



Scenario-based environmental assessment of farming systems: the case of pig production in France

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Abstract

Current intensive pig production is often associated with environmental burdens. However, very few studies deal with the environmental performance of both current and alternative systems of pig production. The objectives of this study were to evaluate the environmental impacts of three contrasting pig production systems using the life cycle assessment method and to identify hot spots for each system. The scenarios compared were conventional good agricultural practice (GAP) according to French production rules, a French quality label scenario called red label (RL) and a French organic scenario called organic agriculture (OA). For each of the three scenarios a “favourable” and an “unfavourable” variant was defined; these variants were used as indicators of uncertainty with respect to key parameters for technical performance and emissions of pollutants. The environmental categories assessed were: eutrophication, climate change, acidification, terrestrial toxicity, energy use, land use and pesticide use. Two functional units (FU) were used to express impacts: 1 kg of pig produced and 1 ha of land surface used. The scenarios were examined with particular emphasis on their contribution to eutrophication and acidification. Given this perspective, the RL scenario can be an interesting alternative to GAP on the condition that its emission of greenhouse gases can be reduced. The results for OA were very dependent on the choice of the FU. Per kg of pig, eutrophication and acidification were similar for OA and GAP, while OA had less eutrophication and acidification than GAP when expressed per ha. For the three scenarios, environmental hot spots and important margins of improvement were identified. Finally, the uncertainty analysis indicated that efforts should be made to produce more reliable estimations of emission factors for NO₃, NH₃ and N₂O in the field.

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1. Introduction

Forty years ago, in western Europe, pigs were produced on many small mixed farms, in association with crops and dairy cows, which provided on-farm sources of pig feed. Housing was on straw-covered floors, producing solid manure. Currently, most pigs

are produced on specialised farms. They are fed with concentrated feed “imported” from outside the farm and kept on concrete slatted floors, producing liquid manure. These changes, from a traditional to an intensive industrial production system, were associated with a huge increase in production and animal densities, which, in turn, contributed to an increased pollution of water, soil and air.

In the course of the last decade, consumers and citizens have become increasingly critical of intensive industrial pig production. In France, consumer

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worries regarding pig production concern product safety, product quality, environmental impact and animal well-being (Rainelli, 2001). Overall, pig production has a poor image with the general public and as a consequence the establishment of new pig farms has become very difficult in many areas, due to the opposition of the local community. Therefore, pig producers are facing a social demand for a better respect of the environment and improved animal welfare, while they have to cope with a very competitive pig world market.

In a survey among stakeholders concerned with pig production in Bretagne (France), two contrasting visions with respect to the future of pig production were proposed. A sizeable minority of pig producers (23%) and a majority of all other stakeholder groups (including consumers) preferred an alternative or organic pig production system to the current intensive production system (Petit and van der Werf, 2003). Furthermore, while pig producers and their suppliers preferred the currently prevailing slurry-based housing system, all other groups preferred a straw-based housing system (Petit and van der Werf, 2003). Whereas some studies have carried out an environmental analysis of the current intensive pig production system (Blonk et al., 1997; Carlsson-Kanyama, 1998; Cederberg, 2002), environmental analyses of alternative pig production systems are rare (Kumm, 2002).

Different methods have been developed for the evaluation of the environmental impacts of products or production systems. Among them, life cycle assessment (LCA) has been shown to be a valuable tool for the environmental evaluation of farming systems (van der Werf and Petit, 2002). In this approach, the potential environmental impacts of a product are assessed by quantifying and evaluating the resources consumed and the emissions to the environment at all stages of its life cycle—from the extraction of resources, through the production of materials, product parts and the product itself, and the use of the product to its reuse, recycling or final disposal (Guinée et al., 2002).

Among the four stages of an LCA, the two first steps consist of an accurate description of the product system(s) to be investigated and an inventory of its input/output data. Comparing different systems producing similar products requires a high degree of accuracy for inventory data and the availability of a large amount of data representative of the systems to

be evaluated. For the widespread current intensive pig production system, such data can be collected from farms and by referring to published data. However, for alternative or more prospective production systems, which represent a small number of farms and which are often at a more or less experimental stage, the availability of representative data is problematic. We therefore propose a scenario-based approach:

- to evaluate the environmental impacts of the current intensive pig production system and those of alternative production systems,
- to identify hot spots and margins for improvement for each system,
- to quantify the uncertainty of the results.

2. Materials and methods

2.1. Pig production systems

This study compared three scenarios for pig production in France and dealt only with the processes up to and including the production on the farm (Fig. 1). The most recent data available were used, mainly from the period 1996–2001. The good agricultural practice (GAP) scenario corresponds to current intensive production (or “conventional” production), optimised in particular with respect to fertilisation practices, as specified in the French “Agriculture Raisonnée” standards (Rosenberg and Gallot, 2002). In the GAP scenario pigs are raised at high density in a slatted-floor confinement building. The organic (OA) scenario corresponds to organic agriculture according to the French version of the European rules for organic animal production (Ministère de l’Agriculture et de la Pêche, 2000) and the European rules for organic crop production (CEE, 1991). The red label (RL) scenario corresponds to the “Porc Fermier Label Rouge” quality label (Groupement des fermiers d’Argoat, 2000). In the OA and RL scenarios pigs are born and raised outdoors until weaning, and in an open-front straw-litter building at low animal density after weaning.

2.2. Crop and feed production

For each scenario feed composition was supplied by the feed producer. According to the growing or

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