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Nitrous Oxide Release from Asian Agriculture Farming

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ABSTRACT

The Earth's atmosphere poses challenges for many organisms. After the industrial era anthropogenic gases have dangerously increased. The agriculture revolution also raised greenhouse gas levels in the atmosphere. N_2O emissions from agriculture reached 328 ppb in 2015 and continued to rise each year. As a potent greenhouse gas, it creates climate change challenges. The application of fertilizers and soil properties caused N_2O gas emissions. Soil parameters like water content, carbon and nitrogen content, pH, texture (sand, silt and clay percentages), bulk density, crops, climate and management practices all contribute to N_2O emissions. This study covered field experiments in Asia and helped locate factors causing N_2O gas emissions. Factors that cause more emissions can result in strategies and policies to fight N_2O gas emissions for sustainability in the environment and agriculture.

Introduction

Climate change is going to become a challenge for us. It is needed to resolve as early as possible otherwise we will no longer be able to survive on this earth. The main reason behind climate change is the global warming which is defined as the rise in the overall temperature of the earth. It is calculated by the climate models that the global surface air temperature will rise up to 4.0-5.8°C in next few decades. This is an alarming situation because the human population is increasing at a very high rate and the demand of food is increasing after every passing day. The increase in temperature is not favorable for the agriculture. The patterns of climate are also changing due to climate change. Therefore, it is very important to mention the reasons behind global warming which leads to climate change. The rise in temperature is caused by the emission of greenhouse gas in the atmosphere due to natural and anthropogenic sources of pollution. The important greenhouse gases are methane, nitrous oxide and carbon dioxide. Climate change the concentration of these gases is not high in atmosphere as compared to CO_2 but unfortunately the global warming potential for about 100 years of these gases is 21and 310 times higher than that of CO_2 respectively. N_2O has more potential for greenhouse effect as compared to CO_2 as it is 250 times more potent than CO_2. According to U.S (EPA) it is mentioned that the concentration of all three above discussed gases are increasing day by day in the atmosphere from last many years. Any silent change in the concentration of the gases can lead to global warming and due to this issue we have to face climate change. The reasons which are considered behind the sudden rise in the level of N_2O in the atmosphere are excess deposition of atmospheric nitrogen and wider use of fertilizers in agriculture. The agriculture soils contributed up to 50% of the global GHG emissions. According to the calculation of models it was estimated that the use of synthetic N fertilizer will rise up to 50% by 2030. There are some reasons due to which the emission of N_2O gas increases. The nitrification and de-nitrification processes in soil after bearing alternating moist and dry situations. There are two other reasons behind the emissions of N_2O which are biological and non- biological. The de-nitrifying bacteria are mediated by autotrophic aerobic nitrification through nitrate oxidizing and ammonia oxidizing bacteria and anaerobic de-nitrification bacteria. These two processes are basically involved in the basic microbial processes of the N-cycle. The high levels of water filled pore space (WFPS) increase the chance of anaerobic soil condition along with denitrification in the compacted soil which enhances the N_2O emissions. These are the problems which are generally faced in temperate and moist climates. The other reason behind the enhancing level of N_2O emission is the incorporation of residual crops in the soil and then ploughing afterwards especially in autumn season. The incorporated residue from local anaerobic zones increases metabolic activity. It provides the favorable sites for the denitrification process. The denitrification process is actually controlled by factors such as available N content and mineral N along with oxygen partial pressure, pH, temperature and soil water content. The process of denitrification and heterotrophic microbial activity is stimulated by available N and organic C content which were added into the soil after supplying organic fertilizers to the soil. The emission of N_2O can also be influenced due to several factors which can be temperature, pH, organic matter, aeration, moisture, compaction, soil management, crop rotation, C/N ratio, texture, available nitrogen concluded that due to soil density and temperature are the main factors due to which N_2O is produced because of nitrification and WFPS normally affect the emission of N_2O due to the process of denitrification. There are also some management practices which affect the emissions of N_2O. Factors like nitrogen fertilization, type of the residues added into the soil, soil tillage, cropping system, crop type water management, organic matter and N management can also influence the emissions of CH_4 and N_2O etc. Method of irrigation has an effect on the emissions of N_2O as alternate wetting and drying method increased the N_2O emissions up to 5 folds while the emission of CH_4 has reduced to 97% through this method as compared to permanent flooding in the paddy rice fields. According to continuous flooding method of irrigation has no effect on the seasonal N_2O emissions. The fluxes of N_2O increase with increase in the drainage timing after the application of N fertilizer with the rate at which N is applied has mentioned that if we use balanced amount of organic and synthetic fertilizers then it will increase the microbial biomass and its activity in the soil and as a result of it the fertility of the soil will increase along with the increase in the yield of the crop and it will also mitigate the greenhouse gas emission. Figure 1 show the N_2O emission from different crop types.

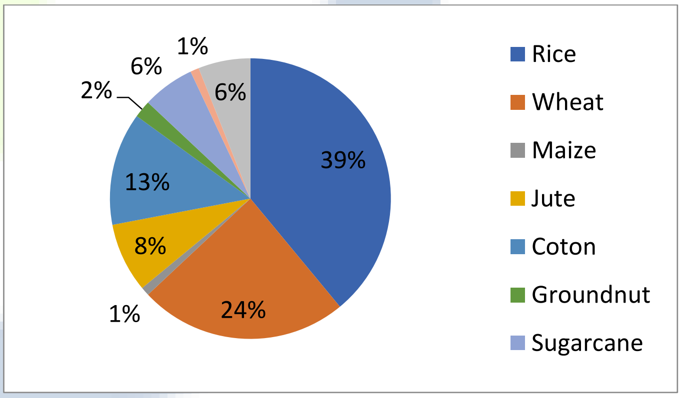

Figure 1. N_2O emission from different crop types

Asia is contributing larger in the emission of N_2O as compared to other continents. The reason behind this increase is the unnecessary and inefficient use of N fertilizer. It was seen that excessive flooding of the field also caused more emission than other methods of irrigation. Except this soil texture and pH of the soil is also contributing in it. The management practices also affect the rate of emission of N_2O from the agriculture soil [5].

2. Greenhouse Gas Emissions from Agriculture

In the northeast US, two methods for increasing soil carbon storage are legume and forage rotation and fertilization. Increased mineral (N) fertilizer resulted in higher N_2O emissions. Solid manure resulted in lower emissions than liquid manure and mineral fertilizer application. Alfalfa and other legume forage have lower N_2O emissions than fertilized annual crops. When ploughing crop stubble or manure into autumn soil, it produced more N_2O than surface residues. Due to the lack of CH4 flux observation, eastern Canada's agricultural soils seem to be a weak sink of CH4. Manure can

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decrease this problem. While agricultural management affects soil carbon storage and greenhouse gas emissions, strategies often involve offsets or tradeoffs.

3. Effect of Tillage

Tillage and crop residue incorporation are popular in modern agriculture. Few studies have examined the integration of annual trace gas fluxes of carbon and nitrogen with grain yield. Using year-round field data, researchers evaluated N_2O and CH4 emissions from the rice-wheat system, no tillage, and wheat straw integration in southeast China. Emission of N_2O was reduced to 38% and CH4 emission increased by 74% with wheat straw incorporation in the rice-wheat system. Regardless, no-till practice increased N_2O emissions by 61% compared to conventional tillage when sowing wheat. The wheat straw's CH4 emissions accounted for 6% of the rice season's carbon residue assimilated. The addition of wheat straw increased CH4 and N_2O emissions compared to systems without residue, regardless of tillage. However, the GHG emissions were primarily a temporary reaction of the rice-wheat system after crop residue integration and tillage conversion [10]. A split factorial experiment was conducted in Northeast Iran with a cold semi-arid climate. The experiment used a completely randomised block design with three replications to assess the impact of tillage methods and nitrapyrin (a nitrification inhibitor) on N_2O emission [1].

4. Effect of Manure Application

Lab incubations of urea and five plant residues with varying C:N ratios were done to assess the effect of plant residue breakdown on N_2O emission. The evaluation lasted 8-118 days. Using plant leftovers not only increased N_2O emissions but also raised CO2 levels. The C:N ratio in plant residues was inversely linked to N_2O and CO2 emissions. In this experiment, the change in N_2O emission and the calculated variations in dissolved organic C were examined [4].

5. Effect of Using Organic and Synthetic Fertilizers

The combination of poultry manure and synthetic fertilizers reduced N inputs with a combination of poultry manure and controlled release urea, and a control group with no N fertilizer treatment. Seasonal and annual variations in N_2O and NO emission and EFs were observed. Compared to conventional practices, all three alternative management practices decreased N_2O and NO emissions without reducing crop yields. The effectiveness on each gas emission varied. Compared to conventional practice or synthetic fertilizer only, the synthetic fertilizer treatment reduced N_2O emissions. The combination of synthetic manure and poultry manure, as well as controlled release urea and poultry manure, showed significant benefits in mitigating both NO and N_2O gases [9]. They aimed to find the main regulating elements and assess the yearly variation of N_2O fluxes from a maize-wheat rotation system with different fertilizer treatments. There were four treatments: compost, half compost N, half inorganic fertilizer N, inorganic N fertilizer, and no N application. Using compost and inorganic fertilizer reduced N_2O emissions. During the maize-wheat rotation, maize caused over 65% of annual N_2O emissions. There was high interannual variation in N_2O emissions, but the relationship was not significant during the maize growing season or on a year-to-year basis. Compared to compost and inorganic N fertilizer treatments, the half compost and half inorganic fertilizer treatment showed higher N fertilizer efficiency and lower N_2O emissions [2].

6. Effect of Synthetic Fertilizer

Quantifying N_2O emissions from agricultural fields is critical for developing national greenhouse gas inventories. The study's goal was to develop an EF that could directly measure the N_2O emissions from agricultural fields of Korea because N_2O emission is impacted by many elements such as climate features, soil qualities, and agricultural techniques [7].

7. Effect of Method of Application of N Fertilizers

A field experiment in which different fertilizers were applied at different rates to notify the emission of N_2O from them. The closed chamber method was used to measure N_2O emissions from soil in green tea fields. Controlled release fertilizer has substantially less N_2O than organic fertilizer, according to the findings. The results had revealed that the N_2O emission from controlled release fertilizer was much less than from organic fertilizer fields and from the control having no fertilizer application [3].

8. Effect of Irrigation on N_2O Emission

The impact of rice production on global warming, it is critical to reduce the emission of CH_4 and N_2O emissions from paddy rice. The objective of this study was to evaluate the impact of using straw compost along with the method of irrigation on the reduction of CH_4 and N_2O emissions from the paddy rice fields. For this purpose, a field experiment was conducted in the field of Vietnam where paddy rice was grown and two irrigation methods were used [6].

9. Meta-analysis Studies about N_2O Emissions

Meta-analysis to study the factors which were controlling N_2O emissions from the agriculture soils. An extensive literature was reviewed and the parameters which were affecting the emission effectors were attentively observed. 81 papers from well-known publishers were selected and data were collected about different parameters like urine type, diet of the animal, air temperature, texture, soil pH etc. After applying statistical tools and models the results were generated which showed that soil pH, mean air temperature and ruminant animal species were the significant factors which were affecting the emission effector [8].

10. Conclusion

The main purpose of the study was to assess the N_2O emission from various agriculture practices in Asia and to identify the major contributors from the agriculture production systems in the above-mentioned region. This study will evaluate the loss of N_2O from agriculture systems in Asia and will identify the factors contributing to greater N_2O loss. This study analyzed the impact of climate zones, soil properties, and fertilizer types on N_2O emissions. The parameters included climate, soil properties and fertilizer types. Soil attributes linked to N_2O release. Soil pH impacts N_2O emissions. Management practices affect soil N_2O emissions. Fertilizer on open fields emitted more than soil or canopy. Synth-organic fertilizer reduced farm N_2O emissions. In warm regions N_2O emissions from agriculture fields have risen. Soil pH 7.2 good for N_2O reduction. Sandy soils emit more N_2O than other soils. Deep N placement reduces N_2O emissions. To reduce N_2O emissions from agriculture, monitor factors.

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