International Journal of Agriculture Innovations and Research
Volume 3, Issue 5, ISSN (Online) 2319-1473

Global Warming: Genesis, Facts and Impacts on Livestock Farming and Mitigation Strategies

Rama Prasad J.
College of Agriculture and Veterinary Sciences,
Ambo University, Ambo, Ethiopia.
Email: ramaprasadjin@yahoo.com

Suhas Sourie J.
Research Scholar, Suresh Gyan Vihar University Mahal
Jagatpura Jaipur, Rajasthan, India.

Cherukuri V. R.
College of Agriculture and Veterinary Sciences, Ambo University, Ambo, Ethiopia.

Lemma Fita
College of Agriculture and Veterinary Sciences, Ambo University, Ambo, Ethiopia.

Chala Merera Erge
College of Agriculture and Veterinary Sciences, Ambo University, Ambo, Ethiopia.

Abstract **– Global warming is the phenomenon of increase in the temperature of Earth's surface bringing permanent change in the environment, which is due to release of anthropogenic greenhouse gases (GHGs) mainly carbon dioxide, methane and nitrous oxide due to combustion of fossil fuels like oil, gas, coal, electronic goods and other sources. Livestock sector is one of the top two or three most significant contributors to the environmental problems, contributing 12.5-18 % of GHG emissions, which include 9% of carbon dioxide, 37% of methane, 65% of nitrous oxide and 64% of ammonia, of total GHG emissions. Global warming is the mother of all challenges, because it poses a threat of far reaching consequences to societies all over the world. Average global temperatures are predicted to increase by 1.8-3.9^{o}C by 2100. Climate change can bring serious impacts on livestock sector by affecting ecological equilibrium, weather patterns, water source and availability, animal health, agricultural production and sustainable development. Climate change increases heat stress in animals which results in loss of production, a consequence to reduced feed intake. Considering the expected impacts of Earth's temperature increase, the International community agreed to follow UN climate change protocols held at Kyoto (1977), Rio de Janerio (1992) and recently at Lima (2014) to reduce the GHGs by 25-40% by 2025, by using alternative energy sources for power generation. Every effort should be made to limit the GHG emissions by using renewable energy sources with more nuclear-fossil energy infrastructure and also using bio-fuels. Livestock sector produces considerable amounts of anthropogenic GHG emissions in their production chain. To mitigate GHG emissions from livestock sector, the strategies encompass nutritional interventions, manure management and animal husbandry practices. Among the nutritional strategies, improving forage quality and the overall efficiency of dietary nutrient use is effective. Several dietary manipulations like inclusion of feed supplements like methane inhibitors, electron acceptors, ionophores, plant bio-active compounds, dietary lipids, exogenous enzymes, or direct fed microbial have a potential to reduce enteric methane emissions from ruminants, but economic viability and long term effects have to be established before implemented. Increasing animal productivity and improving animal health care are considered to be effective animal husbandry related mitigation measures. Several farmyard manure management practices like precision feeding, bio-filtration, acidification, deep cooling and composting have significant potential in reducing GHG emissions from manure storage and after application or deposition on soils. A comprehensive and sustainable action plan has to be initiated by politicians, policy makers, producers and consumers to limit the GHGs from all sources including livestock production with urgency and at reasonable cost.**

Keywords **– Facts and Impacts, Global Warming, Livestock Farming, Mitigation Strategies.**

INTRODUCTION

Global warming is the phenomenon of gradual increase in the average temperature of Earth's atmosphere and of oceans, a change that is believed to be permanently changing the climate of the Earth. Climate change is the imbalance of customary weather factors such as temperature, wind and rain fall characteristics of specific regions on the Earth. Around the world there is a great debate among the people about the global warming. It is considered to be the mother of all challenges and the greatest challenge that human kind will face in the current century, because it poses a threat of far-reaching consequences to the society around the world, in particular in developing and under developed countries, where they are not possessed with technologies to combat [23].

Global warming is mainly attributed to anthropogenic emission of greenhouse gases (GHG) into the atmosphere, mainly carbon dioxide, methane and others, resulting from combustion of fossil fuel and other sources [47], [29]. Human population has increased enormously; people started using more and more energy in the form of fossil fuels, like oil, gas, and coal. When fossil fuels burn to generate power, to run vehicles, to produce electricity and for heating houses, they emit carbon dioxide into the atmosphere. In addition people fell trees, resulting in less utilization of carbon dioxide. There is a strong evidence that emission of chlorofluorocarbons (CFCs) were also major cause of recent abnormal increase in the atmospheric temperature .Like carbon CFCs do not trap heat but in the presence of UV rays the chlorine gets detached from CFCs, drift into the stratosphere and unattached chlorine catalytically convert ozone molecule into oxygen depleting the ozone layer [36],[56]. Although, much evidence has been amassed on the negative impacts of livestock production on environmental integrity, community sustainability, public health and animal welfare, the global impacts of this sector remained underestimated and underappreciated. Therefore, the aim of this paper is to review the genesis of global warming, facts and impacts on livestock production and potential mitigation strategies.

Discussion

1. Genesis

1.1 Greenhouse effects (Gaseous atmospheric pollution)

The greenhouse effect is a natural phenomenon of keeping the earth in a temperature range that allows life to sustain. The Suns enormous energy warms the Earth's surface and its atmosphere. As this energy radiates back towards space as heat, a portion is absorbed by a delicate balance of heat –trapping gases in the atmosphere. Among them carbon dioxide and methane creates an insulating layer. But when these heat-trapping gases increase in amounts resulting in the temperature rise in the Earth's surface, which causes global warming.The greenhouse effect on the Earth is generated mostly by water vapour and opaque to infrared radiation and contributes about 65%, carbon dioxide, 33% and other GHG such as ozone, methane and nitrous oxide (2%).The Earth is warming at 0.750C in the last 100 years (1900-2000) due to emission of GHGs. Higher concentration of carbon dioxide and methane gases in the atmosphere causes the heat from the Sun to become more intense, resulting in the temperature rise on the Earth's crust. As per Global Carbon Project (GCP), the average growth rate of atmospheric carbon dioxide during 1980-2000 is 1.5 ppm per year and during the years 2000-2007 is 2.0ppm per annum [56].

1.2. Atmospheric brown clouds (ABC)

The aerosols or air pollutants are referred to as atmospheric brown clouds .Greenhouse gases act like the blanket that keeps the planet warm on a cold weather conditions by trapping the heat radiation from the planet. This radiation heat would have otherwise escaped to the surrounding outer space. The man made GHGs has thickened the protective layer by 2%. Many air pollutants particularly sulphates and nitrates,reflect solar radiation, which gives rise to the hazy skies, while black carbon aerosols, a major constituent of suit, absorb visible solar radiation resulting in brownish colour of the haze. The reflecting air pollutants in ABCs act like a mirror on the GHGs layer and make the planet brighter and this will have a climate cooling effect. On the other hand, the black carbon in ABCs will make the layer brownish by absorbing more UV and visible Sun light, which inturn warms the atmosphere on the Earth's surface. The current scientific understanding is that the global cooling effect of the mirror is much larger than the warming effect of the brownish suit, because ABCs have masked a significant fraction of the warming effect of the GHGs blanket. However, ABCs are a short term problem, but GHGs continue to increase and there is an emerging need to reduce carbon dioxide emission from fossil fuels.

1.3. Global warming and climate change

The three main GHGs are carbon dioxide, methane, and nitrous oxide [29]. The capacity of GHGs to trap heat in the atmosphere is described in terms of their global warming potential (GWP) which compares their global warming potential to that of carbon dioxide (with GWP set as 1). Although most attention has focused on carbon dioxide, methane and nitrous oxide both are extremely potent GHGs which have greater global warming potentials, than does carbon dioxide. By assigning carbon dioxide a value of 1 GWP, the warming potentials of these other gases can be expressed on a carbon dioxide-equivalent basis [48],[55]. Methane has a GWP of 23 times higher than that of carbon dioxide; and nitrous oxide has a GWP of 296.If emphasis is placed on the sustainable use of energy needs, the temperature could rise by about 1.80 C by the end of this century (2100). If not the temperature could rise by 60 C with even greater probability of causing abrupt or irreversible impacts. As per the United Nations intergovernmental panel on climate change [31], an increase of temperature between 1.8 to 5.40C could trigger massive environmental changes.

1.4 Livestock induced climate change

As per estimates, about 12.5% of total emissions of greenhouse gases are related to livestock production [56],[23].This contribution is even higher (18%) when the deforestation related to the expansion of livestock production area is also considered to meet the growing demand of animal products.Livestock contributes about 9% of total carbon dioxide production emissions, 37% of methane, and 64% of nitrous oxide emissions throughout production process. Though GHG emissions may come from non- ruminant herbivores, wild animals and poultry, but their contributions are negligible. Ruminants emit over 75% of the total carbon dioxide emissions from livestock. In the reference [29] scientist have estimated five major sources of emissions along livestock supply chain (1) Land use and land using chain: 2.5 giga tons carbon dioxide equivalents. (2)Feed production: 0.4 giga tons carbon dioxide equivalent (3) Animal production: 1.9giga tons carbon dioxide equivalent. (4) Manure management: 2.2 giga tons carbon dioxide equivalent and (5) Processing and international transport; 0.03 giga tons Carbon dioxide equivalent .Animal production may have adverse effect on many environmental aspects including air and water pollution, degradation of soil quality, reduction of biodiversity and global climate change. The emission of GHGs in livestock production systems originates from the animals enteric emissions, the manure and the fields used for the production of feed and forages.

1.5. Anthropogenic influences

Although some natural occurrences contribute to GHG emissions [33], the overwhelming consensus among the world's most reputed climatologists is that human activities are responsible for most of this increase in temperature [31]. It [31] is concluded with high confidence that anthropogenic warming over the last three decades has had a discernible influence on many physical and biological systems. Food and Agriculture Organization of the United Nations [18], highlighted the substantial role of the farm animal production sector, identifying it as a major threat to the environment. The FAO found that the animal agriculture sector emits 18%, or nearly one-fifth, of human-induced GHG emissions, more than the transportation sector [55], [29] .

1.6. Impact of growing livestock population and intensive production

Globally, approximately 56 billion land animals are reared and slaughtered for human consumption annually, and livestock inventories are expected to double by 2050, with most increases occurring in the developing world [55], [36] . As the number of farm animals reared for meat, egg, and dairy production rise, their GHG emissions will also increase. According to the U.S. Department of Agriculture [62] GHG emissions from livestock are inherently tied to livestock population sizes because the livestock are either directly or indirectly the source for the emissions. Escalating farm animal population has significantly contributed to increased methane emissions from both animals and their manure [48].

In recent decades, increasing number of animals are reared in intensive production systems in which chicken, pigs, turkeys, and other animals are confined in cages, crates, pens, stalls, and warehouse-like grow-out facilities. These production systems are devoid of environmental stimuli, adequate space, or means by which to experience most natural behaviours. Furthermore, because these commercial industrialized, landlessfacilities tend to produce more manure than can be used as fertilizer on nearby cropland [17]. Manure is instead distributed to a small, local landmass resulting in soil accumulation and runoff of phosphorus, nitrogen, and other pollutants [59]. Extensive or pasture-based farming methods remain the norm in Africa and some parts of Asia, but the trend in Latin America and Asia favour intensive production systems [45]. In recent years, industrial livestock production has grown at twice the rate of more traditional mixed farming systems and at more than six times the rate of production based on grazing. Confining greater number of animals under intensive system of rearing and separating production operations from agricultural land will only accentuate the environmental problems already posed by this sector[55], [29].

1.6. 1 Carbon dioxide emissions from livestock sector

Carbon dioxide gas has the most significant direct-warming impact on global temperature because of the volume of its emissions. Of all the natural and human-induced influences on climate over the past 250 years, the largest is due to increased carbon dioxide concentrations attributed to burning fossil fuels and deforestation [5], The livestock sector accounts for 9% of total carbon dioxide emissions, which are primarily the result of fertilizer production, on-farm energy expenditure, feed transport, animal product processing and transport, and land use changes. Burning fossil fuels to produce fertilizers for feeding crops may emit 41 million metric tons of carbon dioxide per year. Vast amounts of artificial nitrogenous fertilizer are used to grow farm animal feed, primarily composed of corn and soybeans. Most of this fertilizer is produced in factories dependent on fossil-fuel energy The Haber-Bosch process, produces ammonia in order to create nitrogen-based chemical fertilizer, is used to produce 100 million metric tons of fertilizer for feed crops annually [55]. An additional 90 million metric tons of carbon dioxide per year may be emitted by fossil fuels expended for intensive animal/ bird confinement operations. Although a large portion of the energy used for intensive confinement operations goes toward heating, cooling, and ventilation systems, more than half is expended for feed crop production, specifically to produce seed, herbicides, and pesticides, as well as the fossil fuels used to operate farm machinery in the production of forage and feed crops [55]. Carbon dioxide emissions from farm animal processing amounts to several million metric tons per year. The amount of fossil fuels burned varies depending on the species and type of animal product. For example, processing 1 kg of beef requires 4.37 mega-joules (MJ), or 1.21 kilowatt-hours, and processing 1 dozen eggs requires more than 6 MJ, or 1.66 kilowatt-hours. That same 1 kg of beef may result in GHGs equivalent to 36.4 kg of carbon dioxide, with almost all the energy consumed attributed to the production and transport of feed [46]. Approximately 0.8 million metric tons of carbon dioxide are emitted annually from the transportation of feed and animal products to the places where they will be consumed [55].

Farm animals and animal production facilities cover one-third of the planet's land surface, using more than two-thirds of all available agricultural land including the land used to grow feed crops [27]. Deforestation, land degradation, soil cultivation, and desertification are responsible for carbon dioxide emissions from the livestock sector's use of land.Livestock farming is a significant catalyst for the conversion of wooded areas to grazing land or cropland for feed production, which may emit 2.4 billion metric tons of carbon dioxide annually as a result of deforestation.The animal sector has particularly devastated Latin America, the region experiencing the largest net loss of forests and greatest releases of stored carbon into the atmosphere, resulting from disappearing vegetation. One of the chief causes of Latin America's deforestation is cattle ranching [16]. Other important ecosystems are also threatened by increasing farm animal population. Brazil's Cerrado region, the world's most biologically diverse savannah, produces half of the country's soybean crops [35]. Ranching is another major threat to the region, as it produces almost 40 million cattle a year [71] ,[36].

Farm animal production also results in release of up to 28 million metric tons of carbon dioxide/year from cultivated soils [36]. Forests, act as carbon sinks and store more than twice the carbon found in vegetation or in the atmosphere .Human activities, have significantly depleted the amount of carbon sequestered in the soil, contributing to GHG emissions. Desertification, or the degradation of land in arid, semiarid, and dry sub humid areas, is also exacerbated and facilitated by the animal agriculture sector [19]. By reducing the productivity and amount of vegetative cover, desertification allows carbon dioxide to escape into the atmosphere. Desertification of pastures due to animal agriculture is responsible for up to 100 million metric tons of carbon dioxide emissions annually [36], [70].

1.6.2 Nitrogen from fertilizer and livestock feed production

Feeding the global population of livestock requires at least 80% of the world's soybean crop and more than one-half of all corn, a plant whose growth is especially dependent on nitrogen-based chemical fertilizers. Natural sources of biologically fixed nitrogen, the form easily available as nutrient for plants, are limited, necessitating artificial fertilizer production [36]. Modern chemical fertilizer manufacturing, heavily reliant on fossil fuels, has taken a once-limited nutrient and made it available in massive quantities for crop farmers in the industrialized world. The changes to the nitrogen cycle are larger in magnitude and more profound than the changes to the carbon cycle. But the nitrogen cycle is being neglected [7]. A growing proportion of the world's population consumes excess protein and calories, which may lead to human health problems. The associated production of these dietary proteins (especially animal products) leads to further disturbance of the nitrogen cycle [73]. All crops grown in the industrialized world are nitrogen-saturated, and overuse of nitrogen in crop production, resulted in nitrogen runoff into waterways, and millions of tons of nitrogen found in farm animal manure threaten environmental integrity and public health [50].

1.6.3. Methane and nitrous oxide

The livestock sector is also responsible for 35–40% of annual anthropogenic methane emissions that result from enteric fermentation in ruminants and from farm animal manure. Methane emissions are affected by a number of factors, including the animal's age, body weight, feed quality, digestive efficiency, and exercise [48],[55]. Ruminants emit methane as part of their digestive process, which involves microbial (enteric) fermentation [65]. Although individual animals produce relatively small amounts of methane [67], the more than 1 billion ruminants reared annually amount to a significant methane source [20]. Enteric fermentation generates approximately 86 million metric tons of methane emissions worldwide [55].

Cattle confined in feedlots or in intensive confinement dairy operations are fed on unnatural diet of concentrated high-protein feed consisting of corn and soybeans. Although cattle may gain weight rapidly when fed this diet [49], it can cause a range of illnesses [54]. This diet may also lead to enhanced methane emissions. The standard diet fed to beef cattle confined in feedlots contributes to manure with a high methane producing capacity [63]. In contrast, cattle reared on pasture, eating a more natural, low-energy diet composed of grasses and other forages produce manure with about half of the potential to generate methane [63]. Farm animals produce billions of tons of manure; with confined farm animals in the United States alone generating approximately 500 million tons of solid and liquid waste annually [64]. Storing and disposing of these immense quantities of manure can lead to significant anthropogenic emissions of methane and nitrous oxide [66]. Globally, emissions from pig manure alone account for almost half of all GHG emissions from farm animal manure [55] ,[29].

Farm animal manure is the source of almost 18 million metric tons of annual methane emissions. In the reference [66], this increase is due to the trend toward housing dairy cows and pigs in larger facilities that typically use liquid manure management systems, which were first in use in the 1960s [41] but are now found in large dairy operations across the United States and in some developing countries, as well as in most industrial pig operations worldwide. About 70% of anthropogenic emissions of nitrous oxide result from crop and animal agriculture combined, farm animal production, including growing feed crops, accounts for 65% of global nitrous oxide emissions [55], [36].

2. Facts and impacts

Global warming is considered as mother of all challenges that stare at the face of human population, because they pose a threat of far reaching consequences to societies all around the world. In the future, climate change will affect people worldwide and it is the single biggest environmental and humanitarian crisis of all times. Experts claim that climate change would have a serious impact on ecological equilibrium, water availability, human health and sustainable development in general, especially in developing countries, which do not possess necessary means of adaptation to these global phenomena. Global warming is expected to result in changes in weather patterns, including an increase in global precipitation and changes in the severity or frequency of extreme events such as severe storms, floods and droughts. In general, the faster the changes, the greater will be the risk of damage exceeding our ability to cope with the consequences. Mean sea water level is expected to rise by 9–88 cm by 2100, causing flooding of low-lying areas and other damages. Climatic zones could shift pole ward and uphill, disrupting forests, deserts, rangelands and other unmanaged ecosystems. As a result, many ecosystems will decline or become fragmented and individual species could become extinct.

2.1. Impact on water availability

The world is moving towards increasing problems of fresh water shortage, scarcity and depletion, with 64 per cent of the world's population expected to live in water-stressed basins by 2025.Climate change will have a significant impact on sustainability of water supply all around the world in the coming decades. As per the Natural Resources Defence Council (NRDC), more than 48 countries in the world will face extremely severe water shortage. This global phenomenon has a wide spread impact on manifestation of significant shortages in all domains of water cycle, availability and especially affects agriculture production of the affected region, water quality and water supply system. Higher temperatures also increase the rate of evaporation of water. Rising temperatures can cause rising water levels in some areas and decreasing levels in other areas. Fresh water availability worldwide is dwindling, which means that there will be widespread impact on animal agriculture production due to manifestation of significant shortages in all domains of water cycle resulting in anthropogenic disasters. (http;//en.wikipedia.org/wiki/disaster/drought). Drought hazards have adverse impact on the environment, water availability, water equilibrium, water quality, water supply system, hydropower generation, navigation, ground water and vegetation covers.

2.2 Impact on livestock farming

Global agriculture will face many challenges over the coming decades and global warming and climate change will further complicate them. A warming of more than 2.50 C could reduce food supplies and contribute to higher prices of food commodities. The crop yields and productivity vary considerably. Some regions like tropics and subtropics will be threatened, whereas temperate and high altitude areas may benefit. The livestock sector will also be affected due to climate change. Livestock products would become costlier, if agriculture production is affected. Climate change increases the atmospheric temperature, which has a direct impact on animals by increasing heat stress. This results in loss of production due to reduced feed intake and reduction in reproductive efficiency. Changes in rainfall patterns and increased temperature affect feed availability, and weed, pest and disease incidence [36]. Food supplies are also at risk, as it is harder to grow crops in environmental conditions altered by climate change.

2.3. Impact on human and animal health

The ecological foot prints of the livestock sector will increase because of land use and land degradation. Reaching sustainable balance between environmental problems and meeting the current demands of animal derived foods and preservation of ecosystem is massive. As a result of temperature increase there will be increase of mosquitoes, tsetse fly and ticks, both animal and human health will be increasingly vulnerable to insect-borne disease risks. Climate change is one of the most serious public health threats facing the nations, but few people are aware of it [36].

The major scientific studies have shown that increasing the average temperature of earth is a reality. A temperature rise of 20C over the pre- industrial period cannot be avoided. To contain the rise in temperature to 20C, greenhouse gases emission will have to be reduced to by about 40% by 2020.There will be increased health risks. Rising temperatures will cause longer and more frequent heat waves, which result in more heat-related injuries and deaths. Rising sea levels, will cause flooding and increase standing water, which can serve as breeding ground for malaria and other parasites. Floods will also increase coastal erosion and destroy people's homes in coastal states. Thousands of people will be displaced. Longer and more intense heat waves will cause heat-related injuries.

2.4 Disasters and droughts

Many impacts of global warming are already detectable. As glaciers retreat, the sea level raises, the tundra thaws, hurricanes and other extreme weather events occur more frequently, and penguins, polar bears, and other species struggle to survive [60]. Experts anticipate even greater increases in the intensity and prevalence of these changes as the 21st century brings rises in GHGs. Average global temperatures have risen considerably, and the Intergovernmental Panel on Climate Change [33], predicts increases of 1.8–3.9°C by 2100. These temperature rises are much greater than those seen during the last century, when average temperatures rose only 0.06°C per decade [44]. Since the mid-1970s, however, the rate of increase in temperature rises has tripled. The IPCC's report [32], warns that climate change could lead to some impacts that are abrupt or irreversible.

2.5. Conflict, hunger, and disease

Climate change can have far-reaching consequences, perhaps mostly seen in growing conflicts among pastoral communities. Environmental degradation has been cited as one of the catalysts for on-going conflicts in Darfur and other areas of Sudan, where the effects of climate change has led to untenable conditions. As temperatures rise and water supplies dry up, farmers and herders are fighting to gain control over diminishing arable land and water [3]. According to [31], many areas already suffering from drought will become drier, exacerbating the risks of both hunger and disease. By 2020, up to 250 million people may experience water shortages, and in some countries, food production may be cut in half [31]. By 2050 the same year by which the FAO projects that meat and dairy production will double from present levels, primarily in the developing world [55]. Millions people in Asia may suffer from climate-change–related food shortages [10]. Global temperature shifts may also hasten the speed at which infectious diseases emerge and re-emerge [13]. According to World Health Organization, the chief risk factor for emerging zoonotic diseases is environmental degradation by humans, particularly deforestation, logging, and urbanisation [21]. The clear-cutting of forests for soybean cultivation, logging, and other industries enables viruses to exploit such newly exposed niches [26].

3. Mitigation strategies and the way forward

3.1. General options

Considering the expected impacts, Earth's temperature increase in ecosystem, the International community in 1977 agreed to follow Kyoto-protocol at UN climate conference in Japan. They agreed to reduce the emissions of GHGs, by using more alternative energy sources like solar, wind power, or wave power etc. National resources defence council (NRDC) approach is to cut carbon dioxide pollution from America s power plants by 21-31% from 2012 levels by 2020 and 25-30% by 2025. International agreement on climate change at the Earth summit in Rio de Janeiro in 1992 was accorded. Recently in November, 2014 United States of America and People Republic of China surprised the world by announcing a rare accord to cut carbon pollution, which gives hopes for global agreement on climate change. During Lima, Peru, UN climate change conference held in December, 2014 USA has indicated that it would commit to reduce 26-28% less climate change pollution in 2025 than was in 2005, whereas European Union has resolved to reduce pollution rates by 40% by 2030.It is contemplated to organise the next UN climate change meeting in December, 2015 at Paris and a new agreement is likely to be reached on climate change.

Measures to stop climate change need to be taken now, because we will experience its effects during our lifetime. Since it has not affected us very much yet, not very many people are aware of it. We need to raise awareness now, because once we see its effects, it will be too late. The majority of climate scientists agree that we can avoid the worst impacts of climate change if we stabilize greenhouse gas levels around 450-550 ppm. Greenhouse gas levels are currently around 380 ppm, and we do not have much time to stabilize them. This is something that must be accomplished within a couple of years. Climate change is an urgent issue that needs to be addressed now [36].

Despite the fact that climate change is progressing, there are still ways that it can be slowed down. To start with, the government should work to raise awareness about global warming, and what people can do to help. In addition, the government should offer tax benefits for people who use clean energy. Fossil fuels, such as oil and coal, are the largest sources of carbon emission, and fazing them out would significantly reduce the human impact on the environment. Offering tax benefits promote use of clean energy, but will still allow people to choose to use fossil fuels. Efforts are to be made to slow down climate change through using renewable energy and energy efficiency sources like bio-fuels or changing the nation's power system.

3.1.1 Livestock impact and mitigation measures

Overall livestock activities contribute 12.5-18% of total anthropogenic GHG emissions from five major sectors. GHG emissions from livestock have been long recognized to be a function of the efficiency of livestock production and of total number of livestock reared. So improved productivity is essential to reduce emissions. There are species differences to the production of GHG emissions and accordingly cows and buffalos are preferred for milk production. There are various emission reduction options from ruminant production. Mitigation in reducing emissions can be achieved in different ways related to animal feeding and management, manure collection, storage, improved animal waste management through energy (biogas) recovery, and management of crops fed to the livestock by bringing more drastic changes of the whole production system.

3.1.2. Sequestering carbon and mitigating carbon dioxide emissions

Carbon dioxide is the most important GHG, which has significant direct-warming impact on global temperature rise because of volume of its emission. Amount of carbon release from changes in the land use and land degradation are higher. Livestock offers a significant potential for carbon sequestering in the form of improved pastures. Other strategy could be reducing deforestation by agricultural intensification. Creating incentives for forest conservation and decreased deforestation in Amazon and other tropical areas, can offer a unique change of mitigation measure [29]. Another option could be recovering soil organic carbon loses from degraded pastures. Improved grassland management is major area where carbon losses from soil can be reversed [47].

3.2. Methane emission from ruminants

Ruminants produce GHGs in a number of ways, directly through enteric fermentation (methane), nitrogen excretion (nitrous oxide) and stored manure (methane and nitrous oxide) .Indirectly through use of fossil fuels and electric power in animal production systems, and use of feed stuffs for their feeding that have incurred emission of GHG in their production. In general methane production in ruminants represents 4-12% of gross energy intake (GEI) due to inefficiency in converting feed energy. It is not only environmental hazard but also loss of productivity to the animal. Methane originates from anaerobic microbial fermentation process, in reticulo-rumen of ruminants. The high moisture content and rumen temperature inherently present a conducive environment for rumen microbes to survive symbiotically with the host. Substrates required for the microbes are provided through ingestion of feed, which is attacked by microbes and degraded to wide range of end products. During this process, organic substrates are oxidized to carbon dioxide and water, but in internal rearrangement of carbon, hydrogen and oxygen present in the feed between microbial biomass and end products, keeps the system going, and reducing hydrogen ions are generated. To prevent the accumulation of hydrogen ions in the rumen a hydrogen sink is needed. Among the various sinks, conversion of hydrogen and carbon dioxide by methanogenic microbes, into methane in the rumen is the major one [42]. .Other end products of fermentation are microbial biomass and volatile fattyacids (acetic, propionic and butyric). Several factors like dietary characteristics and fermentation conditions influence the methane production in the rumen. It is widely accepted that dietary alterations and composition (roughages to concentrate ratio or the fiber, starch, sugars and protein content of the feed) affect rumen functioning and animal performance. So basic principle to reduce methane emission in the rumen should be to increase the digestibility of the feedstuffs either through modifying the feed or by manipulation of rumen fermentation.When the diet is poor methane emissions are higher. The most promising approach for reducing emissions from livestock sector is by improving productivity and efficiency of livestock production [39].

3.3. Enteric methane mitigation through nutrition

More recently [39] the nutritional mitigation strategy to reduce enteric methane emission from ruminants was extensively reviewed. A number of techniques exist to reduce methane emissions from enteric fermentation from ruminants..These methods include, improving the quality of the roughage, improving grazing practices, use of rotational grazing, inclusion of legumes, feeding highly digestible forages. Increasing forage digestibility and digestible forage intake will reduce methane emission from rumen fermentation.

3.3.1. Dietary manipulations through Feed supplements

3.3.1.1. Inhibitors

The most successful methane inhibitors tested *in vivo* are bromochromomethane (BCM), 2bromoethanesulfonate (2.BES), chloroform and cytodoxins. Among these compounds tested bromochromomethane (BCM) is the effective enteric methane inhibitor [1], but it is a banned compound in many countries of the world because it is an ozone depleting compound.

International Journal of Agriculture Innovations and Research
Volume 3, Issue 5, ISSN (Online) 2319-1473

3.3.1.2. Electron receptors

Recently, electron receptors as feed supplements received considerable attention. Some supplements studied are fumarate, nitrates, sulphates and nitrothanes [38], [8]. Among the many compounds tested nitrates have shown promising results in reducing enteric methane emissions from ruminants, particularly in low protein diets, but proper adaptation is the key for success [30]. This is evident by the gradual and marked increase in nitrate reducing bacterial activity following introduction of nitrates in the rations. Scientist [38], suggested an alternate way of nitrate supplementation through licking blocks.

3.3.1.3. Ionospheres

Monensin is the most promising and most widely used ionophore to limit the enteric methane emission in ruminants [52], but it is effective only on high grain ration or mixed grain rations. There will be consistent decrease in acetate: propionate ratio, which may lead to reduction in methane emission per unit feed. This effect is dependent on dose, feed intake and diet composition.

3.3.1.4. Plant bioactive compounds

Many varieties of plant secondary compounds, specially tannins, saponins etc. are promising options. Hydrolysable and condensed tannins may offer an opportunity to reduce enteric methane [24], [4]. They reported decreased enteric methane emission from 6-27%. It has been reported that anti methanogenic effect of tannins depend on application rate and is positively related to the number of hydroxyl groups in their structure and directly affecting rumen methanogenesis [24]. Tea saponin seems to have great potential. Extracts from plants such as rhubarb and garlic could decrease methane emission, but long term effectsare yet to beestablished.

3.3.1.5. Dietary lipids

The dietarylipids have been reported to suppress the methane emissions when added in the rations in the range of 6-8%, but are also cost effective [25]. When fed at the rate of less than 8% in the diet, at 10 g /Kg DM increase in dietary fat would decrease methane yield by 1g/Kg DM in cattle and 2.6 g/Kg DM in sheep.High oil by-product feeds such as distillers grains and meals from bio-diesel industry can serve as cost effective sources of dietary lipids with potential methane suppressing effect.

3.3.1.6. Exogenous enzymes

Use of exogenous enzymes in ruminant rations has been studied extensively. But, the limited data available indicated that exogenous enzymes may increase feed efficiency. Indirectly reduce enteric methane emission [25], but cannot be recommended as a mitigation practice as of now.

3.3.1.7. Direct fed-microbial

Some direct fed –microbial like yeast based products (YPs) are used as feed additives and may have moderate methane mitigating effect [2]. A variety of direct fed microbial available are live yeast products and yeast cultures as feed supplements, which stabilize pH and promote rumen function.

3.3.1.8. Manipulation of rumen archaea and bacteria

Significant efforts have been devoted to suppress *archaea* and or promoting acetogenic bacteria in the rumen. Vaccines against rumen bacteria may offer a small mitigation opportunity to reduce enteric methane emission based on the concept that of a continuous supply of antibodies to the rumen through saliva [43], [29].

3.3.1.2. Feeds and feeding management

3.3.1.2.1. Feed intake

There is a clear relationship between feed DM digestibility, concentrate feed and the pattern of rumen fermentation. Feed intake is the important variable in methane emission [28]. Addition of starch and lipid combinations to the diets of feedlot bulls reduced GHG emissions [14], inclusion of concentrate feed at above 35-40% of DM is likely reduce methane emission. Supplementation with small amounts of concentrates in the feed is likely to increase animal production and decrease methane emission [37].

3.3.1.2.2. Forage quality

Forage quality, level of concentrates in the diet digestibility and feed intake are interrelated and directly affect enteric methane emissions. Best mitigation strategy is to increase the forage digestibility in order to improve intake and animal productivity, thus reducing methane emission.

3.3.1.2.3. Feed processing

The processing of grain to increase digestibility is likely to reduce enteric methane emission [72], but it is not economically feasible option in low-input production system.

3.3.1.2.4 .Total mixed rations (TMR) and feeding ability

There is little evidence of beneficial effects of synchronizing energy and protein or frequency of feeding on methane emission from rumen. Total mixed rations will have some advantage on intake and fermentation [9].

3.3.1.2.5. Precision feeding

Precision feeding entails closely matching the animal requirements and dietary nutritional supply and synchronizing energy and protein delivery or frequency of feeding which has effect on methane production. Indian scientists [22] documented remarkable progress in animal performance utilizing program to feed balanced rations to lactating cows and buffaloes with reduced methane emissions.

3.3.1.2.6. Mitigation options for production systems based on low quality feeds

In developing countries like India and Ethiopia, crop residues are important basal feeds for ruminant feeding [6]. Technically mitigation options in feeding low quality feeds include chemical treatments like sodium hydroxide, urea and ammonia treatment and supplementation can be effective mitigation measures, but uptake of knowledge by farmer is very little.The most relevant mitigation option for small holder livestock system in developing countries is to increase individual animal productivity by providing better feed.

3.4.1. Mitigation through manure management

Several manure management practices have a significant potential for decreasing GHG emission from manure, like dietary management, storage, dietary manipulation, bio-

International Journal of Agriculture Innovations and Research
Volume 3, Issue 5, ISSN (Online) 2319-1473

filtration, manure acidification, composting etc. Economically feasible mitigation options in the reduction of excess protein in the diet of ruminant and non- ruminant species exist, which can not only decrease manure ammonia and nitrous oxide emissions but also saves feed costs to the producer. Methane emission from anaerobic manure management can be readily reduced by existing technologies, through deep cooling of manure to below 10 degrees centigrade. Bio-gas can achieve 50% reduction of methane from manure. Important way is rising animal N assimilation efficiency (14 percent against 50% for crops), through more balanced feeding. Improved feeding practices like grouping by gender and face production. Improving feed efficiency ratio by tailoring feed according to physiological requirement of livestock is also important.

3.4.2, Animal husbandry mitigation practices

Mitigation options that reduce GHG emissions include increasing herd productivity, and enhancing animal health and longevity, but application depends on political will, incentives for farmers and availability of resources. Enhancing animal productivity include animal genetics, feeding and reproduction, health and overall management.

3.4.3. Animal genetics

Improvement in animal genetics coupled with diet management can lead to significant reduction in methane emission [69]. The potential for using RFI as a selection tool for cow methane emitter is an interesting mitigation option.

3.4.4. Animal health and longevity

Improved animal health and reduced mortality and morbidity are expected to result in increased herd productivity, diluting the non-carbon dioxide emissions from unit product. Other animal husbandry practices include choice of breeding and mating strategy, enhanced fecundity and early weaning are some options. Optimizing the animal husbandry practices can be very successful strategy for mitigating GHG emissions from the livestock sector in both developed and developing countries.

3.4.5. Interactions

Interactions among animals, environment, and production on methane and carbon dioxide emissions are inevitable and complex, but must be considered when recommending GHG mitigation practices with utmost caution. When assessing mitigation measures one must consider the combined effect of interactions among animal-manure-soil-crop process related to whole farm [25].

3.5. Critical mitigation measures

The livestock sector contribution to climate change necessitates comprehensive and immediate action by policy makers, producers, and consumers. Enhanced regulation is required in order to hold facilities accountable for their GHG emissions. Accurately pricing environmental services is the first step. Hitherto, most mitigation and prevention strategies undertaken by the livestock sector have focused on technical solutions. Researchers are investigating the reformulation of ruminant diets to reduce enteric fermentation and some methane emissions [12]. Plant-based bolus, formulated to reduce excessive fermentation and regulate the metabolic activity of rumen bacteria to reduce methane emissions from both the animals and their manure. The USDA and U.S. EPA assist in funding anaerobic digester projects domestically and abroad [68], [58]. They are, now in use at some large-scale intensive confinement facilities, capture methane from manure to use as a source of energy [51], but are not economically viable for small-scale farms [53]. In many countries, producers are burning animal waste for fuel. The world's foremost pig producer, Smithfield Foods (Smithfield, VA), and the top poultry producers, Tyson Foods (Springdale, AR), are using animal by-product fats to create biofuels [34], [51]. As consumers increasingly favour more environmentally friendly products and techniques, reducing consumption of meat, eggs and milk, as well as choosing more sustainably produced animal products, such as those from organic systems. Organic farming has the potential to reduce GHG emissions and sequester carbon [30]. Raising cattle for beef organically on grass, in contrast to fattening confined cattle on concentrated feed, may emit 40% less GHGs and consume 85% less energy than conventionally produced beef [11], [15], [46]. There is an urgent need for global action by scientists, world leaders and individual consumers. Several recommendations were put forth, including the reduction of meat and milk intake by high-income countries to curtail global greenhouse-gas emissions [46].

Globally livestock contribution to environmental problems is very severe and massive and need to be addressed with urgency and at reasonable cost. By 2050, livestock production is expected to double from present levels. There is an emerging need to develop suitable institutional and policy frame works to put in place at local, national and international levels for the suggested changes to occur. It requires strong political will, commitment and increased knowledge and awareness of environmental risks. The environmental impacts of livestock require that governments, international organizations, producers, and consumers focus more attention on the role played by meat, egg, and dairy production sector. Mitigating and preventing the environmental harms caused by this sector require immediate and substantial changes in regulation production, practices, and consumption patterns on a long term sustainable basis.

References

[1] L. Abecia, P G. Toral, A. Martín-García, G. Martínez, N. W. Tomkins, E. Molina-Alcaide, C. J. Newbold, and D. R Yaňez-Ruiz, "Effect of bromochloromethane on methane emission, rumen fermentation pattern, milk yield, and fatty acid profile in lactating dairy goats". *J. Dairy Sci.* 2012, 95: 2027–2036.

[2] P. C. Aikman, P. H Henning, D. J. Humphries, C.H Horn and P. H. "Rumen Fermentation characteristics in dairy cows supplemented with *Megasphaeraelsdenii* NCIMB41125 in early lactation." *J. Dairy Sci.* 2011, 94: 2840–2849.

[3] S. Baldauf, "Africans are already facing climate change". *Christian Science Monitor* 6 November: 4. 2006. [[accessed 24 March2008]]. Available: http://www.csmonitor.com/ 2006/1106/ p04s01-woaf.html.

[4] R. Bhatta, O. Enishi , Y. Yabumoto, I. Nonaka, N. Takusari, K. Higuchi , K. Tajima, A. Takenaka and M. Kurihara,. "Methane

reduction and energy partitioning in goats fed two concentrations of tannin from *Mimosa* spp". *J. Agric. Sci Cambr.* , 2012. (doi:10.1017/S0021859612000299.

[5] R. M. Bierbaum, , J. P. Holdren, M. C. MacCracken, R .H. Moss and P. H Raven, "Confronting Climate Change: Avoiding the Unmanageable, Managing the Unavoidable". available: http://www.unfoueneditors. Washington, DC: United Nations Foundation; 2007. [Accessed 23 October 2007]. dation.org/files/pdf/2007/SEG_Report.pdf.

[6] M. Blummel, S . Anandan, and C. S. Prasad. "Potential and limitations of by-product based feeding systems to mitigate greenhouse gases for improved livestock productivity".13th Biennial conference of animal nutrition society of India, 2008, pp 68-74, Bangalore, India.

[7] S. Bohan . "Nitrogen overdose". *Oakland Tribune* (Oakland, CA) [[accessed 25 March2008] 2007, Available: http://findarticles.com/p/articles/mi_qn4176/is_20070812/ai_n19477123.

[8] E. G. Brown , R. C. Anderson, G. E. Carsten, H. Guitierez-Banuoles, J. L. McRenold, L. Slay, T. R Callaway and D. J Nisbet, "Effects of nitro ethane administration as enteric methane emissions and ruminal fermentation in cattle".*Anim Feed. Sci. Technol,* 2011, 166-167:275-281.

[9] Y, Cao, T. Takahashi, K. Horiguchi , N. Yoshida,and Y. Cai. "Methane emissions from sheep fed fermented or non-fermented total mixed rations containing whole crop rice and rice bran" *Anim.Feed.Sci Technol*. 2001, 157:72-78.

10] M. Casey , Report: "Millions face hunger from climate change". *Christian Post* (Washington, DC) 2007. 10April. [accessed3, January, 2008 available: http://www.christianpost.com/article/20070410/26802_Report:_Millions_Face_Hunger_from_Climate_Change.htm.

[11] C. Cederberg and M. Stadig, "System expansion and allocation in life cycle assessment of milk and beef production." *Int J Life Cycle Asses. 2003*...;8:350–356.

[12] K Connolly, "Pill stops cow burps and helps save the planet". *Guardian* (London, England) 2007, 23 March:.

[13] P, Epstein and E,Mills ," Climate Change Futures: Health, Ecological, and Economic Dimensions. Boston," 2005.. *Centre for Health and the Global Environment*.

[14] M. Eugene , C. Martin, M. Mialon, D. .Krayes, G . Renald , and DoreaeFrisch, O Niel., "Dietary linseed and starch supplementation decreases methane productionof fattening bulls" *.Anim Feed.Sci Technol* .1998 . 166-167: 330-337.

[15] D .Fanelli, "Meat is murder on the environment".*New Scientist. 18* July. [2007). [Accessed23October2007] p.15. Available: http://environment.newscientist.com/article.ns?id=mg19526134.500&feedId=online-news_rss20.

[16] FAO (Food and Agriculture Organization of the United Nations). 2005a. Cattle Ranching Is Encroaching on Forests in Latin America. [[Accessed 23 October 2007]]. Available: http://www.fao.org/newsroom/en/news/2005/102924/index.html.

[17] FAO (Food and Agriculture Organization of the United Nations).2005b. Responding to the "Livestock Revolution"—The Case for Livestock Public Policies. [[Accessed 23 October2007].Available:http://www.fao.org/ag/againfo/resources/documents/pol-briefs/01/EN/AGA01_10.pdf.

[18] FAO (Food and Agriculture Organization of the United Nations). 2006. Livestock a Major Threat to the Environment: Remedies Urgently Needed. [[accessed 23October2007]]. Available: http://www.fao.org/newsroom/en/news/2006/1000448/index.html.

[19] FAO (Food and Agriculture Organization of the United Nations) Desertification. 2007. [[accessed 23 October 2007]. Available: http://www.fao.org/desertification/default.asp? lang=en.

[20] FAO (Food and Agriculture Organization of the United Nations) FAOSTAT .2008. [Accessed 24 March 2008]. Available: http://faostat.fao.org/

[21] F. Fleck, "Expertsurge action to stop animal diseases infecting humans". BMJ.2004;328:1158. [PMC free arti M R cle] [PubMed]

[22] M. R. Garg , P .L. Sherasia , B .M .Bhanderi , B.T. Phondba, S. K., Shelke and , H. P. S. Makkar, "Effects of feeding nutritionally balanced rations on animal productivity, feed conversion efficiency, feed nitrogen use efficiency, rumen microbial protein supply, parasitic load,immunity and enteric methane emissions of milking animals under field conditions". *Anim. Feed. Sci. Technol.* 2012. 179:24–35.

[23] P. J Gerber, H. Steinfield , B,.Henderson, A.,Morret , C .Opio ,D. A. Dijkman, J. G.,FalcucaandTempo, 2013"Tackling climate change through livestock- A global assessment of emissions and mitigation opportunities" FAO of United Nations ,ROME.

[24] G .Goel ,and H. P. S. Makkar,. ".Methane mitigation from ruminants using tannins and saponins.*Trop. Anim. Health Prod.* 2012. 44: 729–739.

[25] C .Grainger and K. A .Beauchemi , "Can enteric methane emissions from ruminants be lowered without lowering their production" *Anim. Feed. Sci. Technol* 2011. 166–167: 308–320.

[26] M. Greger, "The human/animal interface: emergence and resurgence of zoonotic infectious diseases.Crit Rev" *Microbio*l. 2007.33:243–299.[PubMed].

[27] C. Haan, H .Steinfeld and H. Blackburn, "Livestock and the Environment: Finding a Balance". Brussels: European Commission Directorate-General for Development.1997. [Accessed 24 March 2008]. Available: http://www.fao.org/docrep/x5303e/x5303e00.htm

[28] R .S .Hegarty, D. Alcock, D. L .Robinson, Goopy and P. E. Vercoe, "Nutritional and flock management options to reduce methane output and methane per unit product from sheep enterprises". *Anim. Prod. Sci.* (2010). 50: 1026–1033.

[29] A. N .Hristov, C. Oh, J lee, R, F..Meenen Montes, T. J .Ott Firkins, Dell,C, Andesogan A, Yang, W,Tricario J.,Kebrib, G. Waghorn, J,.Dijkstra Osting, 2013. Mitigation of green house gas emissions in livestock production: A reviewof technical options for non-carbon dioxide emissions. (Edited by Pierere J, Gerber, Benjamin Handeson, Harinder P. S. Makkar)FAO Animal production and health paper no;177 FAO , Rome.

[30] R.B .A, Hsulshof , A. Berndt , W. J .J. Gerrits J .Dijkstra, S .M. Van Zijderveld J .Newbold, and R, H .B. Perdok, "Dietary nitrate supplementation reduces methane emission in beefscattle fed sugarcane based diets". J. Anim. Sci. 2012. 90:2317–2323.

[30] IFOAM (International Federation of Organic Agriculture Movements) (2004).The Role of Organic Agriculture in Mitigating Climate Change. 2004. [[accessed 23 October 2007]].Available:http://www.ifoam.org/press/positions/pdfs/Role_of_OA_migitating_climate_change.pdf.

[31] IPCC(Intergovernmental Panel on Climate Change) 2007a . Impacts, Adaptation and Vulnerability. Brussels: Intergovernmental Panel on Climate Change.2007a. [[accessed 24 March 2008]]. Available: http://www.ipcc.ch/ipccreports/ar4-wg2.htm.

[32] IPCC (Intergovernmental Panel on Climate Change) 2007b. Climate Change: Synthesis Report; Summary for Policymakers. accessed 24 March 2008]]. Available: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

[33] IPCC (Intergovernmental Panel on Climate Change) 2007c. Paris [[accessed 24 March 2008]]. Climate Change: The PhysicalScienceBasis.Available: http://www.ipcc.ch/ipccreports/ar4-wg1.htm.

[34] T Johnston, and Tyson, "Teams with Conoco Phillips to Produce Renewable Diesel Fuel". [accessed 23 October 2007] Available: http://meatingplace.com/MembersOnly/webNews/details.aspx?item=17806.

[35] C.A.Klink, and R.B.Machado, "Conservation of the Brazilian Cerrado .Conserv". Biol.; 2005,19:707–713.

[36] G. Koneswaran and D. Nierenberg, "Global farm animal production and global warming :Impacting and mitigating climate change". Environmental health prospective ,2008 ;116 (5) 578-582l.

[37] C .Lee , A .N. Hristov , C .J .Dell , G. W. Feyereisen, J. Kaye and D. Beegle, "Effect of dietary protein concentration on ammonia and greenhouse gas emissions from dairy manure" .J. Dairy Sc .2012 . 95:1930–1941.

[38] R .A. Leng, "The potential of feeding nitrate to reduce enteric methane production in ruminants" .A report to the department of climate change. Common wealth Government of Australia, Canberra. 2008). http://www.penambulbooks.com.

[39] S. Mekuriaw, F .Tegegn and A. Mengistu, "A review on reduction of greenhouse gas emission from ruminants through nutritional strategies," Academia. J .Environ. Sci. 2014, 2 (1):006-014.

[40] A.J . McMichael, J .W. Powles, C.D . Butler and R. Uauy, "Food, livestock production, energy, climate change, and health." Lancet; 370:1253–1263. doi: 10.1016/S0140-6736(07)612562. [Online 13 September 2007] [PubMed] [Cross Ref].

[41] J.Miner, F.Humenik and R.Overcash, "Managing Livestock Wastes to Preserve Environmental Quality". 2000.Ames, IA: Iowa University Press.

[42] J .A. N. Mills, J. Dijkstra, A. Bannink, S .B. Cammell, E. Kebreab and J .France, " A mechanistic model of whole-tract digestion and methenogenesis in the lactating dairy cow :Model development, evaluation and application".*J. Anim. Sci.* 2001,79, 1584-1597.

[43] D.P, Morgavi, E. Forano , C. Martin and C. Newbold," Microbial ecosystem and methanogenesis in ruminants". *Animal prod*. 2010, 4: 1024–1036.

[44] NOVA (National Oceanic and Atmospheric Administration) 2007. U.S. Winter Temperature Near Average, Global December-February Temperature Warmest on Record [Press release] 2007. [[accessed5 March2008]]. Available: http://www.noaanews.noaa.gov/stories2007/s2819.htm.

[45] D. Nierenberg., "Rethinking the global meat industry. In: Starke L, editor. State of the World: A World watches Institute Report on Progress toward a Sustainable Society" .New York: W.W. Norton & Company; 2006. pp. 24–40.

[46] A. Ogino, H. Orito, K. Shimad and , H.Hirooka, "Evaluating environmental impacts of the Japanese beef cow-calf system by the life cycle assessment method" . Anim. Sci.J, 2007; 78:424–432.

[47] C. Opio, P. Gerber, A. Mottel , A. Falcucci, G Tempio,, Maclcod Vellinga , B. Henderson and H. Steinfeld, "Greenhouse gas emissions from ruminant supply chain –A global life cycle assessment." FAO 2013 of United Nation, Rome.

[48] K. Paustian, M. Antle, J .Sheehan and P. Eldor, "Agriculture's Role in Greenhouse Gas Mitigation". Washington, DC 2006 .: Pew Centre on Global Climate Change.

[49] M. Pollan, "Power steer".New York Times Magazine. [[accessed 24 March 2008]]. p. 44. Available: http://query.nytimes.com/gst/fullpage.html?res=9C06E5DB153BF932A05750C0A9649C8B63.

[50] M. Pollan , "The Omnivore's Dilemma": A Natural History of Four Meals..New York2006: Penguin Press.

[51] P R Newswire, "Smithfield Joins the Chicago Climate Exchange." [[accessed 24 October 2007]]. Available: http://sev.prnewswire.com/foodbeverages/20070226/CGM04426022007-1.html

[52] J .B. Russell and , A .J. Houlihan, ".Ionophore resistance of ruminal bacteria and its potential impact on human health."*FEMS Microbiol. Rev* 2003 .27: 65–74.

[53] K. Silverstein, "The appeal of animal waste.Energy"Biz Insider. 2007. 10 August. [[accessed 8 October 2007]]. Available: http://www.energycentral.com/centers/energybiz/ebi_detail.cfm?id=367.

[54] R.A. Smith, "Impact of disease on feedlot performance: a review". J Anim .Sci. 1998 ,76:272–274.[PubMed]

[55] H.Steinfeld, P. Gerber, T .Wassenaar, V .Castel,,M.Rosales and C.deHaan ,"Livestock's Long Shadow. Environmental Issues and Options." Rome: Food and Agriculture Organization 2006 of the United Nations.

[56] H. Steinfeld, O. Hann and H. Black Burn, "Livestock-Environment interactions, issues and options ".FAO . 2013, .of United Nations .Rome.

[57] A.B. Storck, ".More Farms Find Unlikely Power Source: Manure" [[accessed 24 October 2007]]. Available: http://www.meatingplace.com/MembersOnly/webNews/details.aspx?item=18539.

[58] B. Sutherly, "Ohio farms planning to use cows, chickens to generate energy."Dayton Daily News (Dayton, OH) 2007.22 June. [accessed 3 January 2008]. Available: http://www.daytondailynews.com/n/content/oh/story/news/local/2007/07/21/ddn072207farmenergy.html.

[59] P S.Thorne, "Environmental health impacts of concentrated animal feeding operations: anticipating hazards—searching for solutions". Environment Health Perspective. 2007, 115:296297. [PMCfreearticle] [PubMed].

[60] J.C.Topping, and Jr Summit, "Aftermath: Study by NASA and University Scientists Shows World Temperature Reaching a Level Not Seen in Thousands of Years and Raises Grave Concern of Irreparable" [61] Harm. 2007. [accessed 24 March 2008]. Available: http://www.climate.org/2002/programs/washington_summit_temperature_rise.shtml.

[62] USDA.U.S. 2004. Agriculture and Forestry Greenhouse Gas Inventory: 1990–2001. Washington, DC: U.S. Department of Agriculture.

[63] U.S. EPA 1998.Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–1996.Washington, DC: U.S. Environmental Protection Agency.

[64] U.S.EP.2003..National Pollutant Discharge Elimination System permit regulation and effluent limitation guidelines and standards for concentrated animal feeding operations (CAFOs); final rule. Fed Reg.; 68:7175–7274.

[65] U.S. EPA. 2006.Methane: sources and emissions [accessed 24 October 2007]]. Available: http://www.epa.gov/methane/sources.html.

[66] U.S. EPA. 2007a. Washington, DC: Environmental Protection Agency; Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005.

[67] U.S. EPA.2007b.Ruminant Livestock: Frequent Questions.. [[accessed 24 October 2007]. Available: http://www.epa.gov/methane/rlep/faq.html.

[68] U.S.EPA2007c.GovernmentAccomplishments in Support of the Methane to Markets Partnership. [accessed 24 March 2008]. Available: http://www.epa.gov/methanetomarkets/pdf/m2m_07_update_final.pdf.

[69] G.C.Wagharn and R. Hegarty,".Lowering ruminant methane emissions through improved feed conversion efficiency.".Anim. Feed Sci. Technol .2011,. 166–167: 291–301.

[70] WWF (World Wildlife Fund) 2007a Brazilian Savannahs.. [[accessed 24 October 2007]]. Available: http://www.panda.org/news_facts/education/best_place_species/current_top_10/brazilian_savannas_.cfm.

[71] WWF (World Wildlife Fund) 2007b.Facts about Soy Production and the Basel Criteria. [accessed 24 October2007]. Available: http://assets.panda.org/downloads/factsheet_soy_eng.pdf.

[72] W. Z. Yang, M. Oba, and T.A. McAlister, "Precision processing the food value of barley grain for feedlot cattle:"Pranic post bull breeders . Feb, 2012. A12-13.

[73] Z. Zhu, K. Minami, J. Galloway Nanjing, ".Declaration on Nitrogen Management, Presented to the United Nations Environment Programme". [Accessed24October2007].

AUTHOR'S PROFILE

Prof. Rama Prasad. Jwalapur

has worked in S V Veterinary University, at Tirupati, A.P. India, in different positions for more than 35 years and retired as professor and University Head of Animal Nutrition department. Under his chairman ship, 14 students accredited MVSc and 3 students doctoral degree. As principal investigator he completed 8 research projects, sponsored by various national and international organizations. He had an excellent academic record and conferred with honours like FNAVS (2002), best researcher (2005) ,best teacher (2006) and best Scientist(2007) by Government of Andhra Pradesh and Government of India. He travelled widely to Germany, USA, Thailand, Indonesia, Singapore and Malaysia to present research papers in scientific seminars. He has published more than 98 research papers in national and international reputed journals and serving as an editorial board member of reputed journals. At present he is working as professor, Animal Science, Ambo University, Ambo, Ethiopia for the last two years.

Suhas Sourie J.

is a research scholar in Suresh Gnan Vihar University, Rajasthan. for his doctoral degree as in-service student. Presently, working as senior reviewer, Apotex research centre Bengaluru, INDIA.