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BIOTECHNIQUES TO REDUCE THE GREEN HOUSE GASES

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ABSTRACT: The Greenhouse Effect is a natural process that warms the Earth, and it is quite necessary for our survival. In atmosphere gases like water vapor (clouds), carbon dioxide (CO_2), methane (CH_4),and nitrous oxide (N_2O) act as a natural blanket by preventing the sun's heat energy from radiating back into space The natural greenhouse effect helps warm the Earth's surface by as much as 33^{o}C, and without it, would be very tough to survive as it would be too cold [1.There has been increase in Green House Gases (GHGs) since pre-industrial times, which have led to a marked increase in atmospheric GHG concentrations causing global warming. The Largest growth in Global GHG emissions between 1970 and 2004 has come from various energy sectors like transport from burning of more fossil fuels, industry, land use like deforestation, land use change, forestry, agriculture, from buildings. The building sector has a high level of electricity use; hence total direct and indirect in this sector is much higher compared with direct emissions.Due to increase in GHGs, which leads to the greenhouse effect in turn global warming causing melting of ice glaciers in the Polar Regions of the earth, disturbing earth's natural bio-geochemical cycles and harm to all ecosystems. The GHG's like carbon dioxide, methane, nitrous oxide, Freon gas and chloroflourocarbons (CFC's) are major gases in different concentrations affecting the atmosphere and leading to global warming.

Keywords: Greenhouse gases (GHG's), Agriculture, Biotechnique, Chloroflourocarbons, Nitrogen, Freon gas, Impact.

1. HISTORY AND SOURCES OF GREEN HOUSE GASES: Svante Arrhenius was a Swedish scientist that was the first to claim in 1896 that fossil fuel combustion may eventually result in enhanced global warming and proposed a relation between atmospheric carbon dioxide concentrations and temperature. In the 1940's there were developments in infrared spectroscopy for measuring long-wave radiation. At that time it was proven that increasing the amount of atmospheric carbon dioxide resulted in more absorption of infrared radiation. It was also discovered that water vapor absorbed totally different types of radiation than carbon dioxide. Gilbert Plass summarized these results in 1955. He concluded that adding more carbon dioxide to the atmosphere would intercept infrared radiation that is otherwise lost in space, warming the earth. In the late 1950's and early 1960's Charles Keeling used the most modern technologies available to produce concentration curves for atmospheric CO_2 in Antarctica and Mauna Loa. These curves have become one of the major icons of global warming. In the 1980's, finally, the global annual mean temperature curve started to rise. People began to question the theory of an upcoming new ice age. In the late 1980's the curve began to increase so steeply that the global warming theory began to win terrain fast. Environmental NGO's (Non-Governmental Organizations) started to advocate global environmental protection to prevent further global warming. In the 1990's, scientists started to question the greenhouse effect theory, because of major uncertainties in the data sets and model outcomes. 1998 was globally the warmest year on record, followed by 2002, 2003, 2001 and 1997. The 10 warmest years on record have all occurred since 1990.The climate records of the Intergovernmental Panel on Climate Change (IPCC) are still contested by many other scientists, causing new research and frequent responses to skeptics by the IPCC. This global warming discussion is still continuing today and data is constantly checked and renewed. Models are also updated and adjusted to new discoveries and new theory[3.] The main human activities that increase GHG's are energy use in automobiles, goods transport, etc., air conditioning, and agriculture. US is the leading GHG emitter, comprising nearly 20% of the global average emissions, then the former soviet republics comprise the next largest joint emitter at near 14% of global emissions, followed by china(10%), Japan (5%), Brazil, Germany, India (each~ 4%) [4].

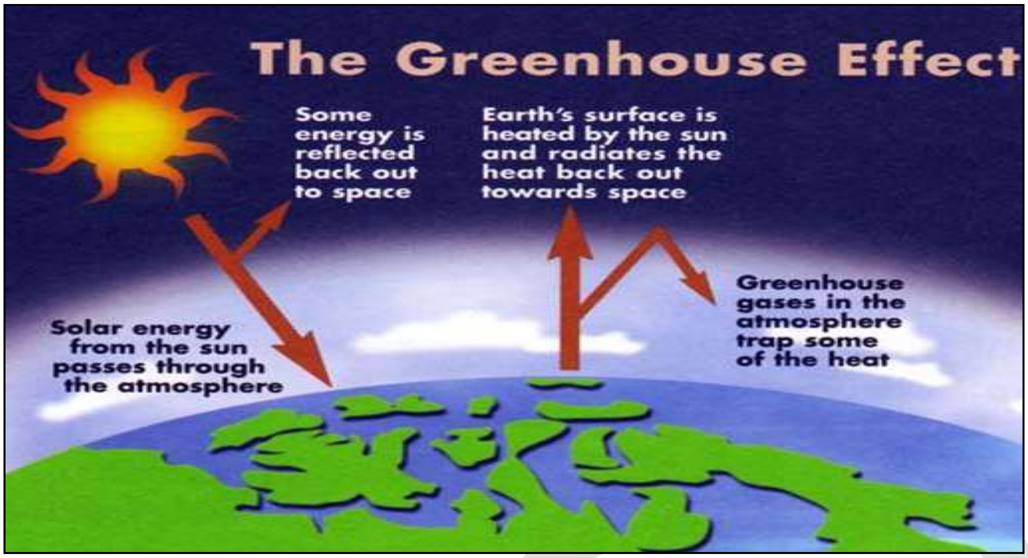

Fig 1: Natural mechanism of Green House Effect [2]

2. ENERGY CHAPTERS OF GREEN HOUSE GASES IN THE YEAR 2011

- In 2011, agricultural soil management was the largest source of N_2O emissions, and enteric fermentation was the second largest source of CH_4 emissions in the United States.
- The industrial end-use sector includes CO_2 emissions from fossil fuel combustion from all manufacturing facilities, in aggregate. This sector also includes emissions that are produced as a by-product of the non-energy-related industrial process activities. The variety of activities producing these non-energy-related emissions includes methane emissions from petroleum and natural gas systems, fugitive CH_4 emissions from coal mining, by-product CO_2 emissions from cement manufacture, and HFC, PFC, and SF6 by-product emissions from semiconductor manufacture, to name a few. Since 1990, industrial sector emissions have declined. The decline has occurred both in direct emissions and indirect emissions associated with electricity use. However, the decline in direct emissions has been sharper [5]

3. TYPES OF GREEN HOUSE GASES (GHG'S)

3.1 Carbon dioxide is present in the highest concentration by far. Based on 1990 concentrations, carbon dioxide is said to be responsible for almost 60% of the total greenhouse effect when efficiency and concentration are considered. Its concentration is increasing in the atmosphere due in large part to the extensive burning of coal and other fossil fuels for energy production. Another cause of CO_2 increase is the destruction of large areas of trees that leads to a reduction in the use of carbon dioxide for photosynthesis.

3.2 Methane is present in the atmosphere at less than 1% levels of carbon dioxide, and it is 25 times more efficient as a greenhouse gas. And which contributes 10% of the total greenhouse effect. The primary anthropogenic sources of methane gases is combustion of fuel, the decomposition of organic materials associated with wetlands, rice paddies and livestock manure.

3.3 Nitrous oxide is a 6% of total greenhouse gases and it is produced from the use of fertilizers and industrial activities.

3.4 Freon gas is mainly used to make refrigerant materials for refrigerators and air conditioners, detergents for non-conductors, and semi-conductors, and just about every spray product. Released Freon gas in the atmosphere stays intact for more than 400 years. And its heat absorption rate is 16 thousand times that of carbon dioxide.

3.5 Hydrogen Fluoride Carbon and Phosphorus Fluoride Carbon these gases have been used in alternatives to Freon gases for refrigerators and other chemical sulfur hexafluoride which keeps increasing in the world wide usage for gas circuit breakers, fire extinguishers and explosion proof substances which leads to greenhouse effect.

Hence the emission rate of carbon dioxide is the highest among all other greenhouse gases. Methane and nitrous oxide are impossible to control and as they originate from the natural world. Few studies have found that the change of carbon dioxide concentration is proportion temperature

4. FACTORS AFFECTING GREEN HOUSE GASES:

1. The total energy influx from the sun, which depends on the earth's distance from the sun and on solar activity
2. The chemical composition of the atmosphere (what gases are present and in what concentrations) and
3. The ability of the earth's surface to reflect light back into space

The only factor that has changed significantly in the last 100 years is the chemical composition of the atmosphere and that is because of human activity.

5. IMPACTS OF GHG’s

5.1 ENVIRONMENTAL IMPACT

- Overall increase in the earth’s temperature.
- Global warming will decrease snow, sea ice & glaciers, rising in sea levels and coastal flooding.
- Storms & heat waves are likely to increase in frequency and severity.
- Many wild species will have difficulty in adapting to a warmer climate & will likely experience greater stress from diseases and invasive species [2].

5.2 HUMAN HEALTH IMPACT

- Increased temperatures & severe extreme weather events could lead to increased risks of death from dehydration & heat stroke.
- Increased risk of respiratory & cardiovascular problems and certain types of cancers.
- The risk of water-, food-, vector- and rodent-borne diseases may increase [2].

5.3 ECONOMIC IMPACT

- Agriculture, forestry, tourism and recreation could be affected by changing weather patterns [2]
- Human health impacts are expected to place additional economic stress on health and social support systems [2]
- Damage to infrastructure (e.g., roads and bridges) from extreme weather events is expected to increase [2].

6. METHODS THAT ARE INITIATED TO REDUCE GREEN HOUSE GASES:

1. Research into a low greenhouse gas (GHG) emission electricity aims to develop cost effective and progressive reductions in emissions from stationary energy generation facilities of greater than 30 megawatts in capacity.
2. Energy Transformed research aims to develop innovations that reduce greenhouse gas (GHG) emissions from the transport sector.
3. Developing and implementing renewable energy technologies to deliver sustainable power for the future.
4. Developing solutions for low emission fuels
5. GHG’s and carbon management in forests by Bio- equestrations which is a natural complement to technological developments to mitigate GHG’s.Bioequestrations can be achieved by planting more trees reducing the rate of deforestation and protecting existing forests from disturbances such a fire [6]
6. Bioeconomy is an emerging term for the sustainable production and conversion of biomass for a range of food, health, fiber and industrial products and energy.

7. GREEN HOUSE GAS EMISSIONS FROM INDIAN AGRICULTURE

Globally, agriculture accounts for 54% of anthropogenic CH_4 58% of N_2O emissions; agriculture soil is the major contributor to the greenhouse effect. The research on GHGs emission from Indian agriculture started in 1990s, when, based on very limited measurements done elsewhere, it was reported that Indian rice fields emit 37.5Mt methane per year. The current estimates show that Indian rice fields covering an area of 43.86 million ha (Mha) emit 3.37 Mt of methane. The nitrous oxide emission from Indian agricultural soils is 0.14 Mt. Several attempts have been made to estimate CH_4 emission from Indian rice fields.[7] .According to report of Indian Network for Climate change Assessment, the net emission of GHG’s from India was 1728 million tons (Mt) of CO_2 eq in the year 2007 [8].

Methane is produced during the microbial decomposition of organic matter under anaerobic conditions. Potential source of methane is seen from rice fields submerged with water, because of continuous submerged soils, organic carbon content and use of organic manure increases methane emission. Burning of crops also contributes to the global methane emission these entire major source of methane is enteric fermentation in ruminants. Nitrogenous fertilizers are the source of nitrous oxide in fertilized soils and indigenous nitrogen from the unfertilized soil and burning of crops also emits nitrous oxide the content of soil water also the availability of carbon enhances the production of nitrous oxide. Generally, residues from nine crops (rice, wheat, cotton, maize, millet, sugarcane, jute, rapeseed-mustard and groundnut) are burnt in the field. Total crop residues generated by these nine major crops are about 566 Mt of which about 93 Mt is subjected to burning in the fields. Burning of crop residues in fields emitted 0.25 Mt of CH_4 and 0.007 Mt of N_2O in 2007 [8]. The burning of rice straw contributed the maximum (39%) to this GHGs emission. Large-scale burning of rice residues in Punjab, Haryana and western Uttar Pradesh is a matter of serious concern not only for GHGs emission, but also for problems of pollution, health hazards and loss of nutrients [9] .Emission of GHGs due to burning of crop residue field has, however, remained almost similar over the years.

1. Enteric Fermentation	**63.4%**
2. Rice cultivation	**20.9%**
3. Soils	**13.0%**
4. Manure management	**2.4%**
5. On field burning of crop residues	**35.9%**

Table 1: Reason for GHG's From Agricultural Activities

7.1 Scientific Strategies Agriculture can help in Mitigating GHGS emission.

The following strategies have been recommended for mitigating methane emission from rice cultivation.

- Altering water management, particularly promoting intermittent irrigation and mid season drainage;
- Improving organic matter management by promoting aerobic degradation through composting or incorporating it into the soil during off-season drained period;
- Use of rice cultivars with few unproductive tillers, high root oxidative activity and high harvest index; and
- Application of fermented manure such as biogas slurry in place of unfermented farmyard manure [10]. A single mid-season drainage may reduce seasonal methane emission. This emission could be reduced further by intermittent irrigation, yielding a 30% reduction as compared to mid-season drainage [11]
- Nitrous oxide can be reduced by using the specific nitrification inhibitors such as nitrapyrin and dicyanediamide. Plant derived organics can also act as natural inhibitors like neem oil, neem cake and karanja seed extract.
- Low carbon agriculture technology like Gross Domestic Product (GDP), decarbonized economy that has a minimal output of GHG's emission in the biosphere.
- Carbon dioxide – soils act both as a source and sink for carbon dioxide emission the net flux is very small. Hence it is balanced well from agriculture source.
- Use of urea super granules with sprinkler irrigation, site specific nutrient management and crop diversification has depicted ability to reduce Global Warming Potential (GWP).

7.2 Advantage: Low carbon agricultural technologies help in the savings of irrigation of water, provides provisions of tolerance to moisture and heat stresses, reduction in GHG's. And also the labor cost.

7.3 Constraints: there are a few drawbacks in low carbon agricultural technologies to reduce GHG's.

- High initial cost.
- Infrastructure and technical capability.
- Installation and maintenance.
- Risk in rainfall areas, weed problem.
- Lack of awareness
- Yield loss in the fields.

8. OTHER PREVENTIVE MEASURES:

- Replace electric hot water system with solar/ gas or 'heat pump' (uses < 1/3 the electricity of the element) [4]
- Replace all incandescent globes with CF's.
- Use fans, evaporative or room reverse cycle air conditioners; avoid large ducted systems. Only heat or cool the room you are in. Set thermostats heating 21° cooling 26° (each degree C of A/C increases emissions by 10%). Dress appropriately for the temperature [4].
- Choose '4 or 5 star' rated fridge & washing machine; don't buy larger than you need.

- Choose a laptop computer; small flat screen TV. Large screens waste energy.
- Use of public transport & biofuels, which helps to minimize GHG's.

9. FUTURE ASPECTS

As we know that all the techniques which have been found is still having few constraints in some or the other way. There is much research required were trial and error methods practically be performed to try and overcome the constraints which are previously seen. Majorly the change can be made by every individual living on earth to protect it from the human activities by avoiding encroachments.

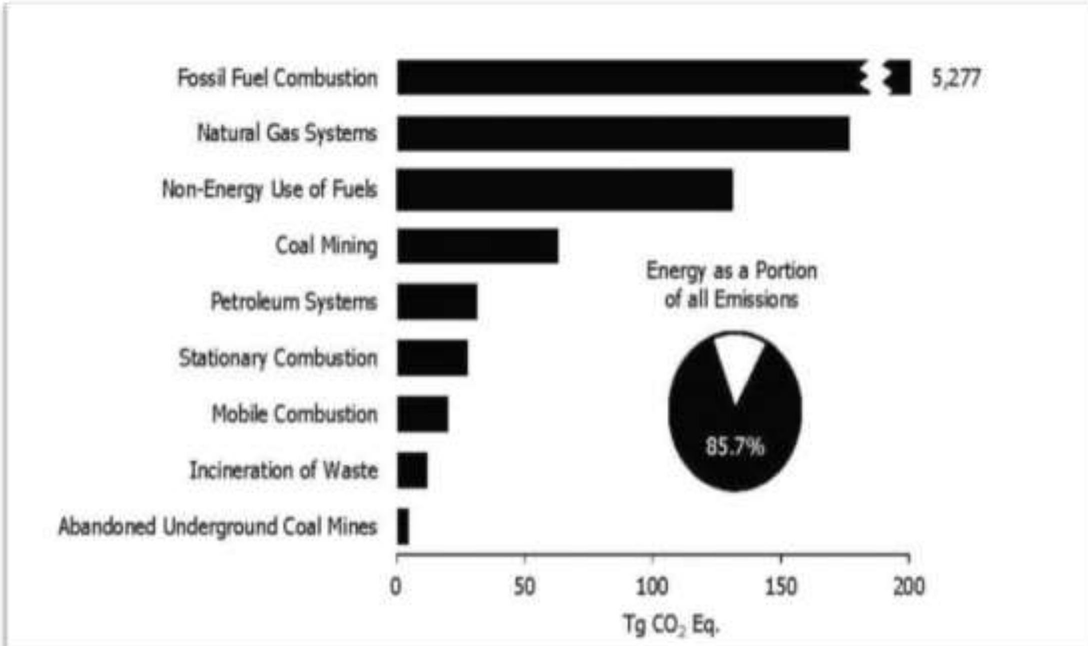

Fig 3: Sources of GHG's in the year 2011 [10]

Location	Methane (kg ha^{-1})	No. of observations	Average (kg ha^{-1})
Nadia, West Bengal	108-290	3	158
Purulia, West Bengal	110	1	110
Barrackpore, West Bengal	18-630	3	222
Jorhat, Assam	97-460	5	175
Tezpur, Assam	10-14	2	11.7
North 24 Parganas, West Bengal	145-462	2	305
Cuttack, Orissa	7-303	44	91
Bhubaneshwar, Orissa	140-186	2	163
New Delhi	10-221	68	39
Allahabad, Uttar Pradesh	5	1	5
Kumarganj, Uttar Pradesh	20	1	20
Maruteru, Andhra Pradesh	150	1	150
Madras, Tamil Nadu	110-182	2	149
Trichur, Kerala	37	1	37
Trivandrum, Kerala	90	1	90
Kasindra, Gujarat	120	1	120
Pant Nagar, Uttarakhand	54-114	4	79
Karnal, Haryana	64-100	2	81
Varanasi, Uttar Pradesh	0.1-261	15	117
Raipur, Madhya Pradesh	4-109	6	34
Ludhiana, Punjab	452-1650	5	875

Fig 4: Seasonal Methane Emission from rice fields at different locations in India [11]

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