International Journal of Life Science and Agriculture Research
ISSN (Print): 2833-2091, ISSN (Online): 2833-2105
Volume 03 Issue 06 June 2024
DOI: https://doi.org/10.55677/ijlsar/V03I6Y2024-11
Impact Factor: 6.774 , Page No : 507-509

Mitigating Methane Emissions from Husbandry: A brief review

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ABSTRACT: Methane is a potent greenhouse gas, produced naturally in the digestive systems of ruminants, from enteric fermentation, including those raised for milk and meat. The husbandry sector, which includes livestock farming and dairy production, significantly contributes to global methane emissions. These emissions not only contribute to climate change but also have negative impacts on the environment and human health. To mitigate these emissions, it is essential to implement sustainable practices and technologies that reduce methane production and emissions. An application objective of this brief review is to be used as discussion material by students of the master's degree in Environmental Management and Sustainable Development at La Salle University, Costa Rica.

Published Online: June 24, 2024

KEYWORDS: methane emissions, methane reduction, methane mitigation, sustainable practices

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1. THE NATURE OF THE PROBLEM

The problem of methane in husbandry, particularly in livestock and dairy production, is multifaceted and involves several key factors: a) **Natural Sources**: Methane is produced naturally in the environment, such as in wetlands, wildfires, and the digestive tracts of certain animals like termites; b) **Livestock Emissions**: Livestock, especially ruminant animals like cattle, sheep, and goats, produce methane as a byproduct of their digestive processes, known as enteric fermentation. This process breaks down food in their systems, releasing methane into the atmosphere; d) **Manure Management**: Methane emissions also occur during livestock manure's storage, treatment, and application. Anaerobic conditions in storage ponds allow methanogens to thrive, producing methane as a byproduct; e) **Scale of Emissions**: The increase in livestock production around the world contributes significantly to methane emissions. For example, a single cow produces almost between 70 to 120 kilograms of methane gas per year, and 1.5 billion cattle raised for meat production worldwide emit at least 104779 tonnes of methane annually [1].

2. RATIONALE

Comparing CO2 to other greenhouse gases, it has a global warming potential (GWP) of 28-36 times that of carbon dioxide (CO2) over 100 years. This means that methane emissions have a significant impact on climate change, although they are relatively short-lived compared to CO2. On the other hand, methane emissions from livestock contribute to climate change, so reducing these emissions is crucial to meeting emissions targets. The biogenic carbon cycle, where methane is part of a continuous cycle between the atmosphere, living organisms, and soil, highlights the need to manage methane emissions effectively [2, 3].

To achieve this goal Technological and Management Solutions can be employed to reduce methane emissions from livestock, such as: 1) Management of stored manure, including covering storage facilities to reduce emissions and using manure digesters to generate methane for energy; 2) Optimizing feed quality and using feed additives to reduce enteric methane emissions; 3) Breeding for lower enteric emissions and optimizing forage quality on pasture; and 4) Implementing sustainable renewable energy sources to reduce dependence on fossil fuels. By understanding the nature of the problem and exploring these solutions, the agricultural sector can play a critical role in mitigating the impact of methane on climate change [4].

To mitigate methane emissions, it is essential to implement sustainable practices and technologies that reduce methane production and emissions such as: **1) Improving Animal Nutrition and Management:** One of the most effective ways to reduce methane emissions from husbandry is to improve animal nutrition and management. This can be achieved by providing animals with diets that are high in fiber and low in energy, as these diets tend to produce less methane. Additionally, managing animal stress and

ensuring they have access to clean water and adequate living conditions can also help reduce methane emissions; **2) Implementing Innovative Technologies:** Innovative technologies can also play a crucial role in reducing methane emissions from husbandry. For example, methane capture and utilization systems can be installed in livestock facilities to capture and convert methane into energy or other valuable products. Similarly, precision agriculture technologies can help farmers optimize their operations and reduce waste, which can also contribute to lower methane emissions: **3) Promoting Sustainable Agriculture Practices:** Sustainable agriculture practices are essential for reducing methane emissions from husbandry. This includes practices such as rotational grazing, cover cropping, and organic farming, which can help reduce soil erosion, improve soil health, and promote biodiversity. These practices can also help reduce the need for synthetic fertilizers and pesticides, which can contribute to methane emissions; and, **4) Encouraging Policy and Regulatory Support:** Policy and regulatory support are critical for mitigating methane emissions from husbandry. Governments can implement policies and regulations that incentivize farmers to adopt sustainable practices and technologies, such as tax credits or subsidies for methane capture systems. Additionally, regulatory bodies can establish standards and guidelines for methane emissions from husbandry, which can help ensure that farmers are held accountable for their environmental impact [5].

3. CONCLUSION

A study by Our World in Data [6] focused on research from Grippa et al. [7] that demonstrates that around 34 percent of global greenhouse gas emissions (referred as carbon) is produced by the global agrifood system. A substantial part of these global emissions is attributed to livestock food systems (mainly cattle production), including methane released by ruminal digestion [6].

On the other hand, according to a report by the United Nations Environment Programme (UNEP), global methane emissions increased by 9% from 2000 to 2017 [8]. This trend is expected to continue, especially in countries with developing economies. However, the reduction in emission intensity resulting from production efficiency improvements is small (less than 1% per year) and may not be enough to counterbalance the increasing emissions due to the growing demand for animal protein [9].

However, if only biogenic emissions are attributed to cattle (that is, the methane and nitrous oxide produced by enteric fermentation), it is evident that their impact on global climate is much lower than that those estimated through Life-Cycle Assessment (LCA evaluates and measures the environmental impacts associated with products, services, processes, or activities, from the extraction of raw materials to the end of the lifecycle). That figure amounts to no more than 5 % of total global emissions and tends to decrease when compared to all sectors that rely on fossil fuel combustion [10].

Another vision is the one proposed by Viglizzo [11], an Argentinian scientist, who compared the C balance reported by (i) national inventories that followed the simplified method (Tier 1) of IPCC (1996/2006), with (ii) an alternative estimation derived from the meta-analysis of science-based, peer-reviewed data compared C storage as soil organic carbon (SOC) in rural lands of four countries (Argentina, Brazil, Paraguay, and Uruguay) within the so-called MERCOSUR region, and hypothesized that C gains and losses in grazing lands are not in balance and that C gains tend to be higher than C losses at low livestock densities; showing that grazing lands generate C surpluses that could not only offset rural emissions but could also partially or offset the emissions of non-rural sectors. The potential of grazing lands to sequester and store soil C should be reconsidered to improve assessments in future GHG inventory reports [12].

In conclusion, mitigating methane emissions from animal husbandry requires a multifaceted approach that involves improving animal nutrition and management, implementing innovative technologies, promoting sustainable agricultural practices, and encouraging policy and regulatory support. By working together to implement these strategies, it may be possible to reduce the environmental impact of animal husbandry and contribute to a more sustainable future. Therefore, a concerted global effort is necessary to reduce ruminant methane emissions.

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