guideline?			Yes No

Grid 2: Systematic reviews and meta-analyses

Source: National Institute for Health and Clinical Excellence. (2007). The guidelines manual (2<sup>nd</sup> ed.). London: author, adapted from Appendix B, p. 112.

Study identification (Include author, title, reference, year of publication)			
Guideline topic:		Key question no.:	
Checklist completed by:			
SECTION 1 : INTERNAL VALIDITY			
In a well-conducted systematic review:		In this study this criterion is: (Circle one option for each question)	
1.1	The study addresses an appropriate and clearly focused question.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.2	A description of the methodology used is included.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.3	The data search is sufficiently rigorous to answer the focus question.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.4	Study quality is assessed and taken into account.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.5	There are enough similarities between the studies selected in the literature review to retain them for supporting the focus question.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
SECTION 2 : OVERALL ASSESSMENT OF THE STUDY			
2.1	How well was the study done to minimize bias? Code ++, + or –		
2.2	If coded as + or – what is the likely direction in which bias might affect the study results?		

SECTION 3 : DESCRIPTION OF THE STUDY		
3.1	What types of study are included in the review? (Highlight all that apply)	RCT CCT Cohort Case-control Other
3.2	How does this review help to answer your key question? Summarize the main conclusion of the review and how it relates to the relevant key question. Comment on any particular strengths or weaknesses of the review as a source of evidence for a guideline produced for the NHS in Scotland.	
	Overall assessment of the article (excellent, good, poor)	
	Will the article be retained for the study?	
	Indicate the reason(s) for accepting or refusing the article.	

Grid 3: Randomized clinical trials (RCT)

Source: National Institute for Health and Clinical Excellence (2007). The guidelines manual (2<sup>nd</sup> ed.). London: author, adapted from Appendix C, p. 116.

Study identification (Include author, title, reference, year of publication)			
Guideline topic:		Key question no:	
Checklist completed by :			
SECTION 1: INTERNAL VALIDITY			
In a well-conducted RCT study:		In this study this criterion is : (Circle one option for each question)	
1.1	The study addresses an appropriate and clearly focused question.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.2	The assignment of subjects to treatment groups is randomized.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.3	An adequate concealment method is used.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.4	Subjects and investigators are kept "blind" about treatment allocation.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.5	The treatment and control groups are similar at the start of the trial.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.6	The only difference between groups is the treatment under investigation.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.7	All relevant outcomes are measured in a standard, valid and reliable way.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.8	What percentage of the individuals or clusters recruited into each treatment arm of the study dropped out before the study was completed?		

1.9	All the subjects are analysed in the groups to which they were randomly allocated (often referred to as intention-to-treat analysis).	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.10	Where the study is carried out at more than one site, results are comparable for all sites.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
<b>SECTION 2 : OVERALL ASSESSMENT OF THE STUDY</b>			
2.1	How well was the study done to minimize bias? Code ++, + or -		
2.2	If coded as + or - what is the likely direction in which bias might affect the study results?		
2.3	Taking into account clinical considerations, your evaluation of the methodology used, and the statistical power of the study, are you certain that the overall effect is due to the study intervention?		
2.4	Are the results of this study directly applicable to the patient group targeted by this guideline?		
	Overall assessment of the article (excellent, good, poor)		
	Will the article be retained for the study?		
	Indicate the reason(s) for accepting or refusing the article.		

Grid 4: Cohort studies

Source: National Institute for Health and Clinical Excellence. (2007). The guidelines manual (2<sup>nd</sup> ed.). London: author, adapted from Appendix D, p. 122.

Study identification (Include author, title, reference, year of publication)			
Guideline topic:		Key question no.:	
Checklist completed by :			
SECTION 1 : INTERNAL VALIDITY			
In a well conducted cohort study :		In this study the criterion is : (Circle one option for each question)	
1.1	The study addresses an appropriate and clearly focused question.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
SELECTION OF SUBJECTS			
1.2	The two groups being studied are selected from source populations that are comparable in all respects other than the factor under investigation.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.3	The study indicates how many of the people asked to take part did so, in each of the groups being studied.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.4	The likelihood that some eligible subjects might have the outcome at the time of enrolment is assessed and taken into account in the analysis.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.5	What percentage of individuals or clusters recruited into each arm of the study dropped out before the study was completed?		
1.6	Comparison is made between full participants and those lost to follow-up, by exposure status.	Well-covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable

ASSESSMENT			
1.7	The outcomes are clearly defined.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.8	The assessment of outcome is made blind to exposure status.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.9	Where blinding was not possible, there is some recognition that knowledge of exposure status could have influenced the assessment of outcome.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.10	The measure of assessment of exposure is reliable.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.11	Evidence from other sources is used to demonstrate that the method of outcome assessment is valid and reliable.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.12	Exposure level or prognostic factor is assessed more than once.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
CONFOUNDING			
1.13	The main potential confounders are identified and taken into account in the design and analysis.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
STATISTICAL ANALYSIS			
1.14	Have confidence intervals been provided?		
SECTION 2 : OVERALL ASSESSMENT OF THE STUDY			
2.1	How well was the study done to minimize the risk of bias or confounding, and to establish a causal relationship between exposure and effect? Code ++, + or -		
2.2	Taking into account clinical considerations, your evaluation of the methodology used and the statistical power of the study, are you certain that the overall effect is due to the exposure being investigated?		
2.3	Are the results of this study directly applicable to the patient group targeted in this guideline?		
	Overall assessment of the article (excellent, good, poor)		

	Will the article be retained for the study?
	Indicate the reason(s) for accepting or refusing the article.

Grid 5: Case-control studies

Source: National Institute for Health and Clinical Excellence (2007). The guidelines manual (2<sup>nd</sup> ed.) London: author, adapted from Appendix E, p. 129.

Study identification (Include author, title, reference, year of publication)			
Guideline topic:		Key question no:	
Checklist completed by:			
SECTION 1 : INTERNAL VALIDITY			
In a well conducted case-control study:		In this study the criterion is: (Circle one option for each question)	
1.1	The study addresses an appropriate and clearly focused question.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
SELECTION OF SUBJECTS			
1.2	The cases and controls are taken from comparable populations.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.3	The same exclusion criteria are used for both cases and controls.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.4	What percentage of each group (cases and controls) participated in the study?	Cases: Controls:	
1.5	Comparison is made between participants and non-participants to establish their similarities or differences.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.6	Cases are clearly defined and differentiated from controls.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.7	Is it clearly established that controls are non-cases?	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
ASSESSMENT			

1.8	Measures have been taken to prevent knowledge of primary exposure influencing case ascertainment.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
1.9	Exposure status is measured in a standard, valid and reliable way.	Well covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
CONFOUNDING			
1.10	The main potential confounders are identified and taken into account in the design and analysis.	Well-covered Adequately addressed Poorly addressed	Not addressed Not reported Not applicable
STATISTICAL ANALYSIS			
1.11	Have confidence intervals been provided?		
SECTION 2 : OVERALL ASSESSMENT OF THE STUDY			
2.1	How well was the study done to minimize the risk of bias or confounding? Code ++, + or -		
2.2	Taking into account clinical considerations, your evaluation of the methodology used and the statistical power of the study, are you certain that the overall effect is due to the exposure being investigated?		
2.3	Are the results of this study directly applicable to the patient group targeted by this guideline?		
	Overall assessment of the article (excellent, good, poor)		
	Will the article be retained for the study?		
	Indicate the reason(s) for accepting or refusing the article.		