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Research Article

LIVESTOCK FARMING AND ENVIRONMENTAL POLLUTION: STATUS AND SOLUTIONS

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ABSTRACT

Vietnam is a country with a developed agricultural sector, with about 70% of the population living in rural areas. The agricultural sector plays a crucial role in the country's socio-economic development. In recent years, livestock farming has seen significant advancements in both scale and quantity. However, small-scale livestock farming in household settings and the lack of planning, especially in densely populated urban areas, have led to serious environmental pollution. This pollution mainly originates from solid waste, liquid waste, dust, noise, and improper animal carcass disposal. Therefore, appropriate measures need to be identified to address these waste forms, minimizing negative impacts on the environment from livestock farming processes.

Keywords: Agriculture, livestock, exhaust gas treatment, livestock waste...

INTRODUCTION

Problem Statement Waste from livestock facilities not only causes environmental pollution but also directly affects human health, reduces animal immunity, increases disease incidence and treatment costs, thereby reducing productivity and economic efficiency. When the immunity of livestock decreases, the risk of disease outbreaks increases. Therefore, the WHO [2005] recommends enhancing environmental sanitation measures for livestock farming, controlling and treating waste, maintaining biological safety, and improving animal health. Livestock waste contains pathogenic microorganisms, especially dangerous infectious agents, which can lead to diseases such as diarrhea, foot-and-mouth disease, blue-ear disease, and avian influenza H5N1, etc.

According to estimates, the amount of solid waste discharged by each animal per day is: cattle 10 kg, buffalo 15 kg, pigs 2 kg, and poultry 0.2 kg. Annually, livestock in Vietnam discharge about 73 million tons of solid waste and 25-30 million cubic meters of liquid waste. Of these, approximately 50% of solid waste (36.5 million tons) and 80% of liquid waste (20-24 million cubic meters) are discharged directly into the environment or used without treatment, causing serious pollution. It is estimated that each ton of fresh manure released into the air emits about 0.24 tons of CO_2 equivalent, resulting in an estimated total emission of 17.52 million tons of CO_2 from livestock waste. Studies have shown that livestock farming contributes 18% to the total greenhouse gas emissions, surpassing the transportation sector.

Environmental pollution from livestock waste has many causes, but this article will focus on two main factors: heavy metals and CO_2.

Environmental pollution caused by heavy metals:

State regulations on heavy metal content in food:

The regulations of the Ministry of Agriculture and Rural Development on the maximum content of some minerals and heavy metals (expressed in mg/kg complete feed for livestock and poultry - Decision No. 104/2001/QĐ/BNN, dated 31/10/2001) are as follows:

Numbers	Elements	Maximum content (mg/kg feed)			
		Chicken		Pig	Cow
		Raising meat	Laying eggs		
1	Zinc (Zn)	250	250	250	250
2	Copper (Cu)	35	35	< 4 months: 175 > 4 months: 100	50
3	Maganese (Mn)	250	250	250	250
4	Mercury (Hg)	0,1	0,1	0,1	0,1
5	Cadimium (Cd)	0,5	0,5	0,5	0,5
6	Arsenic (As)	2	2	2	2
7	Lead (Pb)	5	5	5	5

Table: Maximum content of some mineral elements and heavy metals for livestock and poultry (in mg/kg of complete feed)

Pollution caused by heavy metals in livestock waste:

Currently in Vietnam, the amount of waste from livestock activities reaches about 73 million tons per year. Among them, waste from pig farming accounts for about 24.38 million tons per year, equivalent to 33.4% of the total livestock waste (according to a report by Xuan Ky, published in Nhan Dan newspaper on 08/03/2009). In livestock waste, there is an excess of heavy metals such as copper (Cu) and zinc (Zn), causing soil pollution. One of the main reasons for this situation is the addition of zinc oxide (ZnO) to pig feed at levels exceeding the prescribed limit to prevent diarrhea.

Zinc and copper pollution and its consequences:

Each year, a survey is conducted in England and Wales to assess the waste containing heavy metals from livestock manure. The results of this survey have shown that the highest levels of heavy metals discharged into agricultural land are zinc (up to 3.3 kg/ha) and copper (up to 2.2 kg/ha) in the pig farming areas of West Anglia and Humberside (Chambers et al., 1999). The discharge of zinc and copper from animal manure pollution accounts for more than 35% compared to other factors causing heavy metal pollution. Excessive accumulation of zinc in the soil also harms crops, leading to leaf necrosis. The accumulation of zinc in plants and fruits is also related to the excess zinc content in the human body. Human kidneys can filter a maximum of about 2g of zinc per day. Excessive zinc intake can cause health issues such as cancer, neurotoxicity, affect sensitivity, reproduction, and harm the immune system. Conversely, zinc deficiency in the body can lead to health problems such as erectile dysfunction, testicular atrophy, color blindness, dermatitis, liver disease, and other symptoms (Nguyen Thi Ngoc An and Duong Thi Bich Hue, 2007). Heavy metals tend to accumulate in the soil, especially in the surface layer, causing long-term environmental damage. The toxicity of heavy metals reduces the quantity and diversity of soil microorganisms, affecting beneficial soil microorganisms (such as those improving soil respiration, decomposing organic matter, fixing nitrogen, etc.). Heavy metals also indirectly reduce the decomposition of pesticides and other organic compounds by killing bacteria and fungi, which under normal conditions would decompose these harmful substances (Burton and Turner, 2003).

Carbon Dioxide Emissions from Livestock:

The issue of carbon dioxide (CO_2) emissions into the atmosphere from livestock activities is part of a larger problem of emissions and climate change. During the respiration process of animals, especially livestock such as cattle and pigs, CO_2 is generated and released into the air. Additionally, the decomposition process of organic matter from manure, urine, and other waste products of animals also produces CO_2. A study published in the journal "Nature Climate Change" in 2018 by Gerber et al. estimated that livestock farming accounts for about 14.5% of the global CO_2 emissions from human activities, with the majority coming from livestock farming. Similarly, a report from the Food and Agriculture Organization (FAO) in 2013 indicated that animal husbandry contributes about 18% of global CO_2 emissions, far exceeding the figure for the transportation sector.

The large emission of CO_2 from livestock plays a significant role in increasing greenhouse gas levels in the atmosphere, contributing to global climate change. This leads to various environmental and human health issues, including the greenhouse effect, climate change, and air pollution. Specifically, in the study published in "Nature Climate Change" in 2018 by Gerber et al., livestock activities were shown to contribute to the increase in global CO_2 levels and cause climate change. The increase in CO_2 in the atmosphere is one of the main factors leading to the greenhouse effect and global warming.

In addition to the direct impact of CO2 emissions, livestock activities also result in habitat loss for many animal species and crops. A study from the University of Oxford in 2013 estimated that livestock contributes about 51% of global CO2 emissions when considering both direct and indirect effects such as habitat loss.

Solutions to minimize pollution from livestock waste:

Adjusting feed composition for livestock:

A research group conducted experiments with three different feed formulations. After analyzing the results of the experiments, they selected a formula (referred to as CP2) with the best efficiency. This formula includes the following components: sorghum (25%), cassava leaves (15%), sweet potato vines (20%), rice bran (5%), soybean residue (5%), and jackfruit leaves (30%). Using the CP2 product at a dosage of 1,000g

CP2/ton of mixed feed for pig farming showed higher daily weight gain compared to the control group, at 4.42%. Additionally, feed consumption per kg of weight gain decreased to 9.58%, and feed cost per kg of weight gain decreased by 7.89%. The use of CP2 contributes to reducing odor (mainly caused by NH_3, H_2S) in pig pens. In pig fattening pens, the level of NH_3 decreased by 41.30% and H_2S decreased by 44.44% compared to the control group. Meanwhile, in sow breeding pens, NH3 decreased by 45.26% and H2S decreased by 43.90% compared to the control group.

Treating wastewater with aquatic plants:

After being removed from livestock pens, manure needs to be piled up. This process usually begins by spreading manure layer by layer (each layer about 20cm thick) on the surface, then spreading a thin layer of kitchen ash or lime powder. This process is repeated until all the manure to be treated is used up. Finally, a mixture of pond mud or fine soil with water is used to cover the entire surface of the manure pile. Additionally, sheets (such as nylon or tarpaulin) can also be used to cover the manure pile, helping to minimize the release of gases such as CO2, NH3, and CH4 into the environment. The manure pile fermentation process also generates heat, helping to destroy pathogens such as eggs, larvae, bacteria, and fungi. This limits the spread and transmission of pathogens, ensuring a cleaner and safer environment.

Constructing waste gas treatment systems:

Two highly regarded environmental pollution treatment methods are biogas technology and EM bio-organic products. Building biogas digesters to treat waste from livestock farming has been proven to be an effective solution. Introducing waste into the digester helps to completely decompose it, reduce odor, prevent fly development, and almost completely eliminate parasites. Additionally, using biogas digesters allows for energy recycling from livestock waste, producing methane gas (CH4) that can be used for cooking and lighting.

Promoting sustainable livestock practices:

Implementing sustainable livestock practices can significantly reduce environmental pollution. This includes measures such as rotational grazing, silvopasture systems, and agroforestry practices, which enhance soil health, sequester carbon, and reduce greenhouse gas emissions. Rotational grazing involves moving livestock between different pasture areas, allowing for natural regeneration and preventing overgrazing. Silvopasture integrates trees, forage, and livestock, providing multiple benefits such as shade, shelter, and improved biodiversity. Agroforestry combines trees and shrubs with crops and livestock, creating diverse and resilient agricultural systems.

Enhancing Waste Management Technologies:

Investing in advanced waste management technologies can help minimize pollution from livestock waste. This includes anaerobic digestion systems, composting facilities, and biofiltration systems. Anaerobic digestion converts organic waste into biogas, which can be used as a renewable energy source, while composting transforms organic waste into nutrient-rich compost for soil improvement. Biofiltration systems use living organisms to filter and treat wastewater, reducing the release of pollutants into the environment.

Strengthening Regulatory Frameworks:

Enforcing stricter regulations and standards for livestock farming can mitigate environmental pollution. This includes setting limits on waste discharge, promoting sustainable practices, and incentivizing compliance with environmental laws. Government agencies play a crucial role in monitoring and enforcing these regulations to ensure compliance and protect environmental quality.

By implementing these solutions and adopting sustainable practices, the adverse impacts of environmental pollution from livestock farming can be minimized, leading to healthier ecosystems, cleaner air and water, and improved human health and well-being.

CONCLUSTIONS

In the contemporary context, environmental contamination stemming from livestock husbandry poses a substantial impediment to the sustainable advancement of agriculture and the human habitat. Confronted with the deleterious ramifications of livestock waste pollution, it is imperative to discern efficacious remedies to mitigate these repercussions and uphold equilibrium between agricultural productivity and environmental conservation.

Empirical studies and quantitative data unequivocally attest to the profound repercussions of environmental pollution originating from livestock waste on human well-being, economic progress, and ecological integrity. Nonetheless, several interventions have been posited to abate pollution and fortify environmental safeguarding.

Modulating the constituents of animal rations, employing aquatic vegetation for wastewater remediation, and erecting infrastructure for waste gas abatement represent viable strategies to curtail environmental contamination arising from livestock agriculture. Furthermore, fostering robust collaboration among governmental entities, commercial enterprises, and local communities is indispensable for fostering the efficacious and enduring enactment of these measures.

Nevertheless, to realize the objectives of environmental preservation and sustainable development, heightening societal awareness and commitment are imperative. Only through the universal acknowledgment of the significance of environmental conservation and concerted action towards implementing novel pollution mitigation measures can the overarching goal of harmonizing economic progress with environmental stewardship be realized.

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