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Abstract

In this study we carried out bibliographical research on the impacts that pig production can cause on the environment, highlighting what is necessary for its production. During the research, some current manuscripts on this theme were used in the Google Scholar tool. Brazil is the fourth largest producer and exporter of pork. Despite the importance of this activity, the environmental impacts linked to swine farming have caused extremely relevant effects on the surrounding environment. The high consumption of water resources and the emission of liquid and gaseous objects into the environment are notable among these effects. The undue discharge of untreated waste into rivers, lakes and the soil can cause diseases (worms, allergies, hepatitis), in addition to zoonoses, causing discomfort to the population. The objective of this work is to identify environmentally sustainable alternatives with regard to the disposal of manure and the waste of water from pig farming. Swine farming requires a waste control program for its correct management. Waste treatment, in order to fulfill its final objective and to be effective, needs to convert waste into harmless material when returned to the environment. We have biodigesters as a form of treatment that is an efficient tool contributing to the minimization of waste that goes into the environment.

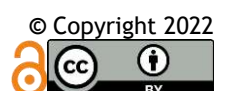
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1 Introduction

Brazil is the fourth largest producer and exporter of pig meat, being only supplanted by China, The European Union, and the USA (EUROMEAT, 2022; SUINOCULTURAINDUSTRIAL, 2022). In this economic framework, factors such as genetics are important for complying with market standards of yield per carcass (CASTRO, 2017).

Animal sanity represents another important factor. In Brazil the Ministry of Agriculture, Livestock and Supply (“Ministério da Agricultura, Pecuária e Abastecimento”) is the authority responsible for sanitary defense and for issues related to animal health (MAPA, 2022). Among illnesses that affect Brazilian swine farming and that create barriers for exportation of pig meat, are swine fever and foot-and-mouth disease (CASTRO, 2017).

In this way, animal welfare also promotes an excellent product quality, due to allow ideal conditions for physical and mental health for animals (SENTAMU et al., 2022).

Environmental impacts related to swine farming include a high consumption of hydric resources and the emission of liquid and gaseous waste products (SAMARIN et al., 2021). The main factors interfering with the consumption of pork are the quality of the food, its physiological state, and the environmental consequences of its production (CASTRO, 2017; ANDRETTA et al., 2021).

Swine waste has impact on hydric resources, being responsible for the eutrophication of water bodies, for changes in aquatic biodiversity, and for favoring the presence of organisms that are deleterious to humans and animals (CASTRO, 2017).

Based on this context, in this study we compiled some information on the environmental impacts that pig production can cause. The objective of this work is to identify environmentally sustainable alternatives with regard to the disposal of manure and the waste of water from pig farming.

2 Methodology

The manuscripts used in this research were selected in a quick search in the Scholar Google tool (<https://scholar.google.pt/>), based on articles, conference papers and theses, using remarkably the combined words “swine/pig farming”, “impacts”, “environment”, “Brasil/Brazil”.

3 Results and Discussion

Swine Farming

Investment studies place Brazil in fourth place in production and world export of swine meat (MAPA, 2022). Elements such as sanity, nutrition, good farm administration, integrated production and, mainly, managerial improvement of producers, contribute to increase domestic supply and to highlight the country worldwide. Yet, production has a large polluting potential due to the large volume of waste produced by each animal and by the concentration of farming activities in small areas. The crucial problem in swine farming lies in the great volume of waste produced and in the sustainability of the rearing activity. The improper launch of untreated waste into rivers, lakes and soil may provoke illnesses (worm diseases, allergies, hepatitis), cause discomfort to the population (insect proliferation, bad smell), and, furthermore, cause environmental impacts (death of fish and animals, toxicity of plants and eutrophication of water courses) (HERNANDES; SCHMIDT, 2010).

Waste Products

Swine farming requires a program for the control and management of waste. Five stages should be considered: production, collection, storage, treatment, and use of waste (in solid, liquid or pasty form). In general, it is estimated that swine waste is 100L/animal/day in a full cycle farm, of 60L/animal/day in farms producing piglets, and of 7.5L/animal/day in farms of final production (HERNANDES; SCHMIDT, 2010).

Waste treatment, in order to fulfill its goal and to be effective, must convert all waste into material that is harmless to the environment.

Liquid Waste

Swine manure composting is a practice that is growing significantly in the last years in several European countries. It was developed as an alternative method for managing and treating of swine waste, modifying its chemical and physical characteristics so as to obtain a final product of high agronomic value (HERNANDES; SCHMIDT, 2010).

Liquid waste is normally destined to settling ponds or applied over the soil, due to the simplicity of the process, to its low cost, and possibility of reducing costs of grain production by substituting part of fertilizers by nutrients contained in these wastes. Liquid swine waste becomes the best option for fertilizing pastures throughout the year. Liquid swine waste becomes a useful and inexpensive option for agricultural production (HERNANDES; SCHMIDT, 2010).

Biodigesters

Treatment systems are tools that contribute to minimize waste discharge into the environment. In swine farms, liquid waste is usually used as agronomical fertilizers. Treatment becomes important, because incorrect management of waste may result in pollution of the environment. Substances and processes that pose a risk to the environment are nitrate, copper zinc, lixiviation, ammonium odors (NH₃), pathogens in the waste, emission of soil methane (CH₄), nitrous oxide (N₂O), and organic load flow of phosphate and pathogens (ZANELLA; MORÉS; BARCELLOS, 2016).

A combination of treatment processes is recommended. This values waste reduces management costs and the prices of storage, transport and treatment.

A biodigester is a biological reactor that degrades animal waste in anaerobic conditions (with absence of oxygen) producing a liquid effluent (biofertilizer) and generating biogas. There are many models of biodigesters. The Canadian biodigester, constructed with PVC canvas, is the most used model in Brazil (ZANELLA; MORÉS; BARCELLOS, 2016).

The product of the decomposition of waste material is a gas of higher energetic power, capable of substituting firewood, gasoline, and liquefied petroleum gas. Other uses include the agronomic use as biofertilizers, and, for treatment systems of lakes, reduction of the organic content, shorter time of hydraulic retention, and reduction of area of anaerobic degradation. It is estimated that the production of swine biogas (by an animal of 90kg) is 0.24m³/animal/day (ZANELLA; MORÉS; BARCELLOS, 2016).

The capacity of the biodigester to degrade waste depends on several factors, such as temperature, volatile solids and activity of microorganisms present in the biodigester. The biodigester is part of the waste treatment system and thus cannot be considered as a final stage.

Gas Emission and Carbon Credit

Carbon credits are a species of currency that can be obtained in international negotiations. The national currency may thus be increased. The reason for creating the system of carbon credits was to find a way of counteracting the emission of gases that produce a greenhouse effect. Such a program would strengthen the political will to review a country's industrial processes and, thus, reducing atmospheric pollution and its impact on climate warming (HERNANDES; SCHMIDT, 2010).

The proposal to insert swine farmers in the market of carbon credit appeared with work for controlling environmental contamination produced in swine farming.

It is known that swine farming can obtain credit in the market of carbon sequestration, aiming at environmental preservation and reduction in the emission of gases responsible for the greenhouse effect (VELHO, 2011).

Environmentally sustainable practices in swine farming contribute greatly to the reduction of methane gas, that is produced by the decomposition of organic matter in swine waste.

The temperature of the earth has increased 6°C along the last 10 thousand years, and 0.6°C in the last 100 years. For swine farming, CH₄ is 21 times more pollutant in terms of global warming than carbonic dioxide (CO₂). The greenhouse effect is a natural phenomenon and is part of the natural dynamics of our planet. Without this effect, life on our planet would be impossible (HERNANDES; SCHMIDT, 2010).

Carcasses

The disposal of swine carcasses in Brazil, although not regulated, is previewed in National Politics for Soil Residues (PNRS), Federal Law n° 12.305/2010, art. 3°, that characterizes, determines the utilization and destiny of solid residues in Brazil. In the law the composting procedure, the energetic use, and other destinations, are established by the regulating instances in the National System of the Environment (SISNAMA), the National System of Health Surveillance (SNVS) and the Unified System of Attention to Agricultural Health (SUASA). All these entities aim to protect public health and maintain environmental quality (VELHO, 2011).

The generation of carcass swine waste is not a problem restricted to Brazil. Use of animal carcasses in the production of rations is prohibited due to the BSE (Bovine Spongiform Encephalopathy) crisis (the mad cow disease) in Europe. This occurrence produced concern for the quality of the ingredients used in the breeding of animals. In Brazil, BSE resulted in the regulation of normative instructions in MAPA N 34, of May 28, 2008. Concern for the destination and use of carcasses and viscera, as well as of other organic residues of animals, increased since then (ZANELLA; MORÉS; BARCELLOS, 2016).

Use of Water

Efficient use of water is mandatory in swine farming; therefore, if not well-managed, this resource may become gradually scarcer and of lower quality (FERREIRA et al., 2007).

Swine farming is an activity that demands a large volume of water. It represents the main input in pig breeding. According to Brazilian Institute FATMA/IMA (2014), it is estimated that the consumption of water per animal per

day is 72.9 liters during a complete cycle, 35.3 liters in a unit that breeds piglets, and 8.3 liters in terminal units.

In breeding farms this increase in water consumption is usually not caused by the demands of the animals, but by waste due to inadequate types of drinking fountains (height, inadequate location, flaws in their functioning, inadequate angle of installation of equipment, etc.).

In swine farming, water represents a vital and essential resource for production, especially due to the necessity of avoiding the dissection of animals during growth and during the various stages in the production chain (FERREIRA et al., 2007).

The most important uses of water in swine farms is to avoid desiccation of the animals, to humidify rations, for nebulization, and for cleaning and disinfecting the farms (OLIVEIRA, 2002; LIMA, 2007). These uses are influenced by several factors, mainly related to the physiology of the animals, to the technical requirements of feeding and hydration, to the construction of installations, to the cleaning and sanitation of living and production quarters (OLIVEIRA, 2002; LIMA, 2007).

It is possible to reduce water consumption in all activities not directly related to the feeding of the animals (OLIVEIRA, 2002; LIMA, 2007). In modern swine farming, one attempts to save water through the following procedures: providing the canalization of rainwater, increasing the lateral edges of gutters, installing efficient equipment for avoiding desiccation of animals, providing adequate maintenance services for the hydraulic equipment responsible for controlling water pressure and flow (OLIVEIRA, 2002). As swine farming demands adequate water resources for its efficient functioning (avoidance of desiccation, washing of installations and animal well-being), it is fundamental to control the volume and quality of the water being used. Besides representing an indication of the zootechnic performance and of the health of the animals, this also permits determination of the cost of the water for the production unit (PALHARES, 2013).

Environmental impacts of swine farming, which were already significant, have increased due to the intensification of the production process. With the environmental issue in focus, the concern of society forces more rigid control and stricter laws for pig breeding. High environmental effects caused by inefficient uses of water can be reduced by avoiding waste and adopting adequate managing procedures. Technological solutions, such as the use of biodigesters, are recommended to process swine waste. Available credit lines may be used by medium sized and large breeding farms, in order to avail of the recommended technological solutions (ZANELLA; MORÉS; BARCELLOS, 2016).

4 Conclusions

It is concluded that swine farming represents an important activity for small, medium and large producers. But it is necessary that these producers be aware of the environmental impacts that waste products have on the environment. Waste items must receive adequate treatment, such as in natural anaerobic water bodies. These have a lower cost of maintenance, but the time of treatment becomes longer. Mechanized composting transforms liquid waste into dry organic fertilizers, and biodigesters transforming waste into energy, are efficient available options.

Treating waste, making breeding farms more hygienic, and using available technology to minimize water use, breeders economize on feedstocks and, at the same time, reduce environmental impacts.

More integration of industries with breeders should be stimulated, in order to increase technical support for the treatment of waste. Waste represents the biggest problem for breeders, particularly for the smaller producers. Companies require an environmental license from the breeder, but often exempt responsibility for the treatment of waste products. Such an attitude must be changed, because the bonus of the production remains with the larger companies, while the onus of the production often remains with the small producers.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

FESS researched and wrote the article. GDD and SAPB established the methodology and contributed to the writing of the article, revising the data. MLC revised the final draft and translated the article into English/proofreading.

DECLARATION OF INTEREST

The authors declare no existing conflicts with participants or collaborators, directly or indirectly.

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