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What's All the Fuss about Livestock, Methane and Global Warming?

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Global warming

Warming of the climate system is unequivocal, at least in the minds of most persons, as is evident from recent observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global sea levels. The global average temperature of earth is increasing continuously due to human activities leading to global warming. In the last one hundred years there has been around 1^0C increase in earth's temperature and it is expected to increase by 2-3 ^{0}C in the next century. This is due to continuous accumulation of green house gases (GHGs) like carbon dioxide, methane, nitrous oxide, water vapours and industrial gases which form an insulating layer as a result, the surface of earth is kept warm and livable.

Global warming, a relatively recent human-induced phenomenon leading to climate change is today's serious problem which needs a great deal of attention to address. The Intergovernmental Panel on Climate Change (IPCC) predicts that by 2100, the increase in global surface temperature may be between1.8-4.0^{0}C. According to FAO-2007, if global average temperature increases by 1.5-2.5 ^{0}C, approximately 20-30% of plant and animal species are expected to be at the risk of extinction.

Livestock and methane emission

The importance of livestock in providing human societies with food, incomes, employment, nutrients and risk insurance is widely recognized. India houses 16.10, 56.50 and 16.50 percent respectively of world's cattle, buffalo and goat population occupying first position in milk, third in egg and fifth in broiler poultry production in spite of the production system being predominantly based on crop residues and agro-by-products, contributing >4.5% to the national Gross Domestic Product (GDP). Among the livestock, ruminants' (that have four compartmentalized complex stomach) production has a large environmental impact with worldwide implications. A significant share of ruminants' environmental footprint is caused by enteric methane that represents about >25% of the annual anthropogenic (man-made sources) methane emitted into the atmosphere with global dairy sector contributing 2.7 to 4% of the total anthropogenic GHG emissions (FAO, 2010). This way livestock are one of the causes for global warming through the emission of green house gas (GHG) methane which is produced naturally during enteric fermentation as well as in manure, although the burning of fossil fuels is the largest anthropogenic contributor. Unlike the burning of fossil fuels, which releases a significant amount of carbon dioxide into the atmosphere, livestock production is mainly associated with methane and nitrous oxide emissions. Enteric methane accounts for about 75% of the total on-farm methane emissions (EPA, 2010). This CH_4 has 100-year

global warming potential and traps outgoing terrestrial infrared radiation 25 times more effectively than does CO_2. Domestic animals especially ruminants like cattle, buffaloes, sheep and goat harbor methane producing organisms called mathanogenic Archaea in their fore-stomach 'rumen' and are the main contributors (98%) to the enteric methane emission in India.

Enteric methane is an end product of the anaerobic microbial fermentation of feeds generated within the gastro-intestinal tract, particularly in the rumen, of ruminants. Under normal anaerobic environment of rumen, microbial fermentation process of structural carbohydrates contained in forage based diets (straws, stovers, grasses and green fodders) produce methane which is formed by the reduction of carbon dioxide and formate by hydrogen, and makes up the largest portion of combustible gases in the rumen (upto 30%). About 4.5g of methane is produced for every 100 g carbohydrates fermented in the rumen and is an energetically wasteful process as animals lose a part of feed energy (4-12 %) during methanogenesis.

Global Warming Potential (GWP) of the GHGs related to agriculture and livestock sectors

GHG	Life time (years)	GWP	Sources
Carbon dioxide (CO_2)	50-200 (avg:100)	1	Combustion of fossil fuels
Methane (CH_4)	12	25	Enteric & waste fermentation, natural gas and oil fields
Nitrous Oxide (N_2O)	114 (up to 150)	310	Agricultural & industrial activities

Share of ruminants in global GHG emission

Agriculture produces 10-12% of total global anthropogenic greenhouse gas emissions, contributing 50% of all anthropogenic methane. Ruminant animals are a major source of total anthropogenic emissions producing an estimated 80 million tonnes of CH_4 annually accounting for 33% of anthropogenic emissions of CH_4. Indian ruminant livestock emits between 10-11 Tg CH_4/ year. It has been recently concluded that methane emission by indigenous cattle, buffalo, goat, crossbred cattle and sheep is 48.5, 39, 4.7, 4.6 and 1.8% of the total methane emitted by the livestock in India. The average daily methane output is estimated to be 200 litre (range: 200-500L) for a 500 kg cow, 30 litre for a 30kg sheep and 8 litre for a 100 kg pig.

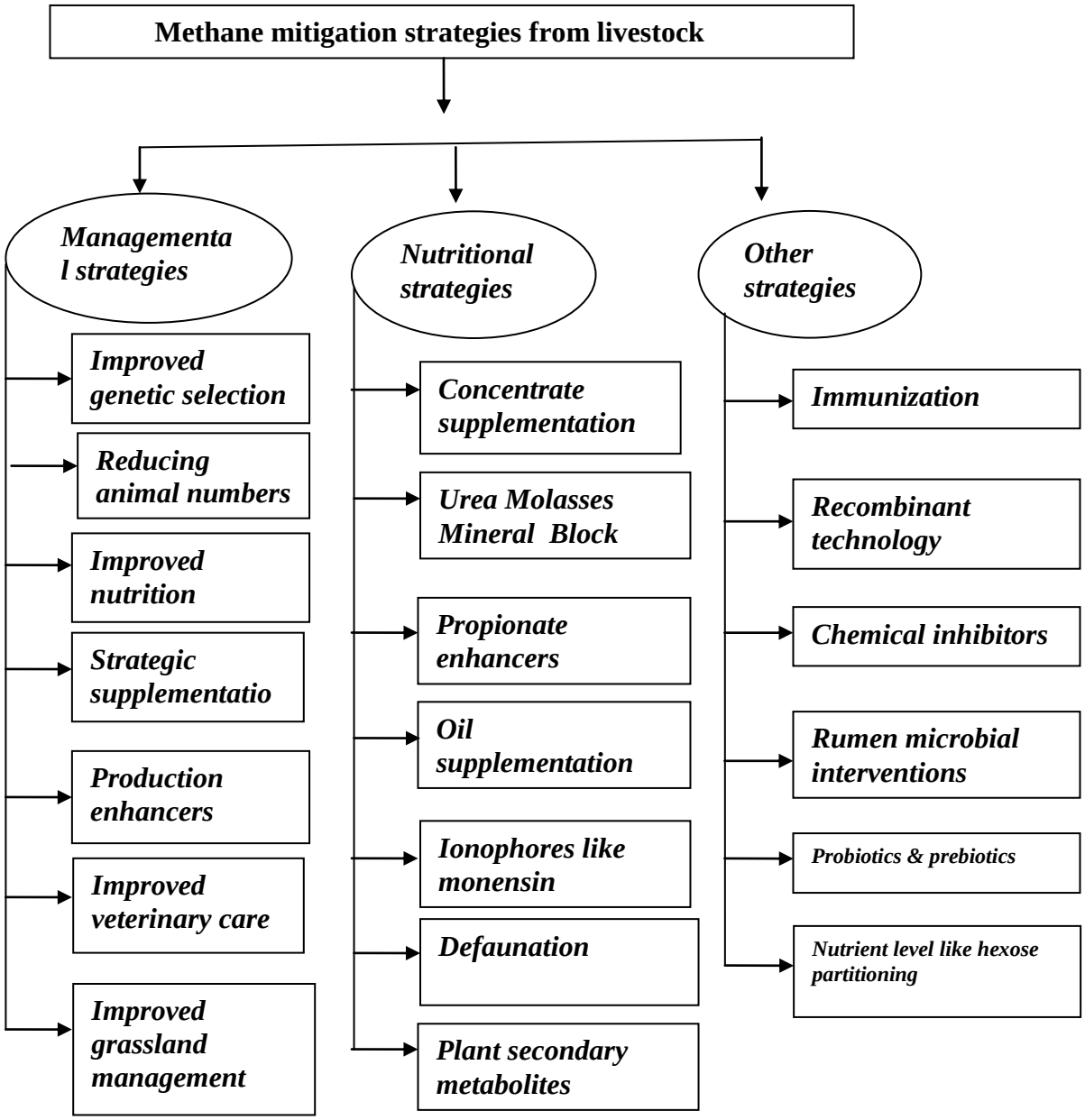
There is therefore an urgent need to develop ways of reducing methane production from ruminants, and unless controlled, continued global warming could bring the earth to a dangerous tipping point. Further, it has been said that the earth would have been 4 ^{0}C colder than its normal temperature, if the GHGs were absent from the troposphere. GHGs are stated to inhibit heat loss from earth through radiation due to increase in concentration in the atmospheric air and it is feared that global temperature may rise, although slowly but possibly irreversibly. The GHGs also causes destruction of ozone layer in the higher stratosphere which may increase the chance of increasing the amount of ultraviolet radiation reaching the earth, thereby predisposing animals and man to

skin cancer, impaired immune system and retinal degeneration, besides damaging agricultural crops.

Control

Food and Agricultural Organizations of United Nations says if CH_4 emissions grow in direct proportion to projected increases in livestock numbers, then global CH_4 emissions from livestock production are expected to increase 60% by 2030, as currently livestock systems are said to occupy 45% of earth's land surface area. GHG emissions from animal agriculture have been long recognized to be a function of the efficiency of production and total numbers. Thus, there are a number of strategies that can be used to alter methane emissions in dairy farms. These include using higher quality forages, feeding higher grain diets, using chemicals like ionophores and the addition of various fats or oilseeds to rations. In addition, there are a large number of proposed additives that could be added to diets to lower methane emissions. These include yeasts, tannin extracts, essential oils, fiber degrading enzymes, saponins and compounds such as garlic or oregano etc.

As India is a global leader with respect to total quantity of annual milk production (127 million tonnes), and our huge bovine population (199 million cattle and 105 million buffaloes) emitting a large amount of methane, challenges are ahead to produce more milk with minimum methane output. Thus improved animal productivity is required to reduce GHG emissions. In this regard, reduction of methane emissions from ruminant production, in particular, dairy cattle and buffaloes, and reduction of methane and nitrous oxide emissions from animal waste should be emphasized and needs to be materialized. Simply by adopting good livestock feeding practices (balanced feeding) and manure management, a considerable amount of methane emission can be reduced thus saving the environment from global warming. Conclusively, we can say by 'improving the animal productivity and reducing the numbers of non-productive animals, the environmental impacts of animal production' can be minimized, as low producing animals are mainly involved in maximum emission of methane.


Methane mitigation strategies from livestock
Managementa l strategies
Nutritional strategies
Other strategies
Improved genetic selection
Reducing animal numbers
Improved nutrition
Strategic supplementatio
Production enhancers
Improved veterinary care
Improved grassland management
Concentrate supplementation
Urea Molasses Mineral Block
Propionate enhancers
Oil supplementation
Ionophores like monensin
Defaunation
Plant secondary metabolites
Immunization
Recombinant technology
Chemical inhibitors
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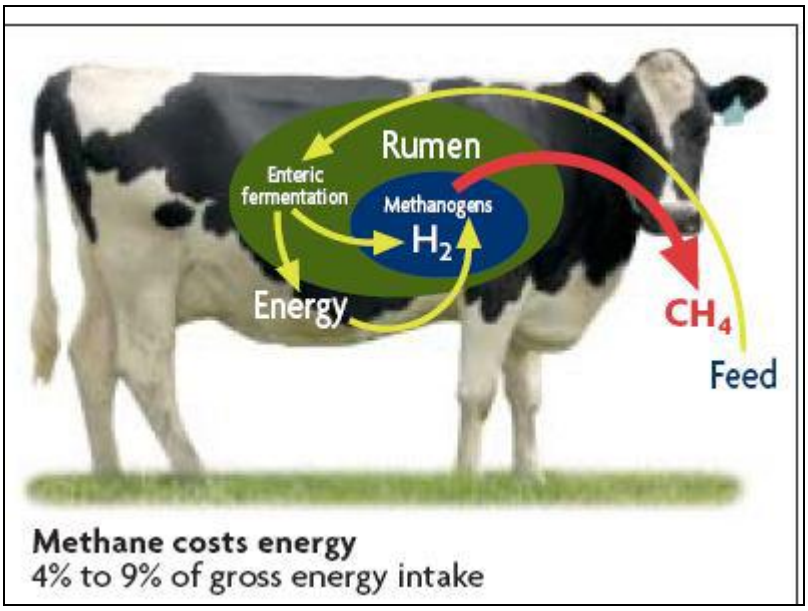
Probiotics & prebiotics
Nutrient level like hexose partitioning



Methane costs energy
4% to 9% of gross energy intake