International Journal of Agriculture and Food Science Technology.
ISSN 2249-3050, Volume 4, Number 5 (2013), pp. 439-444

http://www.ripublication.com/ ijafst.htm

Agriculture Has Potential to Reduce Greenhouse Gases

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Abstract

In the ongoing search for remedies to the planet's greenhouse gas excesses, agriculture is often identified as a key player. This can be achieved by adopt a greenhouse gas mitigation strategy. Agriculture can reduce its own contributions of green house and can act as a carbon "sink," a kind of gas storehouse and converter through its soil, plants, wetlands and forests and reduce emissions in other sectors by displacing fossil fuels with biofuels. Farmers can reduce emissions of nitrous oxide from agricultural soils, methane from livestock production and manure, and CO_2 from on-farm energy use. Using biomass to produce transportation fuels could also significantly reduce our reliance on imported petroleum. For maximum results, policies must be put in place to promote, and make attractive to farmers, practices that increase soil carbon and efficiently use fertilizers, pesticides, irrigation, and animal feeds. Agriculture can also reduce Green House Gas emissions by providing biofuels derived from biomass sources such as corn, soybeans, crop residues, trees, and grasses. Application of best management practices in agriculture and increasing the organic matter content of soils improves soil quality and fertility, increases water retention, and reduces erosion. More efficient use of nitrogen can reduce nutrient runoff and improve water quality in both surface and ground waters. Similarly, improving manure management to reduce methane and nitrous oxide emissions is beneficial to water and air quality and reduces odors. Although challenges remain, Further research and development will result in improved assessments of GHG contributions from agriculture, increases in agriculture's contribution to renewable energy for the nation, better ways to manage lands, and design of more efficient

policies. Perceived risks and availability of information and capital play important roles in perceptions of profitability.

Keywords: Greenhouse gases; agriculture; fertilizer; manure.

1. Introduction

The term "climate change" or "global warming" or "the greenhouse effect" refers to the build-up of man-made gases in the atmosphere that absorb the sun's heat, causing changes in weather patterns on a global scale. The effects contain changes in rainfall patterns, sea level rise, potential droughts, habitat loss and heat stress. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone in which most significant anthropogenic greenhouse gases (GHGs) are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Although these gases are found naturally in the atmosphere, it is their accelerated increase in concentration due to human activities, most notably burning fossil fuels, that is the concern.

CO_2 is the primary gas emitted by most other industries and agriculture produces CO_2, CH_4 and N_2O. Carbon dioxide is the most common GHG but it is not the most potent: CH_4 and N_2O have 23 and 296 times the global warming potential of CO_2, respectively (IPCC, 2001). According to Steinfeld & his coworker CH_4 comes from livestock enteric fermentation, manure management, paddy rice farming, anaerobic (without oxygen) decomposition of organic matter in wet soils, riparian areas, wetlands and manure storages and N_2O comes from nitrification in soil (when ammonium is converted to nitrate in soil), denitrification in soil (anaerobic respiration in soil due to wet soil conditions or high microbial activity where both carbon and nitrate are present) and in the manure storage.

Table 1: Greenhouse gases and their global warming potential, agricultural sources and causes. (Adapted from the Climate Change Connection, 2007.)

Greenhouse Gas	Carbon dioxide (CO_2)	Methane (CH_4)	Nitrous oxide (N_2O)
Global Warming Potential[1]	1:1 (CO_2 equivalent)	23:1 (23 times more potent than CO_2)	296:1 (296 times more potent than CO_2)
Agricultural Sources	• Soils • Fossil fuel combustion	• Ruminant livestock • Manure • Soils • Wetlands	• Soil • Manure

Causes	• Tillage • Soil drainage • Crop residue burning • Operating farm machinery • Heating farm buildings	• Digestion of feeds by ruminants (enteric fermentation) • Decomposition of manure during storage and application • Anaerobic (without oxygen) decomposition of organic matter in poorly drained soils and wetlands	• Nitrification in soil • Denitrification in soil • Indirect GHG production due to N losses from leaching, run-off and NH_3 volatilization • Excess N fertilizer • Decomposition of manure during storage and application

2. Opportunities for Agriculture

2.1 Management Practices to Reduce Greenhouse Gas (GHG) Emission

2.1.1 Land management. Marginal lands do not have the yield potential of higher class agricultural lands so by planting unproductive marginal and often fragile lands to perennial cover, farmers can improve profit margins, create a carbon sink and provide natural habitat. Trees, like growing crops, remove CO_2 from the air, storing it as carbon in trunks, branches, leaves and roots.

3.1.2 Soil management. Agricultural soil is dynamic biological system that both stores and releases greenhouse gases. Whether or not the soil acts as a net source of CO_2 or a net sink for CO_2 can be influenced by soil management. By increasing soil organic matter levels – a process called carbon sequestration – the farmer can decrease CO_2 emissions and increases the soil carbon sink. Soil organic matter levels can be increased by producing healthier crops and reducing tillage operations. Healthy crops not only produce more harvestable material for the farmer but they also decrease greenhouse gases by trapping more carbon in their roots, some of which will be converted to more stable soil organic matter. The use of perennial forages in crop rotations reduces GHG emissions by increasing carbon storage (sequestration) in agricultural soils. For example, perennial forages can sequester 2 to 3 more tonnes of CO_2 per hectare per year than annual crops (Garrett *et al.* 2004).

3.1.3 Nutrient management. Good nutrient management practices help to reduce GHG emissions. Fertilizer type, application rate, timing and placement have been shown to influence the amount of N_2O released to the atmosphere from some soils in some years (Burton, 2007). The information of amount of N present in soil helps in requisite use of N fertilizer. In addition, improved fertilizer efficiency, optimum use of fertilizer at the time that plants need them, inclusion of leguminous cover crops or

green manure crops in crop rotations could also decrease GHG emissions. The reduction in N fertilizer use means that less greenhouse gases are emitted from N fertilizer manufacture

3.1.4 Composting manure. Composting manure is the controlled, accelerated decomposition of manure into a more stable organic form. Compost improves soil quality, organic matter levels, decreases bulk density and increases fertility, aeration and water holding capacity. The use of compost may reduce the need for commercial fertilizers. But, it depends on the method of composting and type of manure.

3.2. Reducing Methane Emission from Dairy Animals

Methane is a gas generated by a group of microbes in the rumen called methanogens mainly by the cow. In general terms, methane emissions are reduced as digestibility and the protein / energy balance is improved. It can be somewhat controlled by:

3.2.1 Changing Herd Size. Running a small number of high-producing cows generates less methane than running a larger number of less productive cows, producing the same volume of milk.

3.2.2 Type of Feed with level of concentrate. Methane producing rumen microbes bloom on highly fibrous feeds (e.g. mature pasture and hays) which are low digestible diets. Improving the digestibility of the diet with cereal based supplements, through a combination of improved pastures, concentrate feeding and decreasing the number of cows will further reduce methane production without reducing milk production.

3.2.3 Improving Pasture Digestibility. With higher feed quality, production of the same amount of milk but less methane from the farm is possible. In addition some feed Additives like yeast culture, coconut oil, antibiotics like monensin can helps in reducing methane emission from cattle but not effectively.

3.3 Biological nitrification inhibition (BNI)

A chemical mechanism that markedly reduces the conversion of nitrogen applied to soil as fertiliser into nitrous oxide. This mechenism found in *Brachiaria* grass used for animal feed which need only half the amount of nitrogen fertiliser because they retain more nitrogen in the soil. To increase BNI through plant breeding in different species of *Brachiaria*, potentially reducing nitrous oxide emissions and nitrate leaching.

3. Conclusion

Many important GHG's produced due to agriculture itself. As, agriculture is in a unique position because of its ability to 'capture' atmospheric carbon in growing crops and store a portion of that carbon in soil organic matter can provide a chance to overcome climate change problem to some extent through some management practices. Conservation farming practices, such as direct seeding, no-till farming and

good fertilizer placement, have increased soil organic carbon levels helping to 'offset' GHG emissions and reduce the industry's net contribution.

Reducing GHG emissions simply means that crops and livestock are raised more efficiently, thus reducing wasteful input losses like nitrogen (N_2O) and energy (CH_4). Adoption of conservation practices like avoid excess nitrate in the soil and high nitrogen inputs to warm and water-logged soils will not only help to reduce GHG emissions but can also benefit water, soil and air quality. Nitrification inhibitors can also play a significant role. In future, some new biological tools like development of vaccine, biological control agent against methane producing organisms, breeding cows that produce less methane, high malate or fumarate forages will be helpful.

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