INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 22, No. 2, p. 58-62, 2023
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Continental methane gas production and its implication to the global animal/livestock production

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Article published on February 11, 2023

Key words: Production, Greenhouse gas emissions, Methane, Continents

Abstract

This study utilized a descriptive type of research. Annual methane gas emissions were identified in each country worldwide. The amount of methane gas emission every year was utilized using secondary data available from the internet. In this study, the trend of methane gas emission is analyzed by getting its average concentration in a forty-two (42) year production from 1970-2012. The highest volume of methane gas is observed in Asia while the least volume is registered by the Australian continent. Symbolic regression was used for curve-fitting rather than the traditional model –based regression analysis. The results indicated that Asian continent has the highest methane gas outputs with volatility of trends over time. Most of the countries in Asia are developing or underdeveloped which have bigger space for rapid industrialization in the name of development. This could be attributed to its booming industries and high agriculture animal production. The production period of agricultural animals directly affects the concentration of methane gas because of the amount of their waste products that are soon to be decomposed by microorganisms. However, Australia has the most stagnant concentration of methane gas among all the sampled continents due to the fact that this continent was already highly revolutionized by computer modernization, and the production of agricultural animals was maintained for numerous years.

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Introduction

Greenhouse gases (GHG) such as methane (CH_4), Nitrous oxide (N_2O), and Carbon dioxide (CO_2) are produced as a by-product of cellular respiration, increased animal production, and excessive power plant and mining operations. In the name of development, the productions of these major greenhouse gases are continuously increasing as induced by anthropogenic activities. Of all these GHG's, methane is considered as the highly accumulated gas in the atmosphere for it is emitted by most living organisms including animals, some bacteria and protozoans. This gas is considered to have more warm inputs in the earth's surface than any other GHG. As a result, these had led to the depletion of ozone layer that protects the ultraviolet rays from the sun, and therefore, causing a warming effect to the earth known as global warming.

Global warming is a serious issue that the world is facing today. It continues to put challenges on the various aspects of lives on earth. It has been the primary cause of the abnormalities and constant changes of climate and weather patterns that in turn poses a threat to biodiversity. Weitzman et. al, 2009 stated that the amount of greenhouse gas accumulated in the atmosphere is parallel to the concentration of warming effect of the earth. Jevrejera S. *et al.,* 2012, said that the warming effect of the earth has severely caused the disruption of biodiversity, making them prone to extinction. Biodiversity loss greatly accounts for the state of balance in the ecosystem, destroying the capacity of the population to grow and survive. According to DeConto *et al.,* 2016, the sudden increased of sea level and melting of glaciers in the polar region are greatly encompasses to the warming temperature of the environment. This would in turn results to the sinking of particular body of islands.

Considering the rampant development of every continent in the world, the outputs of methane gas is a fast-growing chain that accumulates in the earth's environment with more warming effects than any other GHG's. The strategies for reducing resultant greenhouse gas (GHG) emissions should be carried out in the context of the production system and should focus on the accumulation of methane gas (CH_4) as it is said to have the highest concentration among greenhouse gases (Berndt *et al.,* 2013). The Emerging U.S. Methane Mitigation Industry (2014) said that methane is a powerful greenhouse gas and for over 20 years, each molecule has 84 times the climate change potential than of CO_2. Knowledge of such methane gas production calls for more efforts on understanding (Jiang *et al.,* 2016).

The present study is aimed to analyze the trend of methane gas worldwide and to evaluate its rate through periods of time.

Materials and methods

Conceptual Framework

Global warming is a natural phenomenon (fig. 1) caused by the rising temperature of the atmospheric conditions as a result of greenhouse gas emissions. One of the greenhouse gases that highly contribute to global warming is the production of methane gas that continues to rise due to anthropogenic activities. However, mitigation methods for methane gas emissions are essential way of combating its associated risks that could highly affect the earth's atmospheric temperature.

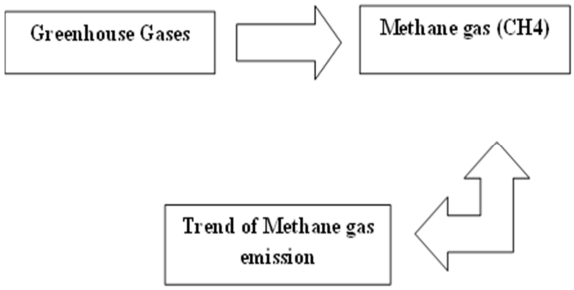

Fig. 1. Research paradigm.

Greenhouse gasses cause an accumulation of heat in the atmosphere as they are reflected back to the atmosphere from the earth's surface. The heat coming from the sun strikes the earth's surface in the form of solar energy contributing to a warmer temperature. As earth's surface becomes sophisticated with high temperature, high pressure would also be indicated. In

this case, the high pressure of air which contains a mixture of gases including GHG's goes up as it is being pushed by the low pressure is reflected back to the atmosphere accumulating in the ozone layer. Since this air that moves upward contains high temperature, this will be concentrated in the atmosphere producing warm temperature making the ozone thin and losing its capacity to trap the ultra violet radiation from the sun, therefore making the earth's surface concentrated also with hot temperature.

Methane gas (CH_4) is a by-product of carbon decomposition. This inorganic compound is usually produced when there is a decomposition process of decayed matters such as animal wastes, and industrial revolution which are acted by microorganisms in the ecosystem. Its warming effect is generally 10 times that of CO2.

Trend of Methane emission indicates the concentration of this GHG in the atmosphere worldwide. The basis for such trend could be the continuous development and modernization as well as the increasing rate of animal production.

Research Design

This study utilized a descriptive type of research design. Annual methane gas emissions were identified in each country worldwide. The amount of methane gas emission every year was utilized using secondary data available from the internet. In this study, the trend of methane gas emission is analyzed by getting its average concentration in a forty-two (42) – year production from 1970-2012 based from European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR). Ten (10) countries for each continent (Antarctica not included) were clustered based on their continental group. Symbolic regression was used for curve – fitting rather than the traditional model –based regression analysis. Given the data set, symbolic regression searches the space of all functions for the discussion combination best fits the observed values. The trial version of the software EUREQA was used for the execution of symbolic regression.

Results and discussions

The highest volume (fig. 2) of methane gas is observed in Asia while the least volume is registered by the Australian continent. Likewise, while the methane production of Asia appears to increase with time, the rest of the continent manifest either a stable configuration or a downward drift. More succinctly, the methane gas production in Asia displays a highly erratic upward movement indicating periods of "ups" and "downs". Such periods also point to cycles and periodicity which altogether contribute to the volatility of the Asian methane gas output over the time period.

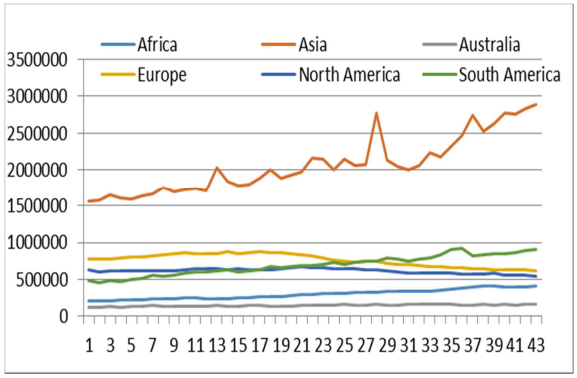

Fig. 2. Methane gas production over the period 1970 to 2012.

In the rest of the continents, periodicity and cycles are prominently absent. The trend curves for these continents are smooth and stable indicating that there is very little volatility in their methane gas outputs. These are the continents: Australia, Africa, North and South America, and Europe.

The Trend Curves

The smoothness of the trends displayed by the continents, except Asia, dictates the use of traditional curve fitting. These trend lines are given by the table 1.

Table 1. Trend Lines of Continents except Asia.

Continent	Trend Lines	Mean Absolute Prediction Error
1. Australia	Yt = 126197*(1.00593**t)	3.83622
2. Africa	Yt = 198973*(1.01750**t)	2.63896
3. North America	Yt = 649556*(0.997331**t)	3.44508
4. South America	Yt = 481746*(1.01559**t)	3.51885
5. Europe	Yt = 890826*(0.992573**t)	5.22107

Table 2. Forecasted Trend Curve in Asia.

Continent	Trend Lines	Mean Absolute Prediction Error
1. Asia	$x = 1.58e6 + 2.05e3t^2 + 1.44e3t^2 \sin(3.52e2t^2)$	4.118997

Tabular values showed that the exponential trend lines for Africa, Australia, and South America have bases that are slightly greater than one (1.01750, 1.00593, 1.01559), respectively. These values indicate that over time, the methane gas outputs of these continents would rise but would do so very slowly. On the other hand, the corresponding exponential trend lines for Europe and North America have bases that are less than one, (0.992573 and 0.997331) respectively. These values signed a slowly descending trend for the methane outputs of these continents.

Forecasted Trend Curve in Asia

The volatility of the trend of methane gas production in Asia as analyzed using the symbolic regression analysis showed a drastic periodicity of its trend. The tabular value indicated that Asian continent has a rapid periodicity of its increasing trend for methane gas outputs based on the trigonometric value [$\sin(3.52e2t^2)$]. Moreover, this value indicates that the rise of methane gas will occur fast as it goes with time.

The trend analysis of Asia indicated (Fig. 3) that there is a continuous increase production of methane gas throughout the continent. Although there are drifting patterns of increased emissions, we can note that Asia is the largest continent in the entire world with an increasing demand for food consumption. There could be three main reasons for such observation: (a) Population growth rate, (b) Population rate, and (c) agricultural animal production).

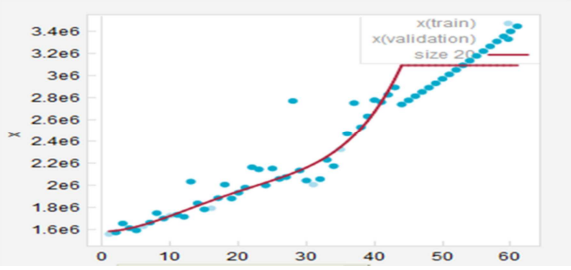

Fig. 3. Forecasted trend of methane gas in Asia.

Accordingly, the population growth rate in Asia and were found to have an inverse directionality to that of the methane production. So therefore, it can be inferred that growth rate of population is not the primary cause for such increased methane gas production. Another finding which has been put into consideration was the population rate of Asia and was found to be linearly increasing over the time periods so it is not also a reliable cause for such high GHG outputs. Considering also the agricultural animal production of Asian continent, as observed, it was in consonant with the increasing and drifting patterns of the methane gas outputs of Asia. Therefore, the central concern for these GHG emissions could be attributed directly to the animal production.

Discussions

The results indicated that Asian continent has the highest methane gas outputs with volatility of trends over time. One can note that Asia is the biggest continent and its total population is one-fourth of the total worldwide population. Most of the countries in Asia are developing or underdeveloped which have bigger space for rapid development. Further, the Asian countries are said to be dependent on the agricultural products, especially rising of agricultural animals for food consumption and economic stability. This variable (agricultural animals) is said to be the central cause of the high methane gas outputs in the atmosphere has also been confirmed by the agricultural trend of the Asian continent. Animal waste products are the key to a high concentration of this GHG because of decomposition process acted upon by microorganisms. However, during harvest period, such production of methane gas would possibly decrease due to the absence of animal wastes which can no longer be decomposed. The changing patterns of methane gas concentration of Asia results to a fluctuation of its trend in this continent that is, dependent on the production of agricultural animals and the rampant development.

In contrast, the continent of Australia has a stable production of methane gas because it has maintained its capacity to produce such GHG.

This lower production of GHG's could be a result of the regulation of the Kyoto protocol which aims to reduce the emissions of GHG's worldwide which Australian continent may have adapted. Although, Australia is a home for the biggest animal production, it has been controlled over the years. It can be seen that though Australia started with a high production of methane gas, it has never decreased nor increased, but maintained constant for numerous years compared to Asia where an abrupt increment was observed over time.

Conclusion

Among the six continents, Asia obtained the highest concentration of methane gas in the world. This could be attributed to its booming industries and high agriculture animal production. The production period of agricultural animals directly affects the concentration of methane gas because of the amount of their waste products that are soon to be decomposed by microorganisms. However, Australia has the most stagnant concentration of methane gas among all the sampled continents due to the fact that this continent was already highly revolutionized by computer modernization, and the production of agricultural animals was maintained for numerous years. The best mitigation method could be adopted by taking initiatives on controlling the production of agricultural animals by means of shortening the duration between raising period and harvesting period.

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