UNIT 3 LIVESTOCK

Structure

3.1 INTRODUCTION

The widely-cited report 'Livestock's Long Shadow' (FAO, 2006), estimates that 7,516 million metric tons per year of CO_2 equivalents (CO_2e), or 18 percent of annual worldwide GHG emissions, are attributable to cattle, buffalo, sheep, goats, camels, horses, pigs, and poultry. But globally for more than 1.2 billion people, livestock is a primary source of food contributing for their nutritional and livelihood security. For example, three per cent of the world's total emissions of greenhouse gases are generated by all the ruminant animals including domesticated in sub-Saharan Africa, but they support some 600 million poor livestock keepers. If we reduce ruminants on the pretext of generation of greenhouse gases, what, other than livestock keeping, would most Sub-Saharan African and South Asian farming households turn to in order to meet their needs for scarce protein, fertilizer, employment, income, traction, means of saving, and insurance against crop failure? Also several research studies confirmed that greenhouse gases and global warming are negatively affecting livestock in terms of feed intake, health, production, reproduction, etc.

Therefore, livestock both contributes to as well as affected by climate change. In the climate change debate, livestock have become a target and a simple way to reduce the world's greenhouse gas (GHG) emissions. However, we cannot ignore livestock contributions to global warming and climate change. Therefore, 1.2 billion small-scale livestock keepers globally need technological and policy support to produce the greater amounts of milk, meat and eggs needed to feed the world and to do so more efficiently with less environmental cost.

Keeping this in view, this unit discusses contribution of livestock to food, nutritional and livelihood securities as well as climate change and measures for mitigation of livestock's threat to the environment.

3.2 OBJECTIVES

After studying this unit, you should be able to:

- explain the livestock sector's contribution to global food, nutritional and livelihood securities;
- recognize the linkages between livestock and global warming;
- elucidate the contributions of livestock to generation of greenhouse gases; and
- discuss the measures for mitigation of livestock's threat to the environment.

3.3 IMPORTANCE OF LIVESTOCK SECTOR

3.3.1 Contribution to National Economy

India's livestock sector is one of the largest in the world with 56.7% of world's buffaloes, 12.5% cattle, 20.4% small ruminants, 2.4% camel, 1.4% equine, 1.5% pigs and 3.1% poultry. In terms of numbers, India had 512.05 million livestock and 729.2 million poultry in 2012 – an increase of 12.39% over the previous census in 2007 (Livestock Census, 2012). Livestock sector grew at an annual rate of 5.3% during 1980s, 3.9% during 1990s and 3.6% during 2000s. Despite deceleration, growth in livestock sector remained about 1.5 times more than crop sector which implies its critical role in cushioning agricultural growth. The overall contribution of the livestock sector to India's gross domestic product (GDP) is nearly 4.11%, which is about 21.58% of the Agricultural GDP (Planning Commission, 2012). This indicates that livestock sector is emerging as an engine of growth in the agricultural sector. This process has been referred to as the "Livestock Revolution" (Delgado, et al. 1999).

Factors contributing for Livestock Revolution and increase in demand for livestock products are:

a) Human population growth

b) Increasing urbanization

c) Rising incomes, purchasing power parity and associated changing food preferences from vegetarian to foods of animal origin, and

d) Boosting trade in both inputs and outputs due to globalization

While overconsumption of meat and other livestock foods is damaging the health of many people of the developed countries, under-consumption of these nourishing foods is hurting, and killing, many people of the developing and under developed countries.

Factors are now starting to contribute to slowing demand for livestock products, such as:

a) Growing concerns for health

b) Environmental and animal welfare issues

c) Increasing prices for feed grains, water, energy and labour and

d) Influence of climate change on extensive land-based livestock production systems

3.3.2 Livestock Production Systems in India

Livestock production systems in India can be broadly categorized as under:

a) Smallholder production – supporting millions of family livelihoods and household food security and contributing to rural food security; and

b) Commercial production – supporting the food supply system and providing employment to producers and others in associated processing, distribution, marketing and support services.

Under smallholders' production system, India has the largest number of families depending on livestock rearing to supplement family income and generates gainful employment in rural areas, particularly among the landless laborers, small and marginal farmers. Distribution of livestock is more equitable compared to that of land. Marginal farm households (< 1.0 hectare of land) who comprised 48% of the rural households control more than half of country's cattle and buffalo, two-thirds of small ruminants (goat, sheep) and pigs as well as poultry as against their share of 24% in land. Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. The growth in livestock sector is demand-driven, inclusive and pro-poor. Incidence of rural poverty is less in states like Punjab, Haryana, Jammu & Kashmir, Himachal Pradesh, Kerala, Gujarat, and Rajasthan where livestock accounts for a sizeable share of agricultural income as well as employment (Planning Commission, 2012). Research showed that livestock rearing has positive impact on equity in terms of income, employment and poverty reduction in rural areas (Rangnekar, 2014).

The commercial production system has gained momentum with livestock revolution associated factors. The observed pattern of growth in crossbred dairy cows, improved breeds of buffalo, sheep, pigs and poultry as revealed by latest Livestock Census (2012) indicates a shift towards economically more efficient species. In the case of bovines, the incremental growth is less in populations of males compared to females, mainly because animal draught power is being replaced with mechanical power and the emphasis was on milk production. In the case of poultry, broiler production has been more vibrant than layer production in terms of annual growth. This shows that the livestock sector of India is both expanding and adapting to emerging socio-economic and technological forces (Rao et al., 2015). Today, an estimated 80 percent of growth

in the livestock sector comes from industrial production systems. Owing to those shifts, livestock are entering into direct competition for scarce land, water and other natural resources with direct implications for livestock production systems vis-à-vis greenhouse gas emissions.

3.3.3 Benefits of Keeping Livestock

Livestock have been providing a range of benefits since before the dawn of agriculture. Indeed, most small-scale farming even today would be impossible without them. Livestock keeping helps in:

a) Sustaining small-scale farming

Example: Livestock manure fertilizes croplands; cattle and buffalo pull ploughs and transport farm produce to markets.

b) Providing subsidiary means of earning and saving an income

Example: People can sell milk, eggs, manure or surplus stock, or seek employment in livestock farming and business.

c) Nutritional security and feeding of hungry people

Example: Families can consume the milk, meat and eggs or sell these high-quality foods to buy cheaper cereal foods.

d) Protecting against the shocks common to the rural poor viz., drought, flood, disease that destroys food crops in the field, market distortions that make farm produce worthless and civil unrest that makes people flee their homes.

Example: When people are forced to move due to drought or internal conflicts, livestock play an important role because they are a mobile food asset.

Check Your Progress 1

Note: a) Use the space given below for your answers.
b) Check your answers with those given at the end of the unit

1. Write the contribution of livestock to National economy.

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2. Name the factors contributing for livestock revolution.

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3. Name the livestock production systems in India?

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4. What are the benefits of livestock keeping?

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3.4 LINKAGE BETWEEN LIVESTOCK AND GLOBAL WARMING

The major causes of global warming among others are:

a) Increase in greenhouse gases (GHGs)

b) Over exploitation of natural resources, and

c) Increase in atmospheric humidity

Increasing concentration of GHGs in the atmosphere is prominent among them, which is closely correlated with the rise in atmospheric temperature. Important GHGs are:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O), and
- Hydrofluorocarbons (HFCs).

While CO_2 represents 73.5% of the total GHGs, the CH_4, N_2O and HFCs represent 16.8%, 8.7% and 0.7% respectively. The major volume of carbon dioxide released in the atmosphere is caused by burning of fossil fuel. Methane emission takes place in the atmosphere through human related activities as well as through natural activities. Livestock is an important source of methane emission. Nitrous oxide is released from livestock (65% of the total, mostly from dung) and industries, and Hydrofluorocarbons is mostly released from chemical industries.

GHGs – Methane from Livestock

While increase in CO_2 concentration is a serious problem, release of methane is equally a major concern, as methane absorbs 23 times more heat than CO_2 and its concentration is steeply rising in the atmosphere. About 60% methane is emitted through human related activities such as fossil fuel production, enteric fermentation in ruminants, rice cultivation, biomass burning, manure and waste management. Methane is also naturally released due to biological activities in wet lands, permafrost, oceans, fresh water bodies and by termites and wild fire. Out of the total methane emitted, livestock contributes about 37% amounting to 80 million tons/annum.

Enteric Fermentation: When the feed reaches the rumen, it is converted into short chain fatty acids, microbial biomass and fermentative gases, mainly carbon dioxide and methane, through microbial degradation, known as enteric fermentation. The proportion of these components produced in rumen varies to a great extent, with the type of feed and microbes (Blummel, *et al* 2001). The variation in digested -outputs occurs due to the type of feed, level of intake, retention time in rumen and type of microbes present. On an average, each adult cow emits about 80-110 kg methane in a year.

Livestock	Country / Region	Methane emission rate (g/animal/day)
Cattle	Developed	150.7
	Developing	95.9
Sheep	Developed	21.9
	Developing	13.7
Buffalo		13.7
Goat		13.7

Source : Sejian *et al.,* 2010

The adverse impacts of livestock on environment are:

- Firstly, livestock demands huge fodder and feed. As there is a severe shortage of cultivated fodder and feed resources, farmers let their livestock for free grazing on community lands and forests. Such stray livestock not only denude vegetation but also accelerate soil erosion.
- Secondly, livestock, ruminants in particular, produce methane and carbon dioxide while digesting feed in their rumen. Livestock dung also releases methane and nitrous oxide during anaerobic decomposition.

It is estimated that livestock contributes 18% of the CO_2 equivalent to greenhouse gases, which is a serious concern. However, livestock being a major source of livelihood and food security for small and marginal farmers in most of the developing countries, it is necessary to find solutions to reduce their ill- effects on global warming and ensure sustainable future for poor farmers. With careful planning, it is possible to reduce the ill-effects of global warming at an affordable cost.

Activity 1: 'Livestock both contributes to as well as affected by climate change globally'. Discuss this statement with some of your colleagues. Compare their views with the one given in this unit and write the common features.

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Check Your Progress 2

Note: a) Use the space given below for your answers.
b) Check your answers with those given at the end of the unit.

1. Write the three major causes of global warming.

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2. Name the important greenhouse gases responsible for global warming.

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3. By what means livestock are emitting greenhouse gases.

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4. Write the two adverse impacts of livestock on environment.

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3.5 LIVESTOCK, ENVIRONMENT AND GLOBAL WARMING

Globally, the most pressing environmental problems associated with livestock are:

i. Greenhouse gas emissions and global warming

ii. Land degradation

iii. Air and water pollution, and

iv. Loss of biodiversity

3.5.1 Greenhouse Gas Emissions and Global Warming

Livestock and dairy operations emit greenhouse gases through the enteric fermentation, digestive processes of ruminants (primarily cattle and sheep) and through the decomposition of manure. Enteric fermentation refers to the microbial fermentation process that occurs in an animal's digestive system and produces methane as a byproduct.

By considering the entire commodity chain, FAO (2006) estimated that livestock contribute up to 18% of the global greenhouse gas emissions that are anthropogenic or generated by human activity. Livestock sector accounts for as much as:

a) 37 percent of anthropogenic methane (CH_4) - mostly from enteric fermentation by ruminants

b) 9 percent of anthropogenic carbon dioxide (CO_2) - most of it due to expansion of pastures and arable land for feed crops and uses of land that encourage the decomposition of organic substances.

c) 31 per cent of nitrous oxide (N_2O) - produced by spreading manure and slurry over lands

Livestock contribute to global warming by both directly (methane, for example, is produced in enteric fermentation / rumination processes of cud-chewing animals) and indirectly (such as the felling of forests to make room for fodder crops and ranching). The herding and farming families of developing countries, typically maintain their ruminant animals on poor-quality feeds that make conversion of feed to milk and meat inefficient and environmentally damaging—skinny ruminants on poor diets, while not competing with people for grain, produce much more methane per unit of livestock product than do well-fed cattle, sheep and goats.

3.5.2 Land Degradation (By Deforestation for Pasture & Feed Production)

The livestock sector is by far the single largest anthropogenic user of land. Grazing occupies 26 percent of the Earth's terrestrial surface, while feed crop production requires about 33 percent of all arable land. Expansion of grazing land for livestock is a key factor in deforestation, especially in Latin America: some 70 percent of previously forested land in the Amazon is used as pasture, and feed crops cover a large part of the reminder. About 70 percent of all grazing land in dry areas is considered degraded, mostly because of overgrazing, compaction and erosion attributable to livestock activity. Livestock sector accounts for 9 percent of anthropogenic carbon dioxide emissions, most of it due to expansion of pastures and arable land for feed crops.

3.5.3 Air and Water Pollution

Livestock also contribute to air and water pollution particularly in areas of high animal densities like factory farming of poultry and pig production systems. Livestock production also impacts heavily the world's water supply, accounting for more than 8 percent of global human water use, mainly for the irrigation of feed crops. Evidence suggests it is the largest sectoral source of water pollutants, principally animal wastes, antibiotics, hormones, chemicals from tanneries, fertilizers and pesticides used for feed crops, and sediments from eroded pastures. While global figures are unavailable, it is estimated that in the USA, livestock and feed crop agriculture are responsible for 37 percent of pesticide use, 50 percent of antibiotic use, and a third of the nitrogen and phosphorus loads in freshwater resources. The sector also generates almost two-thirds of anthropogenic ammonia, which contributes significantly to acid rain and acidification of ecosystems.

3.5.4 Biodiversity

The sheer quantity of animals being raised for human consumption also poses a threat to the global biodiversity. Livestock account for about 20 percent of the total terrestrial animal biomass, and the land area they now occupy was once habitat for wildlife. In 306 of the 825 terrestrial eco-regions identified by the Worldwide Fund for Nature, livestock are identified as "a current threat",

while 23 of Conservation International's 35 "global hotspots for biodiversity" - characterized by serious levels of habitat loss - are affected by livestock production.

Livestock production is one of the major causes of above four problems. However, environmental problems associated with livestock production have been largely ignored by policy-makers, often because of the large role that livestock play in sustaining livelihoods and rural life.

Measurement of Greenhouse Gases Contributed by Livestock

Scientists usually tie their estimates of the greenhouse gas emissions responsible for global warming to sources such as:·

Land use changes

- Agriculture (including livestock), and
- Transportation

The aggregate emissions throughout the livestock commodity chain includes

- **Feed production** - includes chemical fertilizer production, deforestation for pasture and feed crops, and pastures degradation.
- **Animal production** – includes methane emission from enteric fermentation and nitrous oxide emissions from manure.
- **Post production and transportation** – includes carbon dioxide emitted during processing and transportation of animal products.

3.6 IMPACT OF GLOBAL WARMING ON LIVESTOCK

Global warming and climate change, whether the result of anthropogenic activities or not, will impact the economic viability of livestock production systems. Changes in crop availability and quality due to global warming affect animal production through changes in feed supplies. Many environmental factors affect the rates and mechanisms of heat exchange between the animal and its surroundings. Animals are somewhat able to adapt to higher temperatures with prolonged exposure but production losses will occur in response to higher temperature events. The major impacts of increased ambient temperatures on livestock are:

- Depressed voluntary feed intake
- Reduced weight gains
- Reduced resistance to diseases
- Lower conception rates, and
- Lower milk, meat and egg production

Projected changes in climate, primarily manifested as increase in air temperature, will markedly reduce milk, meat and egg production levels globally. The impact may vary from increase in rearing time to market, longer feeding periods and production losses.

Quantification of potential impacts of global warming on livestock production allows producers to gain a better understanding of the magnitude of the changes in production levels faced under climate change. Projected economic losses resulting from temperature-induced reductions in production may justify mitigation of these temperature increases through changes in management practices.

Activity 2 : Visit a nearby dairy/poultry/piggery farm and enquire the neighbours about air and water pollution caused by them. Write down your observations.

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Check Your Progress 3

Note: a) Use the space given below for your answers.
b) Check your answers with those given at the end of the unit.

1. Name the most pressing environmental problems.

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2. How livestock is contributing to global warming?

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3. Write any three major impacts of increased ambient temperatures on livestock.

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3.7 MITIGATION OF LIVESTOCK'S THREAT TO THE ENVIRONMENT

A key risk factor for climate change is the growth of the human population, projected to be roughly 35 percent between 2006 and 2050. In the same period, the FAO projects that the population of livestock worldwide will double, so livestock-related GHG emissions would also approximately double. This would make the amount of livestock related emissions even more unacceptable than today's levels. The mitigation of livestock's threat to the environment will depend on how we resolve the balance of two demands:

a) For animal food products on one side, and

b) For environmental services on the other.

Since the resource base is finite, the expansion of the livestock sector to meet expanding demand must be accomplished while substantially reducing its environmental impact. While livestock production levels in developed countries are holding steady, livestock production systems in developing countries, particularly in the emerging economies, are rapidly changing to meet a rapidly growing demand for livestock foods due to those countries' growing populations, cities and incomes. Some of these fast-evolving livestock production systems are using ever-larger quantities of water and other natural resources and emitting ever-larger amounts of greenhouse gases, which are causing global warming.

3.7.1 Ways to Reduce GHGs Emitted by Livestock

1. ***Reduce consumption of, and demand for, livestock foods in developed countries:***

   Under-consumption of livestock foods is a main problem in developing countries (Southern part of globe), over-consumption of livestock foods—including fatty red meat, eggs and full-fat milk and dairy products—damages the health of many people living in developed countries (Northern part of globe). The demand for cheap livestock foods in rich countries in many cases is met by imports of livestock products or feed grains from the developing world, the transport and supplies of both of which can lead to environmentally damaging land-use practices and over-use of water and other natural resources, which in turn increase the levels of greenhouse gas emissions in those developing countries. Reducing the relatively high levels of consumption of livestock foods in the developed world would thus not only help improve the health of many people in rich countries but also reduce environmentally damaging livestock production practices in both rich and poor countries, leading to significant reductions in the emissions of CO_2, N_2O and CH_4.

   Example: Beef raised on the pampas of Argentina and shipped to the North America might, for example, have generated lower levels of greenhouse gases than corn-fed beef raised, slaughtered and packaged right there in North America.

2. ***Improve the diets of ruminants in developing countries:***

   Providing livestock in developing countries with better quality diets increases their feed-conversion efficiencies and thus reduces the amount of methane generated in the production of a unit of meat or milk.

Examples:

a. Farmers can improve the diets of livestock by better managing their grazing lands: they can rotate the pastures they use, plant improved species of pasture grasses, make strategic applications of animal manure, and develop fodder banks/community fodder farms with legumes and other forages. They can make use of more strategic combinations of available feed resources.

b. Farmers can supplement the poor grass diets of their animals with the grain crop residues after harvesting. Research outputs on improving the nutritive quality of crop residues need to be communicated to farmers.

c. Farmers can supplement feed additives that manipulate the microorganisms living in the rumen to quicken enteric microbial fermentation and mitigate greenhouse gases emission.

d. Suitable policy environments to implement research results cost-effectively.

3. ***Help farmers in developing countries obtain and maintain higher-yielding breeds:***

Where resources allow and breeding services exist, replacing low-producing local animals of the developing world with fewer and better fed animals of higher yielding breeds would reduce total emissions while maintaining or increasing livestock yields. Such shifts include keeping more productive types of a given breed, such as by crossing local cows with genetically improved dairy cow breeds to produce cross-bred cows that possess traits both for hardiness and higher milk yields.

4. ***Better match livestock species to environments in all countries:***

Switching species to find those better suited to particular environments and resources could raise animal productivity levels. In some circumstances, exchanging ruminant animals for pigs, chickens and other monogastrics (which possess single- rather than four-chambered stomachs) could reduce total methane emissions, although high amounts of grain used to feed the monogastrics can offset the methane saved. For this reason, alternative feeds and feeding practices for monogastrics urgently need the attention of the research and development communities.

5. ***Impose regulatory frameworks for managing manure in all countries:***

Regulatory frameworks could reduce nitrous oxide emissions from manures, particularly by enforcing better management of excreta in the larger livestock operations in developing countries and applications of slurry and manure in the developed countries. Furthermore, developing ways to monitor and verify reductions would open the door to mitigation payment schemes.

6. ***Apply land-use policies that forestall cultivation of new lands:***

Some carbon lost from agricultural ecosystems in the past can be recovered. Any management practice that increases the photosynthetic input of carbon and/or slows the return of stored carbon to carbon dioxide via respiration, fire or erosion will increase carbon reserves, thereby sequestering carbon.

We can thus reduce carbon dioxide emissions by applying land-use policies that forestall the cultivation of new lands now under forest, grassland or non-agricultural vegetation.

Rangeland and silvo-pastoral livestock systems would store much greater amounts of soil carbon than they do now if we put in place land use and livestock policies and practices suited to local conditions. Such interventions could serve not only to sequester more carbon but also to provide smallholders farmers and herders with payments for the services their local ecosystems provide the wider community.

7. ***Provide incentives to adopt mitigation strategies, particularly for poor communities:***

Finally, successful implementation of livestock mitigation strategies, particularly in poor countries with scarce resources, inadequate rural and peri-urban infrastructure, and inappropriate agricultural policies, will demand a series of smart and equitable incentive systems that encourage people to adopt mitigation strategies and practices. Success in these countries will also depend on developing new kinds of links among institutions that have not formerly worked together, on reforming livestock and agricultural policies, on inventing techniques for monitoring carbon stocks, and on developing appropriate and easy-to-use protocols for verifying greenhouse gas emissions.

The FAO recommends the following specific measures on the most pressing environmental problems:

- **Greenhouse gas emissions:** Sustainable intensification of livestock and feed crop production to reduce carbon dioxide emissions from deforestation and pasture degradation, improved animal nutrition and manure management to cut methane and nitrogen emissions.
- **Land degradation:** Restore damaged land through soil conservation, silvi-pastoralism, better management of grazing systems and protection of sensitive areas.
- **Water pollution**: Better management of animal waste in industrial production units, better diets to improve nutrient absorption, improved manure management and better use of processed manure on croplands.
- **Biodiversity loss:** As well as implementing the measures above, improve protection of wild areas, maintain connectivity among protected areas, and integrate livestock production and producers into landscape management.

(**Source:** FAO, 2006)

Check Your Progress 4

Note: a) Use the space given below for your answers.
b) Check your answers with those given at the end of the unit.

1. Name the two issues we need to keep in mind while mitigation of livestock's threat to the environment?

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2. Name any four ways of reducing GHGs emitted by livestock?

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3.8 CLIMATE CHANGE AND LIVESTOCK SECTOR: CASE OF INDIA

The interventions discussed above at global level more or less also apply to India's livestock sector. The following are specific interventions suggested to reduce GHGs emission in India (Hegde, 2010).

a) Balanced Feeding:

Efficiency of microbes has a significant impact on production of various products, particularly gases. While the short chain fatty acids provide 70-85% of energy requirement, microbial biomass provide 70-100% amino acid requirements of ruminants. With proper feed selection, supplementation and balancing of various ingredients, it is possible to maximize feed conversion into microbial biomass and short chain amino acids, while reducing gases. With high protein diet, formation of gases can be reduced significantly, while high fiber content in diet can increase the production of gases.

Improve the diets of Livestock

Methane emission by livestock means some 8-10 % loss of energy to the animal – any steps taken to reduce enteric methane emission will improve animal production and condition. Improving the feed and fodder reduce the enteric methane emission. Depending on different species of microbes, nutrients and other chemical substances present in the feed, the degree of fermentation will vary and the volume of gases released will also change. Thus, there is scope for reducing the production of gases by proper manipulation of these factors.

b) Improving Feed Quality:

In India, a majority of the livestock are low productive. They are under-nourished and surviving on open grazing or on poor quality, high fiber roughages. These animals release more methane than high yielding animals, who consume better quality feed. To reduce the ill-effects of poor quality feed, breaking of lignin in roughages before feeding to livestock through various methods should be explored. Steam treatment of sugarcane bagasse and urea - molasses treatment of paddy straw are some good examples. Conversion of high fibre grasses into silage may be easy and beneficial. Even simple chopping of fodder before feeding livestock can reduce methane production.

c) Improved Health Status:

Animals suffering from diseases also release higher volume of methane compared to healthy animals. As most of the farmers are unaware of the

threat posed by their livestock to global warming, no efforts are being made either to reduce the herd size or to control methane emission. These animals further demand fodder, feed and water, thereby creating pressure on the natural resources which are already scarce. Therefore, regular preventive and timely curative veterinary health care will help to reduce the emission of greenhouse gases.

d) Efficiency of Microbes:

It is presumed that there are a wide range of microbes involved in degeneration of biomass. The efficiency of different species and strains is likely to vary widely. Thus, there is scope to identify different species and their strains of micro-organisms present in rumen which are efficient converters of feed into amino acids and microbial biomass. Such microbes even found outside rumen, can be introduced in rumen to improve digestion in ruminants.

Example: Similar effort was successfully made in the past to solve the problem of mimosine toxicity in Australia. Leucaena fodder when fed to cattle in Australia, showed toxicity, but cattle and goats in Indonesia and India did not show any toxicity after consuming Leuceana foliage. After close follow up, an anaerobic bacteria was isolated from goat rumen in Indonesia, which was capable of breaking DHP (3, 4- Dihydroxy-pyridone) into harmless compounds. In the absence of such anaerobic bacteria, ruminants browsing on Leucaena foliage containing mimosine, suffered from goitrogen. With the introduction of this bacteria named as *Synergistes jonesii* in rumen, mimosine toxicity is no longer a problem in Australia and other countries (Jones and Lowry, 1984).

e) Methane absorbing Microbes:

There are also microbes which have the capacity to absorb methane and convert it into other products. Such selected anaerobic micro-organisms capable of feeding on methane, can also be incorporated in rumen flora for reducing the emission of methane while improving the productivity and profitability of livestock husbandry.

f) Methane Traps:

Most of the low productive livestock generally go out for grazing during the day and return to the shed in the evening. They release significant volume of methane and carbon dioxide during the night when housed in cattle shed. Trapping these gases from the barn by fixing efficient filters, is probably possible by using modern technologies.

g) Dung Management:

Animal dung and urine also release methane and nitrous oxide. Methane is generally released through anaerobic decomposition, when dung is heaped as manure for a longer period. In countries like India, farmers have been following the practice of dumping dung in manure pit for 3-6 months for better decomposition, thus contributing substantially to emission of methane. Better management of farm yard manure and compost pits can also reduce emission of methane into the atmosphere to a great extent. Use of dung for production of biogas is the best option to convert

this threat into an opportunity. As the present models of biogas plants are not user friendly and are inconvenient to manage in congested residential areas, new compact models are essential to popularize this technology.

h) Control of Livestock Population:

Control of livestock population is an important measure, not only to reduce the volume of GHGs but also to meet the growing shortage of feeds. With population control, there can be a significant reduction in pressure on natural resources such as land, water and forests. Presently, except about 15-20% of the total livestock population, the remaining is not making significant contribution to rural economy. Among cattle, except about 5% population of indigenous milch breeds, the rest are either genetically eroded or represent native draught breeds whose milk production is less than 500 kg/per lactation. With small holdings, most of the small and marginal farmers representing over 75% of rural families are not interested in maintaining bullock power for carrying out farming operations. Large farmers on the contrary prefer mechanized farming. Hence, utility of males, particularly of draught breeds is posing a big question. Thus, it is necessary to revisit the present livestock conservation and breeding policies.

i) Breed Improvement:

Breed improvement is another important step to reduce methane emission. Generally, high productive animals are fed with superior quality balanced ration, then methane production is also reduced. Therefore, livestock breed improvement can be promoted to produce high quality progeny which are stall-fed and nurtured well. Subsequently, farmers will also realize the need for reducing the herd size. Economic and technical feasibility of using sexed semen under dairy development programme should also be studied as this strategy would control unwanted male population in the future and enable farmers to have only female calves, for expanding their dairy husbandry.

j) Selection and Culling:

Rigorous and periodic selection of superior animals and culling inferior animals is essential to control the herd size. In this process, farmers can get rid of poor quality animals. However, culling of unwanted cattle is not very easy as there are no takers for such poor quality animals and most of the farmers do not wish to sell their cattle to butchers. So, there is a need for an intervention from the Government and Non-Government Organizations to facilitate the procurement of such culled animals and maintain them till their natural death. Common facilities for housing sick animals are also needed as unproductive sick animals are generally not well looked after by their owners and these animals release more GHGs than normal animals.

k) Production of Superior Quality Forage:

Most of the common properties earmarked for community pastures are heavily denuded and devoid of vegetation. Development of community pastures through soil and water conservation, introduction of fodder herbs, shrubs and trees and protection from stray grazing, will not only enhance

the supply of superior quality fodder but also improve the ground water table and micro-climate. Early harvesting of fodder can reduce fibre content in feed and thus improve the nutritive value. This needs to be further studied and best practices for pasture management should be established. Through efficient roof water harvesting, watershed development, contour cultivation and tree-based farming, it is possible to conserve additional quantity of water and recharge the ground water for overcoming water shortage in the future, while enhancing fodder production. There is also scope for improving the quality of crop residues through early harvesting and breeding of low fibre stover varieties. Feeding of such fodder can further reduce methane production. More research is needed to tap this potential.

Research and Development for reducing Methane Production

There is need for further research and technology development to reduce methane and other GHG production through livestock in the following areas:

- Balanced feeding with low fiber diet
- Supplementation of various minerals and nutrients which can reduce gas production during enteric fermentation and utilize gas to convert it into useful nutrients.
- Selection of rumen microbes having higher efficiency in converting feed into nutrients
- Chemical, physical and microbial treatment of high fibre fodder to break lignin/fibre before feeding ruminants.
- Introduction of methane absorbing microbes in digestive system.
- Development of compact models of biogas plants for efficient use of dung and urine for production of biogas.
- Scope for collection of methane from cattle sheds may be explored.
- Breeding of food-cum-fodder crops with low fiber stover should be encouraged.

Activity 3: Discuss with your colleagues on specific interventions to reduce GHGs emission in India related to livestock. Compare their views with those given in this section and write your observations.

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Check Your Progress 5

Note: a) Use the space given below for your answers.
b) Check your answers with those given at the end of the unit.

1. Name the environmental consequences of India's livestock sector.

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2. How the balanced feeding mitigate GHGs emitted by livestock?

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3. How the control of livestock population mitigate GHGs emitted?

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3.9 LET US SUM UP

In this unit, we started by looking at the importance of livestock sector to national economy and we discussed the livestock sector's contribution to food, nutritional and livelihood securities. Later, we examined the linkages between livestock and global warming and understood that livestock is an important source of methane and nitrous oxide emissions. Subsequently, we discussed in detail the effects of livestock on the environment in terms of: greenhouse gas emissions and global warming; land degradation; air and water pollution, and; loss of biodiversity. We also conversed the impacts of global warming on the livestock production and discussed the measures to mitigate the emission of GHGs from livestock with global and Indian perspective.

3.10 KEYWORDS

Domesticated Livestock Species : The major livestock species domesticated are - cattle, buffalo, sheep, goat, pigs and chickens. The minor species are - yaks, mithun, horses, asses, camels, ducks, geese and turkeys

Livestock Revolution : Globally, livestock production is growing faster than any other agricultural sub-sector (with the exception of aquaculture) and it is predicted that by 2020, livestock will produce more than half of the total global agricultural output in value terms. This process has been referred to as livestock revolution.

Enteric Fermentation : When the feed reaches the rumen in livestock, it is converted into short chain fatty acids, microbial biomass and fermentative gases, mainly carbon dioxide and methane, through microbial degradation, known as enteric fermentation.

3.11 SUGGESTED FURTHER READING/ REFERENCES

Blummel, M., Krishna, N. and Orskov, E.R. 2001. Supplementation strategies for optimizing ruminal carbon and nitrogen utlisation: Concepts and approaches. Proceedings of the 10th Animal Nutrition Conference: Karnal, India. Review Papers, November 9-11: 10-23.

Chaco, C.T., Gopikrishna, Padmakumar, Tiwari, S. and Ramesh, V. 2010. India: Growth, Efficiency Gains and Social Concerns. In Gerber et al., Eds, Livestock in a Changing Landscape: Experiences and Regional Perspectives (Volume 2), Island Press.

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. and Courbois, C. 1999. Livestock to 2020: The next food revolution. IFPRI Food Agriculture and the Environment Discussion Paper 28. International Food Policy Research Institute, Washington, DC.

FAO. 2006. Livestock Long Shadow: Environmental Issues and Options. Food and Agricultural Organization of the United Nations, Rome, Italy, 390 pp.

Hegde, N.G. 2010. Mitigating Global Warming while providing Sustainable Livelihood through Integrated Farming Systems: Experiences of BAIF. International Conference on Global Warming: Agriculture, Sustainable Development and Public Leadership. Ahmedabad, India. Mar 11-13: 16 pp.

Hegde, N.G. 2010. Scope for Reducing Ill-Effects of Livestock Husbandry on Global Warming

ILRI (International Livestock Research Institute). 2006. Safeguarding Livestock Diversity: The Time is Now, Annual Report, ILRI, Nairobi, Kenya.

ILRI (International Livestock Research Institute). 2009. ILRI Corporate Report 2008-09, Climate, Livestock and Poverty: Challenges at the Interface, ILRI, Nairobi, Kenya.

Jones, R.J. and Lowry, J.B. 1984. Australian goats detoxify the goitrogen 3, 4- Dihydroxy-pyridone (DHP) after rumen infusion from an Indonesian goat. Experientia, 40: 1435- 1436.

Livestock Census. 2012. Nineteenth livestock census report. New Delhi, India: Ministry of Agriculture, Department of Animal Husbandry and Dairying.

Planning Commission. 2012. Report of the Working Group on Animal Husbandry and Dairying for the 12thFive Year Plan. New Delhi, India: Planning Commission.

Rangnekar, D.V. 2014. In quest of sustainable and holistic livestock development for the benefit of resource poor rural families. Proc. National Seminar on 'New Dimensional Approaches Livestock Productivity and Profitability enhancement under era of Climate Change'. 28-30 Jan. 2014. Organized by Indian Society

of Animal Production and Management at College of Veterinary Sciences and Animal Husbandry, Annand, Gujarat. Pp. 18-27.

Rao, S.V.N., Rasheed Sulaiman V., Natchimuthu K., Ramkuamr S., and Sasidhar P.V.K. 2015. Improving the delivery of veterinary services in India. Scientific and Technical Review of OIE, 34(3), 767-777.

Sejian, V., R. Lal, J. Lakritz and T. Ezeji. 2010. Measurement and prediction of enteric methane emission. *International Journal of Bio meteorology*: 1-16

3.12 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1. The overall contribution of the livestock sector to India's gross domestic product (GDP) is nearly 4.11%, which is about 21.58% of the Agricultural GDP.
2. The factors contributing for livestock revolution are: human population growth; increasing urbanization; rising incomes, purchasing power parity and changing food preferences from vegetarian to foods of animal origin.
3. Smallholder production and commercial production are the two major systems.
4. Benefits of livestock keeping are subsidiary means of earning, nutritional security and feeding of hungry people; protect against the shocks common to the rural poor viz., drought, flood, disease that destroys food crops.

Check Your Progress 2

1. The three major causes of global warming are: increase in GHGs, over-exploitation of natural resources, and increase in atmospheric humidity.
2. Important GHGs are carbon dioxide, methane, nitrous oxide and hydrofluorocarbons.
3. Out of the total methane emitted, livestock contributes about 37% amounting to 80 million tons/annum. On an average, each adult cow emits about 80-110 kg methane in a year.
4. The adverse impacts of livestock on environment are livestock demands huge fodder and feed, denuding vegetation and soil erosion due to grazing, methane and carbon dioxide production releases of methane and nitrous oxide during anaerobic decomposition of dung.

Check Your Progress 3

1. Globally, the most pressing environmental problems are: greenhouse gas emissions and global warming; land degradation; air and water pollution, and loss of biodiversity.
2. Livestock contribute up to 18% of the global GHGs emissions that are 'anthropogenic', or generated by human activity.
3. The major impacts of increased ambient temperatures on livestock are: depressed voluntary feed intake; reduced weight gains; reduced resistance

to diseases; lower conception rates, and lower milk, meat and egg production

Check Your Progress 4

1. The two issues are: animal food products on one side, and (b) environmental services on the other.

2. The ways of reducing GHGs emitted by livestock are: reduce consumption of, and demand for, livestock foods in developed countries; improve the diets of ruminants in developing countries etc.

Check Your Progress 5

1. The environmental consequences of India's livestock sector include: increasing grazing pressure in arid, semiarid and dry lands; involution of mixed farming in high input intensive areas; industrial poultry, dairy and piggery production units and; greenhouse gas production.

2. Efficiency of microbes has a significant impact on production of various products, particularly gases. With proper feed selection, supplementation and balancing of various ingredients, it is possible to maximize feed conversion into microbial biomass and short chain amino acids, while reducing gases.

3. Control of livestock population is an important measure, not only to reduce the volume of GHGs but also to meet the growing shortage of feeds. With population control, there can be a significant reduction in pressure on natural resources such as land, water and forests.