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MEVE-003
Agricultural and Allied Sector

LIVESTOCK AND AQUACULTURE POLLUTION

2

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MEVE-003
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Block

2

LIVESTOCK AND AQUACULTURE POLLUTION

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BLOCK 2 INTRODUCTION

Block 2 deals with the Livestock and Aquaculture Pollution. Livestock and aquaculture are important sources for most of the rural population. It contributes immensely to the food security of the country by providing various highly nutritious products like milk, meat, egg, fish and sea food. The block discusses both advantages and disadvantages of these sectors. The environmental pollution and health impacts have also been detailed in this block.

Unit 1 deals with Livestock and Pollution. It explains that livestock farming generates greenhouse gases such as carbon-dioxide, methane, nitrous oxide etc. which threaten both the environment and human health. Livestock, especially the ruminants, are the largest sources of methane emitters in the world. The unit also details that the livestock sector contributes significantly to the many environmental problems like deforestation, land degradation, air, soil and water pollution, loss of biodiversity, and ultimately to global warming.

Unit 2 deals with Aquaculture and Pollution. It explains that aquaculture is the cultivation of fishes crustaceans, algae, and molluscs. The sector involves the farming of marine fish, including finfish, shellfish, oysters and so on that are used for food production, in jewellery as cultures pearls and in cosmetics. The unit also focuses on the pollution caused by aquaculture practices and their impacts on environment and human health.

Unit 3 deals with the Livestock and Aquaculture Management Practices. The unit focuses on the farm siting and construction, feed practices in aquaculture, monitoring the nutrient balance, water utilization, solid manure handling and liquid manure handling, composting and anaerobic lagoon system, effluent storage, biogas disposal, manure separation and storage practices.

UNIT 1 LIVESTOCK AND POLLUTION

Structure

1.0 INTRODUCTION

When you go around the villages, you might have seen that most of the households rear one or the other livestock. Can you guess what might be the reason behind this? Yes. Livestock is one of the important sources of income, employment, energy/transport and nutrition leading to nutritional and livelihood security to the rural masses. Livestock sector has immense contribution to the food security of the country by providing various highly nutritious products like milk, meat, egg etc. Since time immemorial, livestock rearing is a vital part of Indian agriculture helping in socio-economic development of more than two-thirds of the rural population in India. Livestock rearing is the lifeline for most of the farming community in the country and has both advantages and disadvantages. Can you enlist the different advantages of rearing livestock? The advantages are source of income, employment generation, supply of nutritious food and also acts as an easy source of mobile cash (also known as bank on hooves) especially at difficult times. Since, the activities are not dependent on season or rain as in the case of agriculture, farm animals/birds can be reared throughout the year. Livestock farming, particularly dairy farming (Fig. 1.1), also contributes significantly to enriching the soil with vital nutrients like NPK (Nitrogen-Phosphorus-Potash) from farm yard manure which are essential for the agriculture operations. At the same time, the livestock sector contributes significantly to several environmental problems like land degradation, air and water pollution, water shortage, loss of biodiversity, and ultimately to global warming. This unit will throw light on the contributions of

Livestock in Green House Gases Emission and its effects on environment and human health.

Fig.1.1: Dairy Farming

1.1 OBJECTIVES

After studying this unit, you will be able to:

- Justify the role of livestock industry in livelihood security of farming community;
- Relate livestock population and the quantity of wastes generated from farm animals;
- Explain the role of livestock in greenhouse gas emission; and
- Describe the effects of livestock rearing on environment and human health

1.2 INDIAN LIVESTOCK INDUSTRY

Livestock sector includes animal husbandry, dairying and fisheries. Livestock industry is one of the fastest growing sectors of the agricultural economy and the share of Gross Value Added of livestock sector in terms of Agriculture (Crops & Livestock) is about 28.5% at Current prices and about 4% to the national economy during 2015-16. According to NSS 68th Round (July 2011-June 2012) survey on Employment and Unemployment, 16.44 million workers were engaged in farming of animals, mixed farming, fishing and aquaculture (DADF, 2017). Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. Livestock provides livelihood to two-third of rural community. It also provides employment to about 8.8 % of the population in India.

India is rich in livestock resources (Fig. 1.2) and the indigenous/desi breeds of different species of livestock are acclimatized to the local environmental conditions. Though their productivity is low, they are hardy and resistant to diseases. According to 19th Livestock Census (2012), India possess 190.9 million cattle, 105.3 million buffaloes, 65.07 million sheep, 135.2 million goat, 10.3 million pigs and 1.48 million other livestock species (DADF, 2014).

Cattle

Buffalo

Sheep

Goat

Pig

Chicken (Poultry)

Fig. 1.2: Livestock Resources in India

According to DADF (2017) the production statistics are presented below:

- **Milk:** It is one of the essential food items of human beings which provide sufficient nutritional supplements especially to the children and elder people. India has firmly established itself as the largest producer of milk in the world. The milk production and per capita availability of milk during 2015-16 is 155.5 million metric tonnes and 337 gm per day, respectively. About 49% of milk production is contributed by Buffaloes followed by 27%, 21% and 3% from Cow Exotic/Crossbred, Cow Indigenous/Non-Descript and Goats, respectively.
- **Egg:** It is one of the nutritious foods and a rich source of animal protein. The total egg production in the country was 82.93 billion numbers (8293 crores) and the per capita availability was 66 eggs per annum during 2015-16. About 82.99% of the egg production is contributed by Improved Fowl and 14.40% is from Desi Fowls. The Desi Duck and Improved Duck contributed 2.46% and 0.14%, respectively with respect to total egg production.
- **Meat:** The total meat production in the country was reported as 7.0 million tonnes (70 lakhs) during the year 2015-16. Poultry is the largest contributor of meat in the country (46%) followed by Buffalo (23%) and Goat (13%). The largest producer of meat is Uttar Pradesh which produces 19.59 % of the total meat production in the country followed by Andhra Pradesh including Telangana (14.99%) and West Bengal (10.41%).

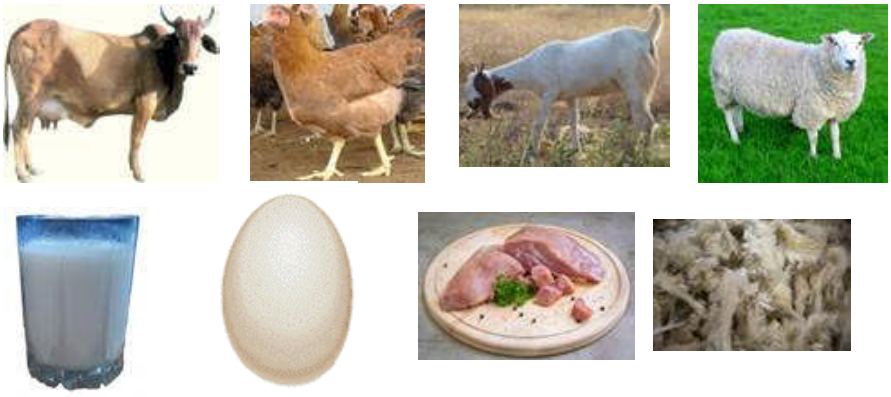

Fig. 1.3: Animal Based Products

- **Wool:** The total wool production in the country was at 27.5 million kg during 1950-51 and has shown a growing trend over the years. Currently, our country produces about 43.6 million kg (436 lakhs) during 2015-16. Nearly two-third (72%) of the wool production comes from Ram/Weather (Male Sheep/Goat) followed by Ewe and Lamb contributing only 24% and 4%, respectively. Rajasthan is the largest producer of wool in the country followed by Jammu & Kashmir and Karnataka.

Note: The livestock census is conducted by Department of Animal Husbandry Dairying & Fisheries (DADF), Ministry of Agriculture and Farmer's Welfare, Govt. of India every five years (Quinquennial). The Basic Animal Husbandry Statistics and the Annual Reports are released by DADF every year. Therefore, for latest data on livestock and production statistics, kindly visit DADF website (http://dahd.nic.in/).

Check Your Progress 1

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) India is rich in livestock resources – Justify the statement.

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2) _____ is the largest contributor of meat in the country.

3) Two-third of the milk production in India comes from Buffaloes. TRUE/FALSE

4) Livestock census is conducted by Department of Animal Husbandry Dairying & Fisheries (DADF), Ministry of Agriculture and Farmer's Welfare, Govt. of India every ____ years.

1.3 FARM ANIMAL WASTE

Every enterprise generates wastes. Similarly, dairy/livestock farm also generates different type of wastes. Can you classify the different types of waste we get from a dairy farm? The dairy/livestock farm waste can be classified into two - organic waste and inorganic waste. As the name suggests, the organic wastes include dung/faeces, urine of animals, droppings of poultry birds, leftover feed/

fodder, Wash water from cleaning of sheds and animals etc. While, the inorganic wastes include plastic bags, chemicals etc. However, in this section, we will focus mainly on the organic wastes with major emphasis on dung and urine. You might think that urine and dung are waste products of livestock. But, actually they are not waste, if utilized properly. Though we call the dung/urine as waste, they are highly nutrient-rich products obtained from the animals/ birds which can be directly used as manure or can be converted into compost/ vermicompost and used in agricultural fields.

1.3.1 Characteristics and Composition of Animal Wastes

Do you know what the beneficial characteristics of animal waste are? Animal waste is a rich source of many valuable nutrients which when recycled properly, can be efficiently used as fertilizer for crops/fodder production as well as to produce energy (biogas). Manure generated from animal waste is organic in nature and is rich in main nutrients required for soil health *viz.* Nitrogen (N), Phosphorus (P) and Potassium (K). In addition to providing essential nutrients for crop growth, manure has several other beneficial effects on soil properties. When the organic animal wastes are applied to the soil, the bulk density of the soil decreases as a result of increase in both the organic fraction of the soil and the stability of aggregates. Organic wastes like dung/faeces and urine also improves water filtration rate, water holding capacity and the hydraulic conductivity of the soil. All these properties of animal waste can be efficiently utilized only if they are properly recycled and managed. In turn, they might cause detrimental effects on the environment if not handled effectively and efficiently.

Can you guess how much animal waste is generated from different livestock species? It is estimated that the amount of dung/animal waste produced by different species of livestock are 4.5 kg/day from swine (liquid manure) and 45-50 kg/day from dairy cow (liquid).

However, the solid portion amounts to only 13-15% of the total volume. Normally, solid manure remains solid with less moisture. However, due to poor drainage, high humidity, rainwater entering the sheds and urine from animals, they may become semi-solid. The quantity and nature of animal waste also depend upon the species and age of the animals as well as the type of bedding material and feed. If you further look into the composition of animal waste, the Nitrogen: Phosphorus (N:P) ratio is different for different types of manure. It is 2:1 in case of cow whereas, it is reverse in case of poultry (1:2). In Pigs (swine), it is 1.5:1. The composition of cow dung (solid) is given in Table 1.1:

Table 1.1: Composition of solid cow dung

Parameters	Composition (in per cent)
Moisture	77.00
Organic Matter	20.00
Nitrogen	0.32
Phosphorus	0.14
Potassium	0.30
Calcium	0.40

1.3.2 Production, Collection and Management of Animal Wastes

Can anyone guess the value of cattle dung? The value of cattle dung is very high as it can be utilized as manure/fertilizer as well as production of cooking gas. You will be surprised to know that even an old bullock gives 5 tonnes of dung and 1,500 kg of urine in a year, which can help in the manufacture of 20 cart-loads of compost manure. For cultivation of cereal crops like sorghum and jowar on dry land, 5 carts of compost manure is required for each acre. Thus, the compost manure provided by one single old bullock can meet the manure need for 4 acres of land.

Do you know how we calculate the quantity of animal waste produced? Generally, it is calculated based on a measure called "animal unit." One animal unit is equivalent to 1,000 pounds i.e. 454 kg of the live weight of an animal. So what will be the animal unit of 4 dairy cows weighing 500 kg each? Right, it will be 4.4 animal units (500*4/454). Similarly, about 300 broiler chicken weighing 1.5 kg will be equivalent to one animal unit of chicken. It is estimated that one animal unit of broiler (meat) chicken produces an average of 14.97 tonnes of manure each year, whereas, one animal unit of dairy cows produces about 15.24 tonnes of manure per year.

Have you ever observed how the farm animal wastes are collected and managed? In our country, animal wastes (especially dung and urine) are usually collected manually (Fig. 1.4) in two ways. One is by collecting the dung and urine separately and the other method is by flushing dung and urine together. However, collection of solid waste and liquid waste separately is more helpful in efficient treatment and disposal of farm waste. It is a common practice in villages or small farms where the animal waste collected are dumped into heaps adjacent to the sheds. The heaps slowly get converted into farm yard manure which is subsequently used in the agricultural fields. Whereas, in commercial dairy farms, solid wastes (dung, leftover feed etc.) are usually collected and removed twice daily with the help of spade with long handle. The waste is scraped, collected and loaded into wheelbarrows, cart or trolley and transported to the manure pit. The liquid waste (urine and other wash waters) are collected through the drainage system.

Fig. 1.4: Dung collection

Fig. 1.5. Biogas plant

Fig. 1.6: Vermicompost

Now, next question which comes to our mind is how these animal wastes are managed or recycled? In India, farm animal wastes are managed or recycled in three ways. They are converted into farm yard manure (FYM) and used as organic fertilizer. In villages, the dung is converted into small cakes and used as fuel for cooking. The more recent methods being adopted by farmers and

commercial dairy/livestock farms include establishment of biogas plant and composting/vermicomposting units which is gradually getting popular. In biogas plant (Fig. 1.5), the animal wastes are digested under anaerobic (lack of oxygen) condition leading to production of methane gas which is used for cooking and the leftover slurry is used as farm manure. Whereas, in vermicomposting, the animal waste are digested using earthworms leading to production of nutrient-rich "vermicast/vermicompost" (Fig. 1.6).

Check Your Progress 2

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) What are the different types of wastes generated from livestock/dairy farm?

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2) How manure can be helpful in restoring the soil health?

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3) One animal unit is equivalent to _____ pounds or _____kg.

4) How the solid and liquid wastes are collected in a commercial dairy farm?

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5) In vermicomposting, the animal wastes are digested under anaerobic (lack of oxygen) condition leading to production of methane gas. TRUE/FALSE

1.4 LIVESTOCK AND GREEN HOUSE GASES EMISSION

Can you define green house gases? Green House Gases (GHGs) are group of gases present in the air which traps, absorbs and emits heat (radiation) in the atmosphere keeping the earth's surface warmer than it would be if they were not present. They include Water-vapour (H_2O), Carbon-dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Ozone (O_3) and Fluorinated gases like Chlorofluorocarbons (CFCs), Hydrofluorocarbons, Sulfur-hexafluoride etc. Under normal circumstances, the major proportions of the gases present in the atmosphere/air i.e. Nitrogen (N), Oxygen (O_2), Argon (Ar) etc. which constitutes about 96-99% of the atmosphere does not absorb or emit infrared radiation. Whereas, the remaining constituents of the air (1-4%) like the water-vapour, carbon-dioxide (CO_2) along with some other trace gases (about 0.05%) are responsible for the atmosphere pollution and green house effect (Dessler and

Parson, 2009). Each and every living creature produces greenhouse gases in some way or the other. In addition to this, these gases are also produced in nature and also through human interventions like industry, agriculture operations, livestock rearing etc.

1.4.1 GHGs from Livestock

We normally believe that animal wastes like dung, urine etc. are harmless. But in reality, they can be quite hazardous. Commercial/industrial livestock farms pollute the air by releasing different types of harmful gases, mainly due to production of large quantities of manure. These gases are dangerous air pollutants and threaten both the environment and human health. The predominant gases produced by the livestock are as follows:

a) Carbon-dioxide (CO_2): Livestock sector is responsible for emission of carbon-dioxide directly through feed and livestock products production, processing and transport; livestock respiration and indirectly through expansion of land for pasture and crop or feed production. Worldwide, ruminant species like cows, sheep, goat etc. emit about two billion metric tonnes of CO_2-equivalents per year. In general, livestock respiration is not counted as a net source of CO_2 emission because they are considered as part of the global biological system cycle. However, carbon-dioxide (unaccounted) from livestock respiration accounts for 21 per cent of anthropogenic GHGs worldwide which works out to about 8,769 million tonnes according to an estimate by British physicist Alan Calverd during 2005 (Goodland and Anhang, 2009). In addition, clearing of forests in order to get more grazing land and farm land also contribute for an extra 2.8 billion metric tonnes of CO_2 emission per year.

b) Methane (CH_4): Livestock, especially the ruminants, are the largest source of methane emitter in the world. Non-ruminant species like pigs, horse etc. also produce CH_4 but the amount is much lower when compared to ruminants. The production of methane gas is mainly due to two processes *viz.* manure storage/recycling and enteric fermentation in the digestive tract of animals. During storage and recycling of animal waste, methane gas is produced under anaerobic condition through bio-degradation of organic materials i.e. dung, urine etc. when manure is managed in liquid form. The major contributors of methane gas amongst the livestock are the ruminant species like cow, sheep, goat etc. which are four-stomached animals when compared to the mono-gastric (single stomached) animals like pig, horse etc. This is due to the differences in the food habits and digestion process. During the process of digestion in the ruminant's stomach, food particles (carbohydrates) are broken down into simple nutrients through fermentation process in the presence of bacteria present in the rumen. This fermentation process also generates two by-products *viz.* carbon-dioxide and methane. Research studies reveal that the methane emissions from a single dairy cow amount to the equivalent of up to 1.5 metric tonnes of carbon-dioxide each year. Globally, this adds up to the equivalent of 2.2 billion tonnes of carbon-dioxide per year. If you compare the properties of methane and carbon-dioxide, methane has 21 times the heat-trapping power of carbon-dioxide over a 100-year period (FAO, 2006). On comparing the life span of these two gases, it was found that methane only stays in the atmosphere for about 9-15 years, whereas,

carbon-dioxide can remain for hundreds of years. However, if you take into account the greenhouse gas's ability to rapidly impact global warming, methane is considered to be far more dangerous.

c) Nitrous Oxide (N_2O): It is another potent greenhouse gas with a long lifetime of 150 years in the atmosphere and large radiative-forcing potential which is 310 times that of CO_2. Nitrous oxide emission from livestock sector is as a result of two major activities *viz.* manure management and feed production, processing and transport. They are also released in large quantities from dairy farms through application of manure and artificial fertilizers on fields and from ammonia losses during and after the growing season. Manure contains two chemical components that can lead to GHG emissions during storage and processing: organic matter that can be converted into CH_4, and Nitrogen that leads to N_2O emissions. During storage and processing, nitrogen is released in the atmosphere as ammonia (NH_3) that can be later transformed into N_2O (indirect emissions). The emissions of N_2O come from the use of fertilizers (organic or synthetic) for feed production and from the direct deposition of manure on pasture or during the management and application of manure on crop fields. Direct or indirect N_2O emissions can vary greatly according to temperature and humidity at the time of application and their quantification is thus subject to high uncertainty (Gerber *et al.*, 2013).

d) Other Gases: They include hydrogen sulfide, ammonia (NH_3) etc. During composting of the carcass, anaerobic microorganisms work to decompose it, releasing fluids and odourous gases such as hydrogen sulfide and ammonia. The livestock sector contributes to about 64 per cent of ammonia emission mostly from poultry sector, which contributes significantly to acid rain.

Check Your Progress 3

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Define GHGs?

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2) Match the following:

Column A	Column B
1. Carbon-dioxide	a. Enteric fermentation
2. Methane	b. Manure management
3. Nitrous oxide	c. Composting
4. Ammonia	d. Respiration

3) The major contributors of methane gas amongst the livestock are the ruminant species – Justify the statement.

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4) On comparing the life span of these two gases, it was found that methane only stays in the atmosphere for about _____ years.

1.4.2 Global and Indian Scenario

According to Steinfeld (2006), livestock related sources of green house gas emissions include enteric fermentation and respiration, animal manure, livestock related land use change, deforestation linked to livestock, livestock related release from cultivated soils, feed production, on-farm fossil fuel use and post-harvest emissions. Garnett (2007) states that livestock reared in extensive systems, such as ruminants, tend to have a lower per area footprint than those in intensive systems like poultry and pigs, but have a higher footprint when expressed in terms of per kg of product. Cattle produce the most greenhouse gas emission among ruminants followed by sheep, goats and buffaloes.

Since long, there has been debate over exactly how much the livestock industry contributes to climate change. Can you guess how much the livestock sector contributes to greenhouse emission in the world scenario? You will be astonished to know that in terms of the environment, it is well-known fact that livestock sector contributes for 14.5% (7.1 gigatonnes CO_2-eq per annum) of global human-induced (anthropogenic) greenhouse-gas emissions, surpassing that of the transportation (FAO, 2006). If you look into the sources of the GHG emission, feed production and processing and enteric fermentation from ruminants are the two main sources of emissions, representing 45 and 39 per cent of sector emissions, respectively. Manure storage and processing contributes only 10 per cent. The remainder is attributable to the processing and transportation of animal products (Gerber *et.al.*, 2013). The highest total of livestock-related greenhouse-gas emissions comes from the developing countries like India, which accounts for about two-thirds of the global emissions from cattle and other ruminants and half of the global emissions from poultry and pigs. Livestock constituted 63.4% of the total GHG emissions from agriculture in India. The major reason for this condition might be due to the fact that systematic management of farm animal waste/manure is not commonly practised in India. The total GHGs emission from Indian livestock is estimated at 247.2 MT in terms of CO_2 equivalent emissions.

Now, let us turn our focus towards gas-wise and species-wise scenario:

- **Carbon-dioxide:** According to the FAO, when emissions from land use and land use changes are included, the livestock sector accounts for 9 per cent of CO_2 deriving from human-related activities. According to IPCC (2007), the entire livestock supply chains emits about 2 gigatonnes CO_2-eq of CO_2 per annum, or 5 per cent of anthropogenic CO_2 emissions. Cattle are the main contributor to the sector's emissions with about 4.6 gigatonnes CO_2-eq, representing 65 per cent of sector emissions. Pigs, poultry, buffaloes and small ruminants have much lower emission levels, with each representing between 7 and 10 per cent of sector emissions (Gerber *et.al.*, 2013).

- **Methane:** According to FAO report, cows contribute 44 per cent of methane production. The entire livestock supply chains emits 3.1 gigatonnes CO_2-eq of CH_4 per annum, or 44 per cent of anthropogenic CH_4 emissions (IPCC, 2007). Enteric methane emission from livestock

was the major source accounting 85.6% of total GHG from world livestock in year 2010 (Patra, 2014). Globally, Cattle emit most of the enteric methane (73.7%), followed by buffaloes (11.3%) and small ruminants (11.2%). As far as India is concerned, its livestock contributed 15.1% of total global enteric methane emission. Dairy buffalo and indigenous dairy cattle together contribute 60% of these methane emissions. Enteric fermentation constitutes about 91.8% of the total methane emissions from Indian livestock when compared to methane from manure management (7%). Bovines contribute a bulk of the methane emission from enteric fermentation i.e. cattle (49 %) and buffalo (42 %), followed by small ruminants like goat (5%) and sheep (3%), and negligible emission of 0.7 % from other categories. Although the Indian livestock contributes substantially to the methane budget, the per capita emission is only 24.23 kg CH_4 /animal/year (Chhabra *et. al.,* 2013).

Nitrous Oxide: According to IPCC (2007), the entire livestock supply chains emits about 2 gigatonnes CO_2-eq of N_2O per annum, or 53 per cent of anthropogenic N_2O emissions which has 296 times the Global Warming Potential (GWP) of CO_2. Globally, cattle (46.2%) accounted for the major share of N_2O emission, followed by swine (24.8%), poultry (15.4%) and buffalo (7.57%) and remaining other livestock species. India's contribution was only 4.0% of total global nitrous oxide emission from manure during 2010. Nitrous oxide emission was mostly contributed by buffalo (31.4%) and cattle (26.8%), goat (15.8%), poultry (15.0%) and sheep (7.8%) in India.

Check Your Progress 4

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) What are the livestock related sources of green house gas emissions?

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2) Livestock sector contributes for _____ % of global human-induced (anthropogenic) greenhouse-gas emissions.

3) List the major sources of GHGs emission from livestock sector.

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4) In India, dairy buffalo and indigenous dairy cattle together contribute 60% of _____ emission.

1.5 EFFECTS OF LIVESTOCK REARING ON ENVIRONMENT AND HUMAN HEALTH

Livestock production systems are intensifying worldwide, particularly in urban and peri-urban areas. In recent times, the livestock rearing has changed from extensive/mixed farming systems to specialized (commercial/industrial) dairy

farming with zero grazing under confinement and is termed as intensive livestock farming. Though this has resulted in improving the profitability, at the same time, it has also contributed significantly to the pollution of air, water and soil. The livestock waste which is a major source of harmful green house gases, pollution and harmful pathogens is emerging as a serious environmental and human health concern.

The effects of livestock include pollution (air, soil, water), propagation of flies and parasites, loss of biodiversity and occupational health hazards. Let us see the various effects of livestock rearing on environment and human health:

1.5.1 Environmental Health

The most common environment concern with animal wastes is that it affects the atmospheric air with offensive odours, release of large quantities of noxious gases like CO_2 CH_4, N_2O, ammonia etc. which might contribute to green house effect and acid rain. Being one of the largest populations and densities of both people and livestock in the world**,** India is already facing severe emission, water, land and hunger challenges. A growing problem with the massive number of cattle in India, is the amount of animal waste that is generated. This has resulted in the serious environmental concerns caused by the livestock industry, including carbon emissions, land & water usage changes and pollution. Additionally, continuous increase in the consumption of animal products in India is expected to be the driving force behind global increases in demand for meat and dairy over the coming decades. As production & consumption continues to grow, these environmental challenges are only going to worsen if India continues its current level of growth in animal production and consumption going forward. Now, let's turn our focus on the different impacts of the livestock farming on the environment:

i) Deforestation and land degradation

- The livestock sector is by far the single largest anthropogenic user of land. Expansion of livestock production is a key factor in deforestation. Livestock uses about two-third (70%) of all agricultural land and one-third (30%) of the earth's entire land surface, predominantly for permanent pasture. In addition, the total area dedicated to feed/fodder crop production amounts to about two-third (33%) of total global arable land. As forests are cleared to create new pastures, it is a major driver of deforestation.

- Deforestation to clear land for pastures, fodder extraction, expanding agricultural cultivation of crops in forests and on grazing lands and the widespread use of fertilisers to grow crops like maize and soyabean as livestock feed are all contributing to rising rates of land degradation and desertification in India. Hunger for land for both crops and livestock is also a primary cause of bio-diversity loss.

- Goats contribute significantly towards deforestation and soil erosion attributed to its feeding habit i.e. browsing. However, the goat's bad reputation arises mainly due to mismanagement by man rather than inherent fault.

- According to the Ministry of Agriculture, Government of India, the carrying capacity of Indian grasslands is about 0.20 to 1.47 adult cattle

units (ACU)/ha. Grazing intensity in the country is as high as 12.6 adult cattle units (ACU)/ha as against 0.8 ACU/ ha in developed countries and 1 ACU/ha allowed by Indian government norms. The quality and productivity of grazing lands are also showing a declining trend due to improper management, unregulated land use, overgrazing and lack of reseeding of pastures. It is argued that one of the reasons for deforestation is uncontrolled grazing of livestock in forest land. All these factors contribute to land degradation, particularly in the open grazing areas in the arid and semi-arid ecosystem.

- As far as land degradation is concerned, livestock causes wide-spread land degradation through overgrazing, compaction and erosion (FAO, 2006). This impact is even higher in the drylands where inappropriate policies and inadequate livestock management contribute to advancing desertification.

ii) Pollution (Soil, Air and Water)

- The IFPRI-FAO study conducted by Mehta *et al.* (2002) shows that there are bio-security issues associated with industrial poultry production in India such as polluted water, soil toxicity, wastage disposal and health hazards, especially when the production units are located too close to densely populated areas. Soil toxicity occurs due to build up of nitrogen and phosphorus in the soil deposited through manure over a period of time. Farms close to population centers and water bodies produce ecological harm due to over concentration of nutrients and human health issues.
- Biodegrading livestock waste also emits odorous gases that contain as many as 60 compounds like ammonia and amines, sulphides, volatile fatty acids, alcohols, aldehydes etc. (Sweeten, 1995).
- The livestock industry contributes significantly to depletion of water resources and water pollution. The major water polluting agents are animal wastes, medicines, chemicals from tanneries, fertilizers and the pesticides used to spraying crops produced for livestock. In addition, widespread overgrazing disturbs water cycles, reducing replenishment of ground water resources and utilization of water towards the production of feed and fodder.
- Animals can negatively affect water quality by having free access to water sources where they are able to deposit waste and cause the water to become cloudy from stirring up mud. Water contamination can occur in many different ways. In extensive systems, livestock often have access to bodies of water where they are able to deposit waste. This waste travels downstream and has direct contact with humans. In intensive production systems, bacteria can enter water sources during heavy rainfalls that might result in an overflow of the manure catchment basin or from manure that has been put on fields as fertilizer.
- The animal wastes and its by-products intentionally or unintentionally enter rivers, streams, and groundwater. These organic and inorganic pollutants contribute to the contamination of an estimated 70 per cent of India's surface water and an increasing percentage of its groundwater.

iii) Hunger

- The increasing demand for grains to feed livestock will create pressure to cultivate (and/or import) feed grains, which will ultimately compete with grain production for human consumption. India produced about 24.17 million tonnes of maize during 2014-15, of which about 50% was used by the poultry sector.

iv) Loss of biodiversity

- Very high concentrations of nutrients like phosphorus and nitrogen released from the animal waste and storage structures cause a range of ecological problems like fish kills or a loss in biodiversity when released into the environment. Livestock farming depletes soil nutrients and pollutes the environment as waste runoff from farms causes algae blooms that consume oxygen in water, killing essential bacteria and destroying healthy ecosystems (Baur, 2015). Further, Nitrogen in water also contributes to increased algae blooms that reduce the oxygen availability to fishes.
- According to the Millennium Ecosystem Assessment (MEA), the most important drivers of biodiversity loss are habitat change, climate change, invasive alien species, overexploitation, and pollution. Livestock production and intensification contributes to all of these drivers. It is estimated that approximately 30 per cent of global biodiversity loss can be attributed to aspects of livestock production.
- Ten per cent of the world's plant and animal species that face some degree of threat are experiencing habitat loss based on livestock production (FAO, 2006).
- Of the world's thirty-five biodiversity hotspots, containing the highest levels of endemic species that have lost 70 per cent or more of their original habitat, twenty-three are affected by livestock production.

Check Your Progress 4

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Which changes in the livestock sector have contributed significantly to the environmental pollution in recent times?

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2) List the different impacts of the livestock farming on the environment.

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3) _____ contributes significantly towards deforestation and soil erosion attributed to its feeding habit.

4) What are the most important drivers of biodiversity loss?

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1.5.2 Human Health

Rearing of livestock may affect the human health through physical, chemical and biological hazards. When a person handling the animals becomes sick or gets hurt due to contact with animals and its wastes, it is termed as Occupational Health hazard. In other words, an occupational hazard is a hazard experienced in the workplace. Let us see the impact of livestock on human health:

i) **Physical Hazards:** Labour working in the livestock farm and handling livestock especially large animals may get injured due to stepping on, crushing, kicking and biting by the animals. It is established beyond doubt that high dust exposure in animal/poultry confinement buildings is a respiratory health hazards like chronic bronchitis, asthma-like symptoms like wheezing and shortnesss of breath during work.

ii) **Chemical Hazards:** Improper handling of solid animal waste is a serious health hazard especially for the workers who come in direct contact with the animal waste. According to the Environmental Protection Agency (EPA), drinking water contaminated with nitrate concentrations from animal waste/manure above ten parts per million (ppm), can cause developmental deficiencies in infants and death in severe cases due to oxygen deprivation. Nitrates introduced into the body through affected water significantly reduce the blood's oxygen carrying capacity, and deprive the body of oxygen. High nitrate concentrations are also believed to have caused spontaneous abortions and possibly cancer. In addition, some of the noxious gases generated by the animals/birds like methane, ammonia etc., when inhaled by the humans may result in nausea, headaches, breathing problems, sleep interruption, appetite loss and irritation of the eyes, ears and throat. Given the variety and extent of exposures related to livestock production, respiratory diseases may be the major health problem. Gases play an important role in causing lung disorders. In animal confinement buildings and facilities, ammonia levels often contribute to respiratory problems. Similarly, the gases in livestock facilities can also pose other risks to workers; for example, methane is highly flammable, and if not vented properly from manure tanks it can cause explosions. Acute poisoning from hydrogen sulphide gas released from manure storage facilities in dairy barns can cause fatalities.

iii) **Biological Hazards:** Livestock acts an important source of biological hazard. Over 150 zoonotic diseases have been identified worldwide, with approximately 40 significant for human health. The health consequences of zoonotic diseases range from the relatively benign flu-like symptoms of Brucellosis to debilitating Tuberculosis or potentially lethal strains of *Escherichia coli* or Rabies. The common zoonotic diseases are Anthrax, Brucellosis, Hydatidosis, Leptospirosis, Q fever, Rabies, Salmonellosis, Tuberculosis etc. The spread of zoonotic diseases may be through direct or indirect contact, vector-borne or food-borne.

Now, having learnt about the effects of livestock on environment and human health, do you know how we measure the impact of livestock on climate change? It is known by its carbon foot print. A carbon foot print is defined as the total amount of greenhouse gases produced directly and indirectly from the Livestock and is usually expressed in equivalent tonnes of carbon-dioxide. Emissions from livestock are measured either in terms of kg CO_2 equivalent per kg meat or milk produced or per hectare of land used. With increased prosperity, people are consuming more egg, meat and dairy products every year. Global meat production is projected to double from 229 million tonnes in 1999/2001 to 465 million tonnes in 2050, whereas, milk output is set to reach 1043 million tonnes. GHG emission could touch 2,930 million tonnes CO_2-eq in 2050 due to animal population growth driven by increased demands of meat and dairy products in the developing countries (Patra, 2014). But such rapid growth exacts a steep environmental price, according to the FAO Report (2006), Livestock's Long Shadow - Environmental Issues and Options. "The environmental costs per unit of livestock production must be cut by one half, just to avoid the level of damage worsening beyond its present level," it warns. This can be achieved by adhering to various strategies to mitigate or reduce greenhouse gas emissions in livestock farming like:

- **Augmenting the Production efficiency** of the animals by getting more output of meat, milk and eggs per unit input through improved feeding practices, breeding strategies, diversification etc.
- **Reducing enteric fermentation** through practices such as improvement of animal nutrition and genetics like increasing dietary fat, providing supplements etc.
- **Better manure management** by adopting to manure collection, storage (shortening storage duration), and disposal practices (improving timing/ application of manure) that not only reduce GHGs emissions, but also address the water and air quality concerns.
- **Improving the Energy efficiency** in the animal production system by shifting towards more energy efficient lighting, heating and cooling systems (Smith, 2014).
- **Adopting to Carbon Sequestration** (capturing and storing carbon in the soil) by maintaining cover crops, decreasing deforestation rates, replanting trees or other perennial vegetation for reversing deforestation, improvement in land and water management etc. (Patra, 2014)

Check Your Progress 6

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Define Occupational Health hazard?

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2) Gases in livestock facilities can also pose other risks to workers – Justify with an example.

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3) List the important zoonotic diseases.

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4) What are the various strategies to mitigate or reduce greenhouse gas emissions in livestock farming?

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1.6 LET US SUM UP

Livestock is one of the important sources of income, employment, energy/ transport and nutrition (milk, egg, meat etc.) to the rural masses. It contributes significantly to enriching the soil with vital nutrients like NPK from farm yard manure which are essential for the agriculture operations. Dairy/livestock farm generates both organic and inorganic wastes. Livestock farming generate important greenhouse gases like carbon-dioxide, methane, nitrous oxide etc. which threaten both the environment and human health. Livestock, especially the ruminants, are the largest source of methane emitter in the world. Livestock related sources of green house gas emissions include enteric fermentation and respiration, animal manure, livestock related land use change, deforestation linked to livestock, livestock related release from cultivated soils, feed production, on farm fossil fuel use and post harvest emissions. Livestock sector contributes for 14.5% of global anthropogenic greenhouse-gas emissions, surpassing that of the transportation. Livestock constituted 63.4% of the total GHG emissions from agriculture in India. Livestock sector contributes significantly to the many environmental problems like deforestation, land degradation, air, soil and water pollution, loss of biodiversity, and ultimately to global warming. Rearing of livestock may affect the human health through physical, chemical and biological hazards. According to the FAO Report (2006), "The environmental costs per unit of livestock production must be cut by one half, just to avoid the level of damage worsening beyond its present level".

1.7 KEY WORDS

Anthropogenic : Caused or produced by humans.

Browsing : To eat, nibble or feed on leaves, tender shoots or other soft vegetation

Carbon footprint : The total amount of GHG emissions associated with a product along its supply chain; usually expressed in kg or tonne of carbon-dioxide equivalent (CO_2-eq) per unit of output.

CO_2-eq emission : The amount of CO_2 emissions that would cause the same time-integrated radiative forcing, over a given time horizon, as an emitted amount of a mixture of GHGs. It is obtained by multiplying the emission of a GHG by its global warming potential (GWP) for the given time horizon.

Global Warming Potential (GWP) : Defined by the Intergovernmental Panel on Climate Change (IPCC) as an indicator that reflects the relative effect of a GHG in terms of climate change considering a fixed time period, such as 100 years, compared with the same mass of carbon-dioxide.

Greenhouse gas : Gases that trap heat in the atmosphere. eg. water vapour, CO_2, methane, nitrous oxide etc.

Hardy : Capable of enduring difficult conditions.

Inorganic Waste : These are non-biodegradable waste like chemicals of mineral origin, pesticides etc.

Livestock : Livestock are domesticated animals reared by human beings to produce commodities such as food, fiber, and labour. Eg. Cattle, Buffalo, Sheep, Goat etc.

Organic Waste : These are materials that are biodegradable and come from either a plant or animal like cow dung.

Zoonotic : A disease that can be transmitted from animals to people or, more specifically, a disease that normally exists in animals but that can infect humans.

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1.9 ANSWERS TO CHECK YOUR PROGRESS

Your answers should include the following points:

Answers to Check Your Progress 1

1. India is rich in livestock resources because it possess 190.9 million cattle, 105.3 million buffaloes, 65.07 million sheep, 135.2 million goat, 10.3 million pigs and 1.48 million other livestock species
2. Poultry
3. TRUE
4. Five

Answers to Check Your Progress 2

1. Different types of waste generated from a livestock/dairy farm can be classified into two - organic waste and inorganic waste. Organic wastes include dung/faeces, urine of animals, droppings of poultry birds, leftover feed/fodder, Wash water from cleaning of sheds and animals etc. While, the inorganic wastes include plastic bags, chemicals etc.
2. Manure is rich in main nutrients like Nitrogen, Phosphorus and Potassium. In addition to providing essential nutrients for crop growth, manure has several other beneficial effects on soil properties. When the organic animal wastes are applied to the soil, the bulk density of the soil decreases as a result of increase in both the organic fraction of the soil and the stability of aggregates. Organic wastes like dung/faeces and urine also improves water filtration rate, water holding capacity and the hydraulic conductivity of the soil.
3. 1000 pounds or 454 kgs.
4. Animal wastes are usually collected manually in two ways in a commercial dairy farm. One is by collecting the dung and urine separately and the other method is by flushing dung and urine together. Solid wastes (dung, leftover feed etc.) are usually collected and removed twice daily with the help of spade with long handle. The waste is scraped, collected and loaded into wheelbarrows, cart or trolley and transported to the manure pit. The liquid waste (urine and other wash waters) are collected through the drainage system.
5. FALSE

Answers to Check Your Progress 3

1. Green House Gases (GHGs) are group of gases present in the air which traps, absorbs and emits heat (radiation) in the atmosphere keeping the earth's surface warmer than it would be if they were not present. They include Water-vapour (H_2O), Carbon-dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Ozone (O_3) and Fluorinated gases like Chlorofluorocarbons (CFCs), Hydrofluorocarbons, Sulfur-hexafluoride etc.

2. 1-d, 2-a, 3-b, 4-c

3. The major contributors of methane gas amongst the livestock are the ruminant species like cow, sheep, goat etc. due to the differences in the food habits and digestion process. During the process of digestion in the ruminant's stomach, food particles are broken down into simple nutrients through fermentation process in the presence of bacteria present in the rumen. This fermentation process also generates two by-products *viz.* carbon-dioxide and methane.

4. 9-15

Answers to Check Your Progress 4

1. Livestock related sources of green house gas emissions include enteric fermentation and respiration, animal manure, livestock related land use change, deforestation linked to livestock, livestock related release from cultivated soils, feed production, on-farm fossil fuel use and post-harvest emissions.

2. 14.5%

3. Feed production and processing, enteric fermentation from ruminants and manure management

4. Enteric Methane

Answers to Check Your Progress 5

1. In recent times, the livestock rearing has changed from extensive/mixed farming systems to specialized (commercial/industrial) dairy farming with zero grazing under confinement and is termed as intensive livestock farming. Though this has resulted in improving the profitability, at the same time, it has also contributed significantly to the pollution of air, water and soil.

2. The different impacts of the livestock farming on the environment are deforestation and land degradation; soil, air and water pollution; loss of biodiversity; competition for food grains between humans and animals/ birds

3. Goats

4. According to the Millennium Ecosystem Assessment (MEA), the most important drivers of biodiversity loss are habitat change, climate change, invasive alien species, overexploitation, and pollution

Answers to Check Your Progress 6

1. When a person handling the animals becomes sick or gets hurt due to contact with animals and its wastes, it is termed as Occupational Health hazard. In other words, an occupational hazard is a hazard experienced in the workplace.

2. The gases in livestock facilities can also pose other risks to workers; for example, methane is highly flammable, and if not vented properly from manure tanks it can cause explosions; Acute poisoning from hydrogen sulphide gas released from manure storage facilities in dairy barns can cause fatalities.

3. Anthrax, Brucellosis, Hydatidosis, Leptospirosis, Q fever, Rabies, Salmonellosis, Tuberculosis.

4. Augmenting the Production efficiency of the animals, Reducing enteric fermentation, Better manure management, Improving the Energy efficiency in the animal production system and Adopting to Carbon Sequestration.

UNIT 2 AQUACULTURE AND POLLUTION

Structure

2.0 INTRODUCTION

Aquaculture is the cultivation of fishes crustaceans, algae, and molluscs. Aquaculture includes developing freshwater and saltwater populaces under controlled conditions and can be diverged from business angling, which is the gathering of wild fish. It is also known as aquafarming. Aquaculture, in turn, is "the propagation and rearing of aquatic organisms in controlled or selected aquatic environments for any commercial, recreational, or public purpose." (NOAA, 2001). Mariculture is a specialized branch of aquaculture that involves the cultivation of marine organisms for food and other products particularly in the open ocean, an enclosed section of the ocean, or in tanks, ponds filled with seawater. This includes the farming of marine fish, including finfish and shellfish like prawns, or oysters and seaweed in saltwater ponds. Some examples of non-food products produced by mariculture include: fish meal, nutrient agar, jewellery (e.g. cultured pearls), and cosmetics.

Fish is a very good source of good-quality proteins, lipids and a wide variety of essential nutrients. Production of farmed fish, or aquaculture, is probably the fastest growing food sector worldwide, as now it accounts for nearly 40% of the world fish production.

As indicated by the Food and Agriculture Organization (FAO), aquaculture "is comprehended to mean the cultivating of oceanic life forms including fish, molluscs, shellfish and amphibian plants. Cultivating infers some type of intercession in the raising procedure to improve generation, for example, consistent stocking, nourishing, insurance from predators, and so forth. Specific sorts of aquaculture incorporate fish cultivating, shrimp cultivating, shellfish cultivating, mariculture, algaeculture, kelp cultivating, and the development of decorative fish. Specific strategies incorporate aquaponics and coordinated multi-trophic aquaculture, both of which use fish and plant cultivating techniques.

2.1 OBJECTIVES

After reading this unit you should be able to:

- define what is aquaculture and pollution;
- describe about the sources of aquaculture pollutants;
- define the feed practices in aquaculture;
- explain the effects of pollutants on environment and human health;
- describe the antibiotic usage and resistance; and
- understand the occupational health effects due to aquaculture.

2.2 SOURCES OF AQUACULTURE POLLUTANTS

Alongside the improvement, concerns are evoked about the conceivable impacts of consistently expanding aquaculture squander both on efficiency inside aquaculture frameworks and on the surrounding oceanic biological community. Escalated fish and shrimp cultivating, being characterized as throughput-based frameworks adds to eutrophication. Nitrogenous mixes (alkali, nitrite, and nitrate) are considered as real contaminants in aquaculture wastewater. Smelling salts is the primary nitrogenous waste delivered by oceanic creatures. Past, outdated advances and fragmented plan of waste administration frameworks in aquaculture contribute a ton to the decay of the aquaculture condition. Aquaculture contamination cause economic misfortunes in billion dollars.

Marine aquaculture usually consists of both land-based and offshore aquaculture. Off shore culture is mostly done in shallow seas, mud flats and protected bays. The main production types of offshore aquaculture are floating and semi-floating raft culture, net cage culture, sea ground sowing, vertical (hanging) culture and pond on tidal areas. Pond culture is also one of the most important methods among freshwater aquaculture. Also reservoir, lake, river and channel fish farming contributes most to the remaining fresh aquatic production forms. All these sources generate wastes and pollutants.

Aquacultural wastes include all materials used in the process which are not removed from the system during harvesting. These wastes mainly consist of uneaten feed or excreta, chemicals and therapeutic agents that are added to the ponds. They are discharged either in the sediments or in the farm effluents. The effluents contain both dissolved and particulate pollutants (inorganic and organic). An aquatic farm water quality depends mainly on the species

cultivated. Other conventional pollutants like nutrients, biological oxygen demand, and total suspended solids are mainly derived from feed, excreta and fertilizers. Fertilizers stimulate phytoplankton growth and fish production. Inorganic compounds of N and P are among the most usual fertilizers, but K, trace metals, and silicates may also be present. Since fertilizers increase the concentrations of nutrients in pond water, they may cause eutrophication in receiving water bodies. Pesticides, heavy metals and emerging pollutants used in intensive aquaculture also are some sources of pollutants. Heavy metals can also be found in pond effluents because they are common constituents of proteinates and vitamin/mineral premixes (e.g., Cu and Zn). They are also added as oxidizing agents for controlling phytoplankton and pathogenic organisms (e.g., KMnO4) or as algicides (e.g., CuSO4). Intensive fish farming is also a source of steroid hormones such as estrone, testosterone and androstenedione. Estrone is an important natural endocrine disrupting compound found in natural water due to its ubiquity and estrogenic potency. Steroids are found in the blood plasma of fish and can be excreted via urine or bile, especially during periods of reproduction. These contents are also seen in aquaculture effluents.

Check Your Progress 1

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Describe about aquaculture.

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2.3 FEED PRACTICES

One of the major expenses for farmers is fish feeding. Good fish feed administration can lessen general culture cost, enhance cultivation and guarantee solid development of fish stock. It is important to utilize a right sustaining technique, computing the feeding cost and guaranteeing the cost adequacy of fish cultivation.

Nutrients required for fish:

Protein, fat, starches, vitamins and minerals are the fundamental supplements for fish. Protein gives vitality and manufactures muscles. Protein Fat gives energetic fish. Carbohydrates: The energy required for growth is provided by carbohydrates. But it makes digestion difficult for carnivores aqua species. Vitamins and minerals are also important nutrients that are required for resistance. It is imperative that dietary prerequisites of fish fluctuate with various species, sizes, development stages and feeding habits. For instance flesh eating fish needs protein and fat than the omnivorous and herbivorous species, while marine fish require more protein and fat than freshwater fishes.

2.3.1 Common Fish Feed

The feeds are normally in the form of granules or pellets that provide the nutrition in a stable and concentrated form. It enables the fish to feed efficiently

and grow to their full potential. They are then combined with other ingredients such as vegetable proteins, cereal grains, vitamins and minerals and formed into feed pellets. There are two types of fish feed namely, vegetarian feed and trash fish. Pellet field is also a fish feed technology.

- Vegetarian feed:- It consists of Wheat grain, rice grain, weed, soy leftovers, flour and pea nut cakes are appropriate for freshwater fish
- Trash fish: - Fishing by-catch or fish caught and fed directly to larger species being raised in aquaculture pens.
- Hatchery feeds: - They are specialized feeds produced for fish hatcheries. In species such as salmon and trout, the newly hatched first feed from their yolk sacs and then can be fed with starter feeds. Marine species such as sea bass, sea bream, flounders and turbot consume the nutrition in their yolk sacs during the first few days post hatching and then are fed for several weeks on live prey, in the form of rotifers and brine shrimp. Special feeds can be used to enrich the nutritional value of the prey. Rotifers are usually bred in the hatchery while brine shrimp are generally collected from the wild, e.g. salt lakes.

2.3.2 How to Choose the Right Fish Feed

With such a significant number of assortments of fish feed, One basic route is to analyze the healthful requirement of the species, accessibility, value, stockpiling technique, cleanliness and ecological effects of different bolsters and see which one suits the necessities of your fish cultivate best.

- Nutrition: Trash fish and vegetarian feed might not have adequate supplements to fulfill the necessities of all refined fish. It might prompt ailing health which will disable the common protection of the refined fish and elevate the dangers of infections. Pellets can be encouraged for use with plant protein, different fats, vitamin complex and minerals as required by particular fish species. They are exceedingly nutritious and can viably enhance the wellbeing of fish stock.
- Hygiene: High moisture in fish feed can spoil them. Vegetarian feeds have low dampness content. Trash fish is high in dampness (around 70%). If not stored at low temperatures, it can get vigorously pervaded with microbes or parasites. The fat of waste fish oxidizes and spoils. Spoiled waste fish may cause sickness or death. Dry pellets do not decay on the grounds that it is low in dampness content (around 100/0). The moisture content of wet pellet is around 35% however the waste fish influences it to decay all the more effectively. Refrigeration is hence fundamental.
- Storage methods: The feeds can be stored for a few months when kept in a cool dry place. High moisture trash fish can be kept for around one week when kept at low temperatures of – 200°C. Else they should be utilized instantly after purchase.
- Environmental impacts: A fine vegetarian feed will contaminate the waters if left to suspend for a really long time. Waste fish shreds can cause contamination in lakes, sea-beds bringing about danger of anoxia and death rate in fishes. By utilizing proper pellet size and thickness, environmental contamination caused by the nourish deposits can be essentially decreased.

Check Your Progress 2

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Describe about feed practices in aquaculture.

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2.4 EFFECTS OF POLLUTANTS ON ENVIRONMENT AND HUMAN HEALTH

In this section we will discuss the impacts of aquaculture pollution in human health and environment.

2.4.1 Effect of Pollutants on Environment

Aquaculture is necessary to keep overfishing under control, but it also negatively impacts the environment. Eutrophication is a common issue that comes along with aquaculture. Eutrophication refers to the excess enrichment in a given ecosystem of nitrogen and phosphorous. Aquaculture causes eutrophication in a number of ways. In open water aquaculture systems, the excess fish feed introduces extra nitrogen and phosphorous directly into the water (Talbot & Hole 1994). Closed off inland systems contribute to eutrophication as they dump effluent directly into natural waterways.

The emissions of marine animal waste from aquaculture facilities into the ecosystem will not only affect other fish, but will also result in nutrient pollution. For example, one of the most harmful aquaculture systems is open net-cage farming. It involves the use of large mesh fishing nets to hold the farmed fish, and there is no way to prevent waste from escaping into the water. This waste can contain antibiotics, pesticides and fish feces which pollutes the open water and makes it unsafe for human drinking, recreational use, and for other wildlife.

Another negative impact is through discharge. Just like any other animal production system, aquaculture generates waste throughout the process. Aquaculture waste can be separated into solid and dissolved waste, specifically carbon, nitrogen, and phosphorous. Solid waste is derived from uneaten and/ or spilled feed and from fish feces. Dissolved waste comes mostly from metabolites excreted by the fish. These two types of pollutants grow within a location and eventually will reduce the water quality of that particular system, while also leads to an influx of disease-carrying fish.

Aquaculture also leads to algal blooms. These are toxic to humans and animals and can make local water unsafe for drinking, recreation, and destroy local wildlife. Natural wetland capacities can be reduced due to aquaculture practices. Aquaculture advancement can harm the natural biogeochemistry of the wetlands.

2.4.2 Effect of Pollutants on Human Health

Solid wastes from aquaculture consist of feces or uneaten food. This can cause oxygen depletion and ammonia toxicity when it decomposes. The urine and

feces from the aquatic animals can cause high content of ammonia nitrogen and an increase of biochemical oxygen demand. All this can lead to health impacts. A number of chemicals are used in the aquaculture industry, including compounds applied to construction materials such as stabilizers, pigments, antifoulants and so on. Also pigments incorporated into feeds, disinfectants and chemotherapeutants are used. Antimicrobials are administered in the diet and most end up in the environment. All these cause ecological and human health disorders. The abuse of chemicals can also destroy the effective microbes and bring an imbalance of the aquatic ecology system.

Industrious organochlorine pesticides, for example, aldrin, endrin, dieldrin, chlordane, toxaphene, chlordecone, dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethylene (DDE), l,l-dichloro-2,2-bis(p-chlorophenyl)ethane (DDD), heptachlor epoxide and mirex can pose dangers for a long time. Natural contaminants, particularly polychlorinated biphenyls and dioxins deposits, can likewise cause potential health issues.

Potential aquaculture creation destinations can be assessed to limit ecological pollution or to decide moderation needs. Issues are typically site-particular and can be managed well. Pesticides utilized as a part of aquaculture to control sea-going weeds or different bugs ought to be utilized sustainably. In zones where farming crops are developed near aquaculture lakes, a sufficient cushion zone ought to be set up. The past land-utilized history of a planned creation site ought to be explored.

Check Your Progress 3

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Explain the effect of aquaculture pollution on the environment.

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2) Describe how the aquaculture and pollutant is affecting the human health.

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2.5 ANTIBIOTIC USAGE AND RESISTANCE

Antimicrobial substances can be characterized as substances that have the ability to execute or repress the development of microorganisms. After their formal revelation by Fleming in 1928, anti-infection agents have been found to be useful in fundamental medications for human and creature wellbeing and welfare. Anti-toxins can be determined from common sources or have manufactured roots. Anti-infection agents ought to be sheltered, permitting their utilization as chemotherapeutic operators for the treatment of bacterial irresistible maladies. Antimicrobials are additionally utilized for aquaculture, and their utilization can be sorted as helpful, prophylactic or metaphylactic.

Remedial utilization relates to the treatment of set up contaminations. Metaphylaxis is a term utilized for solutions for mass medication of a group of animals, in advance of an expected outbreak of disease. Prophylaxis implies the protection measures designed to preserve health and prevent the spread of disease. In aquaculture, anti-infection agents are helpful for brief timeframes by means of the oral course to fish etc. All medications lawfully utilized as a part of aquaculture must be endorsed by the administration organization in charge of veterinary pharmaceutical, for instance, the Food and Drug Administration (FDA). The accompanying antimicrobials approved for use in aquaculture include: oxytetracycline, florfenicol, and Sulfadimethoxine/ ormetoprim. These administrative organizations may set guidelines for anti-microbial utilize, including admissible dosage, resistances, and use by species, including measurements rates and constraints.

In the vast majority of the nations with a vital aquaculture industry, government organizations apply some controlling activities. For instance, in Norway the utilization of antimicrobials requires a veterinarian's medicine, and subsequently, their utilization is helpful. They are sold in drug stores or in plants approved by the Norwegian Medicines Agency. In Norway, it is compulsory to report the measure of anti-infection agents utilized. Serious fish cultivating has advanced the development of a few bacterial illnesses, which has driven to an expansion in the utilization of antimicrobials. Current levels of antimicrobial use worldwide in aquaculture are difficult to decide in light of the fact that unique nations have diverse circulation and enrollment frameworks.

2.5.1 Mechanism of antibiotics

Antibiotic medications may have diverse kinds of substance structures, and they follow up on distinctive parts of bacterial hardware. The antimicrobials work by two instruments:

- A bactericidal impact, the antibiotic for the most part executes the microorganisms by meddling with either the development of the bacterium's cell divider or its cell substance. Example: Penicillin, fluoroquinolones, and metronidazole.
- A bacteriostatic impact, i.e., the anti-microbial prevents microorganisms from increasing by meddling with bacterial protein generation, DNA replication, or different parts of bacterial cell digestion. Example: Sulfonamides, chloramphenicol and macrolides.

A portion of the anti-toxins that restrain bacterial cell divider combination incorporate penicillins, cephalosporins and glycopeptides. Beta-Lactam drugs obstruct the union of the bacterial cell divider by meddling with the compounds required for the blend of the peptidoglycan layer. Antibacterial medications that work by restraining protein combination incorporate macrolides, aminoglycosides, antibiotic medications and chloramphenicol. These antibacterial medications take favorable position of the basic contrasts amongst bacterial and eukaryotic ribosomes to specifically restrain bacterial development. Macrolides, aminoglycosides, and antibiotic medications tie to the 30S subunit of the ribosome, while chloramphenicol ties to the 50S subunit. Fluoroquinolones apply their antibacterial impacts by disturbing DNA and cause twofold strand DNA breaks in DNA replication. For instance, the bactericidal

activity of ciprofloxacin comes about because of the hindrance of topoisomerase II (DNA gyrase) and topoisomerase IV (both Type II topoisomerases), which are required for bacterial DNA replication, translation, repair, and recombination. Sulfonamides and trimethoprim (TMP) hinder the pathway for folic corrosive amalgamation, which at last restrains DNA combination. Disturbance of bacterial film structure can also occur. It is hypothesized that polymyxins amass in the bacterial cell film and cause inhibitory impacts by expanding bacterial layer porousness.

2.5.2 Resistance Mechanism

The utilization of antibiotic medications in aquaculture has specific contrasts from their utilization in earthly creatures. In aquaculture, antimicrobials are routinely added to the feed, which is at that point put in the water where the fish are kept. Now and again, antimicrobials might be included specifically to the water. These methods result in a particular weight in the uncovered situations. The utilization of antimicrobials in aquaculture may include a wide natural application that influences a wide assortment of microscopic organisms.

A few bacterial animal categories may survive negative conditions or natural a great many choosing changes that enhance their wellness in the new conditions. Moreover, microscopic organisms exploit portable hereditary components, for example, plasmids and transposable components. With these components, microscopic organisms can get to an extensive pool of nomad qualities that move from one bacterial cell to another and can spread through bacterial populaces. Some of these qualities may give the capacity to oppose anti-toxin impacts. Anti-microbial protection occurs through:

- Natural protection: This might be because of the failure of the antibacterial species to enter the microorganism's cell. It has been proposed that a few types of microbes are naturally impervious to entire classes of antimicrobial operators. In such cases, all strains of that bacterial species are impervious to all individuals from the antibacterial classes.
- Obtained protection: For this situation, the bacterial species is ordinarily defenseless to a specific medication, however a few strains express tranquilized protection. At first defenseless populaces of microbes end up impervious to an antibacterial species and multiply and spread under the specific weight actuated by the utilization of that species.

Genes in charge of anti-infection protection can be exchanged between microbes by three procedures that include horizontal DNA exchange:

- Change, such as microbes obtain qualities from the take-up of (remote) DNA from the outer condition.
- Transduction: The microbes acquire qualities through contamination with viral DNA.
- Conjugation: The microbes acquire qualities by cell-to-cell mating. In this procedure, a plasmid is passed starting with one living being then onto the next through a pilus. This may happen between individuals from same species or between microbes from various genera or families. The spread of qualities coding for anti-infection protection is encouraged by versatile hereditary components called transposons, which can move from plasmids to the bacterial chromosome.

Check Your Progress 4

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Describe the mechanism of antibiotics in aquaculture.

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2) Explain resistance mechanism.

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2.6 OCCUPATIONAL HEALTH EFFECTS

This segment depicts the known impacts of aquaculture work and recognizes about the impacts related with various species. Aquaculture, including mariculture, is a fast growing sector globally. This sector also has some occupational safety and health issues. Many fish farming tasks are dangerous. A safety or health hazard is any work design or property (physiological, physical, chemical, biological, or psychological) that may cause harm to workers or bystanders. Potential occupational hazards in aquaculture have been associated with fatalities that include drownings, electrocutions, crushing-related injuries, hydrogen sulfide poisonings, and fatal head injuries. Non-fatal injuries have been associated with slips, trips, falls, machine operation and repair, strains and sprains, chemicals, and fires. Risk factors include cranes, aerators, tractors and lifting heavy loads, slippery surfaces, rotting waste due to hydrogen sulfide production, storm-related rushing water, diving conditions, night-time conditions, lack of training, no personal flotation devices (PFD), and so on. Other hazards include punctures or cuts from fish teeth or spines, needle-sticks, exposure to low temperatures, and bacterial and parasitic infections (Myers, 2010).

2.6.1 Identifying Occupational Hazards in Aquaculture

This section discusses the hazards associated with different species and rearing technologies. It will help fish farmers in recognizing hazards associated with their working conditions. The recognized hazards involves observed occupational injury or illness history. The endpoint for the recognition of hazards is an inventory that lists the hazards associated with all tasks, equipment, and substances: • Injury and illness information and data regarding the industry and related industries, e.g., farming or fishing. • Information from past incidents and workplace injuries. • Information from workers as well as family members • Product literature and information from suppliers. • Best industry practices. • Examine areas or activities where children or visitors may be present. To identify and better understand hazards before product use, employers need to obtain and read the manuals and safety sheets that are provided by equipment, machinery, and chemical manufacturers. Employers should develop and implement communication and emergency plans for timely response in the

event of an incident. The five important categories of hazards are 1) physiological (work design), 2) physical, 3) chemical, 4) biological, and 5) psychological (Moreau & Neis, 2009). Sudden deaths have occurred in hatcheries associated with hydrogen sulfide exposure, slips and falls. Other hazards associated with hatcheries include exposures to aerators, pumps, heaters, and other types of machinery; fuels, solvents, hypochlorite, formaldehyde, formalin, confined spaces, water jets, unguarded saws, ozone, and hair entanglement in hatching trough paddles. Some occupational hazards identified in African aquaculture include: noise, cuts, sprains, fractures, asthma, rhinitis, snake and fish bites, bronchitis, chemical burns, pesticides and disinfectant poisoning, parasites, and pathogens. In another review, Further, hazards such as machine entanglements, hearing loss, slips and falls, drowning, lacerations, infections, electric shock, hypothermia, repetitive strains, sleep deprivation, decompression illness, organophosphate poisoning, respiratory illness, sunburn, keratotic injury, leptospirosis, and dermatitis have also been observed. These are some of the occupational hazards associated with aquaculture farming practices.

2.6.2 Control of Hazards

Eliminating the occupational hazards caused from animals, equipments and so on are extremely important. These include the following. The faulty machines can be replaced. Safer chemicals can be used. Engineered controls include machinery guards and shields. Design controls include the locked fences. There can be active and passive controls. For safety, the workers are sufficiently protected through training, supervision, and personal protective equipments (PPE). They are also provided with safe clothing, and respirators during handling of hazardous chemicals and biological agents. Under passive controls the protection does not depend upon the worker's actions and under active controls the protection depends upon the worker's actions (Haddon, 1974).

The Global Aquaculture Alliance for Best Aquaculture Practices (BAP) is a standards-based certification system that combines site inspections and records review to help program participants meet the global demands for wholesome seafood produced in an environmentally and socially responsible manner. It has developed standards to certify shrimp hatcheries and shrimp, tilapia, channel catfish, pangasius, and salmon farms. This emphasizes on worker safety and employee relations, worker safety and health, storage and disposal of farm supplies, drug and chemical management, microbial sanitation, and harvest and transport.

Check Your Progress 5

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Describe the occupational health effects due to aquaculture.

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2.7 LET US SUM UP

In this unit we have studied about the:

- Sources of aquaculture pollutants
- Feed practices in aquaculture
- Effects of pollutants on environment
- Effects of pollutant on human health
- Antibiotic usage and resistance in aquaculture and
- Occupational health impacts in aquaculture.

Aquaculture is a threat to our environment. An efficient aquaculture system limits the environmental impact and also repairs the overfished oceans and lakes. Regulation of aquaculture can help in the manufacture of better products for human consumption, and can benefit the economy.

2.8 KEYWORDS

Aquaculture : It is the cultivation of different fishes, crustaceans, algae, and molluscs. Aquaculture includes developing freshwater and saltwater populaces under controlled conditions and can be diverged from business angling, which is the gathering of wild fish. It is also known as aquafarming.

Mariculture **:** It is a specialized branch of aquaculture that involves the cultivation of marine organisms for food and other products particularly in the open ocean, an enclosed section of the ocean, or in tanks, ponds that are filled with seawater. This includes the farming of marine fish, including finfish and shellfish like prawns, or oysters and seaweed in saltwater ponds. Some examples of non-food products produced by mariculture include: fish meal, nutrient agar, jewellery (e.g. cultured pearls), and cosmetics.

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2.10 ANSWERS TO CHECK YOUR PROGRESS

Your answers should include the following points:

Answers to Check Your Progress 1

1. Your answers should include the following points:

   Definition of aquaculture

   Definition of mariculture

   Concepts

Answers to Check Your Progress 2

1. Nutrients required for fish

   Protein, vitamin, carbohydrates and minerals

   Common fish feed: -vegetarian feed, trash feed and pellet feed

   Choose the right fish feed: nutrition, hygiene, storage methods, and environmental impacts

Answers to Check Your Progress 3

1. Refer to section 2.4
2. Human sickness because of natural chemicals is regularly connected with long-term.

   Refer to section 2.4.2

Answers to Check your progress 4:

1. Refer to section 2.5.1
2. Refer to section 2.5

Answers to Check Your Progress 5

1. Refer to section 2.6

UNIT 3 LIVESTOCK AND AQUACULTURE AND MANAGEMENT PRACTICES

Structure

3.0 INTRODUCTION

Coordinated cultivating of fish and animals is an old work on comprising of the way of life of fish (or shrimp) related with the cultivation of trained creatures, for example, pigs, ducks, chicken, etc. Integrated cultivating is customary in Asia, particularly in China and is presently likewise connected in Europe and, on a little scale, in Africa and some Latin American countries. In numerous nations, aquaculture is currently considered as a wellspring of contamination of the earth because of the arrival of natural issue into the waterways. This is especially the instance of trout ranches. Escalated cultivating of pigs and poultry deliver expansive amounts of excrement and creature wastewaters which should now be dealt with the goal to counteract genuine natural problems. The most pervasive technique for compost transfer is its utilization as manure ashore, yet exorbitant utilization of manures will prompt eutrophication of inland and waterfront waters. There is a plausibility of reusing natural squanders, composts and homestead effluents in angle lakes. Ancient practices based on the modifications of natural water bodies to entrap young fish in enclosures until harvest, have now evolved into more systematic and scientific methods. A number of aquaculture practices are used globally in three types of environments. They include the freshwater, brackish water, and marine

environments. Freshwater aquaculture is carried out either in fish ponds, fish pens, fish cages or, on a limited scale, in rice paddies. Brackish water aquaculture is done mainly in fish ponds located near the coastal zones. Marine culture uses either fish cages or substrates for molluscs and seaweeds such as stakes, ropes, and rafts. The fundamental standards engaged with coordinated cultivating are the usage of the synergetic impacts of between related ranch exercises, and the preservation, including the full use, of homestead squanders. It depends on the idea that "there is no waste", and "waste is just a lost asset which can turn into an important material for another item". Best management practices (BMP's) are defined as the management of activities to achieve an ongoing minimisation of the activities' environmental harm through cost-effective and continually assessed measures. By their nature, BMP's refer to a wide range of interventions that can be made to improve or optimise performance in financial, social, environmental and in the prevention of avoidable impacts associated with aquaculture activities.

3.1 OBJECTIVES

After reading this unit you should be able to:

- understand farm siting and construction;
- define the feed practices in aquaculture;
- describe the monitoring nutrient balance;
- explain about the solid and liquid manure handling;
- describe composting and anaerobic lagoon system;
- define effluent storage;
- understand biogas disposal; and
- describe manure separation and storage.

3.2 FARM SITING AND CONSTRUCTION

3.2.1 Farm Siting

Proper site determination is a standout amongst the most vital elements that decide the accomplishment of the fish farming. Before the development of the lake, the water maintenance limit of the dirt and the dirt fruitfulness must be dealt with on the grounds that these elements impact the reaction to the natural and inorganic treatment in the ranch lake. The chosen site ought to have satisfactory water supply round the year for lake filling and different employments. The lake development must be founded on the topographic zone. In swampy and muddy regions, bunds ought to have a more prominent collection of soil to manufacture the lake of the best size. Self-depleting lakes are perfect for higher height zones. The site ought to be effortlessly open by street or any type of transport to achieve the market for simple fish transfer. What's more, the openness of information sources, for example, encourage, seed, manure and the development material ought to likewise be accessible adjacent the site. The site ought to be free from contamination, modern waste, residential waste and some other unsafe exercises. Farm siting depends upon three factors:

- Ecological factors

1. Soil: The quality of soil impacts the lake efficiency and water quality and decides the dyke development. The properties of soil surface and soil porousness are resolved to choose the appropriateness of a site. Lake base ought to be able to hold the water. Loamy, mud loamy and sediment earth soil writes are most appropriate for lake development. A decent quality rock ought not to surpass 10 percent. In this way the rough, sandy, rock and limestone soil composes are to be avoided.

2. Water: A satisfactory measure of water is required to construct the fish cultivate on the grounds that water profundity should be balanced at consistent interims. Characteristic water bodies, for example, repository, stream, and lakes have stable water quality parameters (Water temperature, broke down oxygen, pH, alkalinity and water hardness) when contrasted with borewell and well water. The site ought to be far from the surge zone. Water ought not be acidic or basic and if observed to be along these lines, appropriate amendment is to be finished by applying lime or natural excrement separately. The perfect water temperature is 20 – 30 degree Celsius for a fish cultivate. Water Salinity is the measure of salt break up in water.

3. Topography: Sort of lake development is dictated by the land geography. Ordinarily, regions affected by the flood and poor precipitation territories should be maintained a strategic distance from. Territories, for example, modern zones, fields with underground oil pipelines, unpredictable land region, fields with high power posts and radio poles and very established vegetation region are additionally not suggested for lake development.

    - Biological factors: Organic elements incorporate the species to be refined, seed source and type of culture and they should be considered before site determination of farm.

    - Social and economic factors: The environmental and natural components are an essential for good practices in aquaculture site determination and site administration. It is additionally critical to become more acquainted with the social and financial foundation of the region and comprehend the way of life and conventions, especially thoughts and convictions privately connected with aquaculture hones. The social texture, market, and its structure, benefits specifically or in a roundabout way connected with aquaculture area, for example, transportation, stockpiling, discount advertise viewpoints and so forth are to be considered. The land recognized for homestead ought to be without lawful issues and fish cultivating ought to be acknowledged by the nearby individuals. Different variables incorporate accessibility of work, power, therapeutic offices, and transportation.

3.2.2 Construction

Plan and design is essential for a pond or lake development. The unearthed earth ought to be utilized to build the dyke and with a trudging incline towards the outlet for the best possible depleting office. Ideally development of lake must be finished amid summer with the goal that the lake can be utilized for stocking. Various steps involved in construction are the following:

- Set up the site by evacuating undesirable things, for example, the trees,

shrubberies, and shake

- Development of drainage free and secure dyke by utilizing the mud center
- Burrowing the lake and development of dyke over the mud center
- Bay and outlet development
- Lake dyke secured with soil and plant grass species (maintain a strategic distance from since quite a while ago established plants, for example, Rhodes grass and star grass)
- Lake ought to be fenced to maintain a strategic distance from burglary and section of savage creatures.

1. Preparation of sites: The place is cleared of ropes, links and different things. Trees and brambles and different obstructions that upset development of substantial hardware around the site are to be evacuated - physically/creature control/utilizing apparatus. All vegetation including wood is to be cleared in the territory. Trees inside 10 meters encompassing, tree droops, huge stones, are likewise to be expelled. The surface soil which has the most noteworthy convergence of roots and natural material isn't reasonable for lake development. Consequently, around 30 cm of surface soil must be expelled.

2. Dyke construction: Dykes ought to be minimal, strong and release free. An attractive dyke is built utilizing 15 - 30 percent of sediment, 45 - 55 percent of sand and 30 - 35 percent of dirt. To raise the dyke, the mud buddle (1:2 sand and earth) is kept as 10 - 15 cm thick layer and it can be shaped at focus or inside the waterside of the lake. The peak of the dyke ought to be adequate to help united ranch exercises and the highest point of bank ought to be over 1 m. Additional outlet is basic on the dike as a wellbeing measure to evade harm because of overabundance bring up in the water level.

3. Inlet and Outlet construction: Feeder trenches are developed to give adequate measure of value water to the lakes aside from in lakes which are filled by water. Deltas are given at best of the lake and screens are utilized to channel the directed water to dodge passage of undesirable particles to the way of life framework. The channel pipe estimate must be planned is such a path, to the point that it ought not to take more than 1 or 2 days to fill the lake.

   The outlet pipe is set up at base of the lake. It is utilized to dewater the lake amid gather and fractional depleting for lake water trade to keep up the water nature of the lake amid the way of life period. The outlet is built preceding lake dyke development.

4. Soil and vegetation coverage of dyke: For the decrease in dirt disintegration, crawling grass can be developed on the best and sides of dyke. The banana and coconut trees can be planted in the bank. The slant of the dike can be planted with grasses, for example, Hybrid Napier, gunny grass and elephant grass to supply encourage to the grass carps raised in the lakes.

5. Fencing of ponds or lakes: The lakes are fenced. Live fences give protection

to cultivate and enhance the presence of the fish cultivates. Some examples are live fence, heaped fence, woven fence, post and rail fence, wire fence, wire netting wall and stone divider. Each kind of fence has its own points of interest. Wired net fence is essentially utilized as a part of fish homesteads to stop gatecrashers and secure the fish stock.

Check Your Progress 1

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Explain farm siting.

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2) Describe the construction of aquaculture.

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3.3 FEED PRACTICES

Fish/shrimp developed in semi-concentrated and escalated culture lakes are given supplementary and full counterfeit sustains, separately, the previous to enlarge the characteristic nourishment in the lake, the last to thoroughly supplant the normal creatures in the water as a wellspring of sustenance.

A wide assortment of encourage fixings is utilized to get ready supplemental/ manufactured sustains. The easiest fish sustains are set up at the lake site utilizing locally accessible crude materials like rice or corn grain, copra dinner, and rice process sweepings as wellsprings of starches. These are typically blended with creature protein like waste fish/angle feast, shrimp heads, and snail meat. Supplemental nourishes for tilapia are readied utilizing 80% rice grain and 20% fish supper. Those for shrimps in enhanced broad culture as a rule incorporate crisp crude materials like snail/mussel/mollusk meat or carabao cover up and other slaughterhouse scraps.

Commercial feed (CP) arrangements are additionally accessible now in an extensive variety of brand names, generally for semi-serious and concentrated shrimp culture. These business weight control plans comprise of various fixings like fish dinner, blood supper, bone meat, and shrimp head feast, together with vitamin and mineral premix and starch sources like rice/corn grain or wheat. The unrefined protein (CP) substance of these shrimp bolsters is for the most part not lower than 30% to fulfill the protein necessity of shrimps.

Commercial feeds as a rule come in different details to coordinate the protein prerequisites. In this manner, shrimp sustains come in various structures as starter, cultivator, and finisher, with starter bolsters having the most noteworthy CP substance of around 40% and finisher nourishes having the least CP substance of around 20%. Starter sustains are normally given in the main month

of culture, finisher feeds in the most recent month, and producer in the middle. Some shrimp culturists incline toward not to give manufactured doses in the initial two weeks of culture when the recently supplied post hatchlings can subsist on the tiny fish accessible in the water.

The nourishing rate is figured as a level of the assessed creature biomass in the lake, with higher apportions given when the creatures are little and bit by bit diminishing as they end up greater. Every day sustaining rate, for the most part, begins at 5% and 10-15% of the evaluated biomass of fish and shrimps, separately, and declines to a low of 2% and 5%, for fish and shrimps, individually, toward gather. The day by day encouraged proportions are given in rising to partitions over the span of a day. Freshwater fish like tilapia are typically bolstered twice every day - early morning and late evening. Penaeid shrimps are nourished all the more habitually, from three to four to as regularly as six to seven times each day.

Sustains are communicated into the water or potentially provided on encouraging plate. In semi-concentrated and serious shrimp lakes, little feeding vessels are utilized via overseers who circumvent the lake circulating nourish by communicating. At specific focuses along the outskirts of the lake, feeding plate are submerged into the water after known amounts of bolster are put to supply nourishment to the shrimps in the lake and also to screen utilization and shrimp development. The nourishing plate is observed after a few hours to check whether the shrimps are solid and bolstering. By checking the feeding plate, one can get an idea of the sizes and amount of shrimps in the lake.

Check Your Progress 2

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Describe about feed practices in aquaculture.

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3.4 MONITORING NUTRIENT BALANCE

The contamination stack in wastewater is variable; it relies upon a few parameters. It is discovered that the waste amount released from a fish cultivate is specifically identified with temperature. The extent of supplements in the particulate division expanded with temperature. This relationship depends on the way that an expansion in temperature likewise expands the rate of digestion. In coordinated escalated aquaculture frameworks, the waste load, for example, nitrates and phosphates can be diminished if the framework angle is refined with different living beings, for example, plants utilized as biofilter, which can change over supplement releases into significant items. It can be concluded that the blend of fish culture with resulting phototrophic and herbivorous transformation expands supplement maintenance in the way of life framework (e.g., 20%– 42% encourage nitrogen to 29%– 45% bolster nitrogen). This relative little increment is because of the herbivores, as herbivorous transformation considerably diminishes the supplement maintenance

accomplished by phototrophic change by 60%– 85% bolster nitrogen and 50%–90% sustain phosphorous.

Different aggravates that are available in aquaculture wastewater are waste, anti-toxins and a few hormones. The squander incorporates phosphorus (P) and nitrogen (N) based supplements, or suspended solids.

Check Your Progress 3

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Explain the monitoring of nutrient balance in livestock and aquaculture management.

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3.5 WATER UTILIZATION

Water in the lake is kept at specific levels for ideal fish development. A lake water profundity of 1 meter is viewed as best for culture of tilapia, carps, and shrimps; conventional milkfish lakes can do with 40-60 cm of water. Lake water is not simply kept up at a specific profundity; its quality should likewise be kept high to guarantee ideal development. This is especially critical in semi-serious and escalated culture frameworks where a lot of metabolites are continuously discharged into the lake and where overabundance, unconsumed encourages add to the base load and serve to dirty the water. Lake water is constantly refreshed by the section of new water from the stream or water source while old water is depleted through the outlet/seepage entryway and through the waste channel into the ocean or stream.

Flow through the arrangement of water administration that permits the concurrent passage and exit of water into and out of the lake is fundamental in any high-thickness culture framework. This is affected by the arrangement of discrete gulfs and outlets for every one of the lakes, every channel managing the stream of water from the supply waterway to the lake and every outlet controlling the release of water out of the lake into the seepage trench. Both the supply and deplete doors are so outlined as to bring water into an empty water from the lower levels of the lake, where water quality has a tendency to get poorer quicker because of the amassing of squanders and their ensuing deterioration.

The normal renewal of lake water, is influenced by the utilization of pumps which draw water from the source even at low tide. Despite the fact that there is no rigid lead with regards to the rate of water change important for medium-to high thickness aquaculture, semi-concentrated culture frameworks generally change water at the rate of 10% day by day for a proportional aggregate substitution of water each ten days or three times each month.

Concentrated lakes/tanks for the most part need to accommodate air circulation to counteract anoxia that may prompt mass mortalities. Oxygen exhaustion in high-thickness lakes comes about not just from the quicker rate of usage of

oxygen break up for respiratory exercises; it is likewise caused by the quick rate of decay at the lake base by high-impact or oxygen-expending small scale creatures.

Paddlewheels or different kinds of aerators are hence given in the lakes to impact the implantation of more prominent amounts of oxygen into the water and anticipate shrimp mortalities. The aerators are typically worked at consistent/intermittent interims for certain settled lengths during the day.

Lake water is additionally consistently tested and estimations taken of fundamental/basic parameters especially oxygen, pH, and saltiness. This is critical to determine the requirement for restorative/healing activity for monitoring the water quality.

Check Your Progress 4

Note: a) Write your answer in about 50 words.

b) Check your answers given at the end of this unit.

1) Describe how water utilization is done in aquaculture management.

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3.6 SOLID MANURE HANDLING AND LIQUID MANURE HANDLING

The kind of equipment is utilized as a part of excrement taking care of framework relies upon the solids content. Domesticated animals compost is named a solid, semi-solid or liquid utilizing the accompanying criteria:

- Solid/Strong – The compost's strong substance is more noteworthy than 20%. The utilization of sheet material further adds to the solids substance of the excrement. To create a strong fertilizer, the fluid must be depleted off and the excrement dried or bedding included. At this consistency, the strong fertilizer would then be able to be stacked.
- Semi-Solid (likewise alluded to as slurry) – Contains 5% to 20% solids.
- Liquid – Contains fewer than 5% solids. The extra fluid originates from washing and draining house squander water.

3.6.2 Solid Manure Handling

Manure from tie slow down or neck chain dairy tasks are regularly taken care of because of liberal measures of sheet material blended with the compost. These horse shelters regularly have a drain cleaner for gathering and after that either a transport or pump to exchange the compost outside to the capacity territory. Customary cleaning of the horse shelter is additionally vital to an effective fly control program. Other fly control measures incorporate expelling wet sustain amid fly reproducing season, discarding dead creatures and fetal membrane and keeping excrement putting away zones dim. You can likewise store excrement in encased structures, secure ventilation bays with screens and routinely splash with endorsed bug sprays.

Compost from most sorts of hamburger activities is taken care of and put away as a strong, for the most part on a chunk or on the ground. The compost and

bedding amasses in the stable until the point when it is occasionally evacuated. Front-end loaders are typically utilized to expel the compost from the stable and exchange it to the capacity region.

Pigs are for the most part housed in stables with a pen framework in light of cement floors. Hoard compost can be taken care of as a strong on account of the bedding blend (sawdust, wood shavings, and so forth.) yet business activities, by and large, utilize a fluid compost framework.

Fur cultivates by and large house fox and mink reproducers in outside pens with a wire base or inside little structures or horse shelters. In outside frameworks, the fertilizer falls through the work to the ground beneath. The excrement is then physically taken care of also, taken to the fertilizer stockpiling zones, which is for the most part outside. Excrement created in indoor frameworks is taken care of in a comparable manner. Since the amounts of fertilizer is little on hide ranches, it is proper for agriculturists to compost the excrement for spreading at a later date. In different circumstances, administrators who are not running blended endeavors may have other domesticated animals administrators handle their excrement for spreading on cultivate arrive.

3.6.3 Liquid Manure Handling

Manure frameworks with the expectation of complimentary slow down dairy horse shelters are typically intended for semi-strong or on the other hand fluid fertilizer. These frameworks don't include the utilization of any sheet material. Excrement is either gathered under slatted floors or with the utilization of scrubbers. It is then held in a pit under the floor or is exchanged to long haul capacity using transports, gravity stream pits or pumps. As of now, just a modest number of dairy ranches are utilizing free slow down offices in the territory.

Table 3.1: Manure handling for different wastes

Operation	Solids	Semi solid/liquid
Collection	Gutter Cleaners Front End Loaders	Slatted Floors Scrapers cable or hydraulic tractor
Transfer	Manure Wagons Open Tank Spreaders Dump Trucks Earth Moving Equipment Conveyors Pumps	Pumps submerged, open impeller piston pneumatic Augers Vacuum Tank Wagon Pipeline Gravity Continuous Flow Gutters Large Diameter Pipes
Storage	Stockpile Bunk Silo	In-Building Below Ground concrete (open/covered) earthen

		Above Ground concrete/glass lined steel
Treatment	Aerobic compost dry incinerate	Aerobic pre-storage partial total Anaerobic Solid/Liquid Separation
Utilize/disposal	Land Application Energy Production Bedding	Land Application Irrigation Energy Production

Check Your Progress 5

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Describe solid manure handling.

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2) Explain liquid manure handling.

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3.7 COMPOSTING AND ANAEROBIC LAGOON SYSTEM

Composting the soil creature composts has a few focal points over applying new excrement to the dirt. In spite of the fact that the way toward treating the soil involves more work and capacity zones, the advantages to the dirt exceed these elements. The point of making manure is to deliver the dull, brittle substance called humus from materials that would some way or another be considered as ‘squander’ on the smallholder cultivate. Humus is found on woodland floors and is the aftereffect of regular procedures that separate plant and creature trash and is loaded with advantageous microorganisms and plant supplements. Fertilizing the soil is the way toward accelerating this separate of materials, which would somehow happen all the more gradually if the individual materials were added to the dirt specifically. Treating the soil empowers the way toward separating plant materials to be controlled and the fertilizer would then be able to be connected where required. The humus coming about because of treating the soil significantly adds to soil richness and product nourishment.

Compost can be made both with and without creature compost. Creature excrement is added to the manure heap so as to get the microorganisms and different living beings required for the disintegration procedure. In any case,

these can likewise be presented utilizing top soil or ant colony soil set up of excrement in the layers of the manure heap.

Benefits of composting manure system:

- It enhances the natural, concoction and physical properties of the dirt by empowering the development of gainful living beings, for example, worms, microscopic organisms, growths and different microorganisms. Treated the soil compost adds natural issue to the dirt. This is additionally the situation while applying crisp compost, however new fertilizer connected specifically to the dirt may cause a transitory awkwardness of supplements, which might be unsafe to trim development.
- Fresh compost is acidic. The way toward fertilizing the soil builds the pH (making it less acidic) bringing about a more ideal soil condition for plant development and expanding the accessibility of supplements.
- It diminishes misfortunes of nitrogen by making this key product supplement more steady and accessible over a more drawn out timeframe. This is additionally the case for the other plant supplements contained in the manure, for example, phosphorus, potassium, calcium, magnesium and micronutrients, which are discharged to the plants slowly. The advantages of treated the soil compost will in this manner keep going for in excess of one season.
- The procedure of treating the soil excrement, if completed accurately to achieve temperatures of 58 degrees centigrade will slaughter weed seeds contained in the creature composts. In the event that temperatures achieve 60 degrees centigrade, plant and creature pathogens are additionally lessened.
- It will likewise diminish the smell of crisp fertilizer, making it more pleasant to deal with.

3.8 EFFLUENT STORAGE

Having very much planned and built storeroom will spare you time and cash. The key is great arranging and working with the individuals. The advantages of an all-aroxund planned capacity framework include:

- Significant serenity
- Expanded adaptability around watering
- Successful use of supplements and water
- Decreased danger of emanating rebelliousness
- Natural security

Following a few gatherings of ecological pros and disease transmission specialists, a WHO Scientific Group on Health Aspects of Use of Treated Wastewater for Agriculture and Aquaculture touched base at the microbiological quality guidelines for wastewater use in farming. These rules depended on the accord that the genuine hazard related with water system with treated wastewater is much lower than already thought and that prior principles and rules for emanating quality, for example, the WHO (1973) suggested principles, were prohibitive, especially in regard of bacterial pathogens.

The new rules are stricter than past models in regard of the necessity to lessen the quantities of helminth eggs (Ascaris and Trichuris species and hookworms) in effluents for Category A and B conditions to a level of not in excess of one for each liter. Likewise suggested by the rules is the desire that protozoans will be decreased to an indistinguishable level from helminth eggs. Albeit no bacterial pathogen constrains is forced for Category C conditions where cultivation laborers are the main uncovered populace, and that there is practically no confirmation demonstrating a hazard to such specialists from microscopic organisms, some level of diminishment in bacterial fixation is suggested for any profluent utilized circumstance.

The WHO Scientific Group thought about the new way to deal with profluent quality would expand general wellbeing insurance for the huge quantities of individuals who were presently being tainted in regions where crops are eaten uncooked are being inundated in an unregulated, and frequently illicit, way with crude wastewater. It was felt that the prescribed rules if embraced would accomplish this change and set targets which are both innovatively and monetarily achievable. Nonetheless, the need to translate the rules deliberately and change them in the light of neighborhood epidemiological, sociocultural and natural elements was additionally called attention to.

Wastewater treatment forms accomplishing the prescribed microbiological quality reliably because of their natural plan qualities, as opposed to by elevated requirements operational control, are to be favored. Notwithstanding the microbiological quality prerequisites of treated effluents utilized as a part of horticulture, consideration should likewise be given to those quality parameters of significance in regard of groundwater tainting and of soil structure and harvest profitability.

Check Your Progress 6

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Explain about composting and anaerobic lagoon system

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2) Describe the effluent storage in live stock

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3.9 BIOGAS DISPOSAL

Biogas refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste. Anaerobic assimilation is fundamentally a straightforward procedure completed in various advances that can utilize any

natural material as a substrate. It happens in stomach related frameworks, bogs, squander transfer destinations, septic tanks and the Arctic Tundra. People tend to influence the procedure as entangled as conceivable by endeavoring to enhance nature utilizing complex machines; however a basic approach is as yet conceivable.

Biogas is produced exclusively through the action of microorganisms, not at all like treating the soil in which parasites and different animals are likewise engaged with the debasement procedure of organic material.

It has a tendency to happen normally wherever high centralizations of wet natural issue aggregate, most usually in the base dregs of lakes and lakes, in swamps, peat marshes, digestive organs of creatures and in the anaerobic insides of waste transfer destinations.

Biogas is a blend of methane (otherwise called bog gas or petroleum gas), carbon dioxide and various follow components. Promotion can happen over a wide temperature go from 4 to in excess of 100 °C and an assortment of dampness substance from around 60% to over 99%. Ordinary anaerobic digesters are generally intended to work either in the vicinity of 35 and 40 degree Celsius or in the range in the vicinity of 52 and 57 degree Celsius. There are two purposes behind these high temperatures. To begin with, higher temperatures increment yield for a given digester limit, and second they increment the decimation of pathogens exhibit in crude excrement.

3.10 MANURE SEPARATION AND STORAGE

Manure can be thought of as a blend of water, minerals, and natural segments. A portion of the minerals will be dissolved and break down in the water, while the rest will tend to settle to the base or buoy to the highest point of the excrement stockpiling. The thickness of the natural segments depends if they settle to the base of the capacity unit or stay in suspension. The measure of water, wellspring of compost, and excrement dealing with framework will decide the degree of these patterns. The absolute most critical factor influencing the propensity to isolate is the measure of water in the compost. With low dampness (strong) compost, next to no evident partition happens. As the dampness content increases the inclination for division additionally increases.

3.10.1 Benefits of Separation

Regardless of whether transportation separation and phosphorus application rates are not a worry utilizing solids division preceding capacity decreases the solids amassing in holding lakes and tidal ponds. This expands the time between muck expulsion tasks and amplifies the fluid stockpiling limit of the holding lake or tidal pond.

Another potential advantage is the diminishment in odours. Under the anaerobic conditions found in holding lakes and tidal ponds microorganisms deliver musty mixes. Lessening the measure of accessible fertilizer with solids partition has a tendency to diminish the generation of questionable odours.

In creature constrainment frameworks where water from holding lakes and tidal ponds are utilized to flush fertilizer from the outbuildings, solids partition can bring about a superior quality reuse flush water.

The isolated excrement solids have a diminished dampness content and expanded supplement fixation both of which increment its incentive as a manure source. Furthermore, contingent upon the subsequent dampness content it turns into a potential manure fixing. Where the subsequent manure might be utilized as bedding or possibly showcased off ranch.

Compost partition is likewise prone to assume a basic part in planning excrement for change in into vitality. Distinctive vitality change advances will require the compost to have diverse physical and substance properties.

Check Your Progress 7

Note: a) Write your answer in about 50 words.
b) Check your answers given at the end of this unit.

1) Explain about biogas disposal process.

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2) Describe the manure separation and storage in livestock.

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3) What are the benefits of manure separation?

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3.11 LET US SUM UP

In this unit we have studied about the following:

- Farm siting and construction
- Feed practices in aquaculture
- Monitoring the nutrient balance
- Water utilization
- Solid manure handling and liquid manure handling
- Composting and anaerobic lagoon system
- Effluent storage
- Biogas disposal
- Manure separation and storage

3.12 KEY WORDS

Best management practices (BMP's) : are defined as the management of activities to achieve an ongoing minimisation of the activities' environmental harm through cost-effective and continually assessed measures.

Biogas : refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant material, sewage, green waste or food waste.

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3.14 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress 1

Your answers should include the following points:

1. - Proper site determination is a standout amongst the most vital elements that decide the accomplishment of the fish farming.

- Water maintenance limit of the dirt and the dirt fruitfulness must be dealt with on the grounds
- chose site ought to have satisfactory water supply round the year for lake filling and different employments.
- Lake development must be founded on the topographic zone.
- Farm siting depends upon three factors
- Ecological factors: - Soil- Water- Topography
- Biological factors
- Social and economic factors:

2. - Set up the site by evacuating undesirable things, for example, the trees, shrubberies, and shake
   - Development of drainage free and secure dyke by utilizing the mud center
   - Burrowing the lake and development of dyke over the mud center
   - Bay and outlet development
   - Lake dyke secured with soil and plant grass species
   - Lake ought to be fenced to maintain a strategic distance from burglary and section of savage creatures.
   - Preparation of sites
   - Dyke construction
   - Inlet and outlet construction
   - Fencing of ponds

Answers to Check Your Progress 2

Your answers should include the following points:

1. - Fish/shrimp developed in semi-concentrated and escalated culture lakes
   - Wide assortment of encourage fixings is utilized to get ready supplemental/manufactured sustains.
   - easiest fish sustains are set up at the lake site utilizing locally accessible crude materials like rice or corn grain, copra dinner, and rice process sweepings as wellsprings of starches.
   - These are typically blended with creature protein like waste fish/ angle feast, shrimp heads, and snail meat. Supplemental nourishes for tilapia are readied utilizing 80% rice grain and 20% fish supper.
   - Commercial feed arrangements are additionally accessible now in an extensive variety of brand names, generally for semi-serious and concentrated shrimp culture.

- These business weight control plans comprise of various fixings like fish dinner, blood supper, bone meat, and shrimp head feast (to fill in as attractant for the shrimp), together with vitamin and mineral premix and starch sources like rice/corn grain or wheat.
- The unrefined protein (CP) substance of these shrimp bolsters is for the most part not lower than 30% to fulfill the high creature protein necessity of shrimps, really assessed to be around 40% amid the prior phases of development.
- Commercial feeds as a rule come in different details to coordinate the protein prerequisite of the way of life form.
- Starter sustains are normally given on the main month of culture, finisher feeds on the most recent month, and producer encourages in the middle.

Answers to Check Your Progress 3

Your answers should include the following points:

1. - The contamination stack in wastewater is variable, it relies upon a few parameters.
   - It is discovered that the waste amount released from a fish cultivate is specifically identified with temperature.
   - Extent of supplements in the particulate division expanded with temperature.
   - This relationship depends on the way that an expansion in temperature likewise expands the rate of digestion.
   - In coordinated escalated aquaculture frameworks, the waste load, for example, nitrates and phosphates can be diminished if the framework angle is refined with different living beings, for example, plants utilized as biofilter, which can change over supplement releases into significant items.
   - It can be concluded that the blend of fish culture with resulting phototrophic and herbivorous transformation expands supplement maintenance in the way of life framework.
   - This relative little increment is because of the herbivores, as herbivorous transformation considerably diminishes the supplement maintenance accomplished by phototrophic change by 60%– 85% bolster nitrogen and 50%– 90% sustain phosphorous.
   - Different aggravates that are available in aquaculture wastewater are encourage inferred waste, anti-toxins and a few hormones.
   - The encourage inferred squander incorporates parts that are either broken up, for example, phosphorus (P) and nitrogen (N) based supplements, or that are in the strong stage, for example, suspended solids.
   - These solids can generally convey 7%– 32% of the aggregate nitrogen (TN) and 30%– 84% of the aggregate phosphorus (TP) in wastewater.

- The rest of transported out of the ranch in the broke down portion, since it is to a great extent impractical to expel them by molecule partition methods, which are normally utilized for aquaculture wastewater treatment.

Answers to Check Your Progress 4

Your answers should include the following points:

1. - Water in the lake is kept at specific levels for ideal fish development.
   - Lake water profundity of 1 meter is viewed as best for culture of tilapia, carps, and shrimps; conventional milkfish lakes can do with only 40-60 cm of water.
   - Lake water isn't simply kept up at a specific profundity.
   - To keep the crumbling of the lake condition, lake water is constantly refreshed by the section of new water from the stream or water source while old water is depleted through the outlet/seepage entryway and through the waste channel into the ocean or stream.
   - Flow through the arrangement of water administration that permits the concurrent passage and exit of water into and out of the lake is fundamental in any high-thickness culture framework.
   - Every channel managing the stream of water from the supply waterway to the lake and every outlet controlling the release of water out of the lake into the seepage trench.
   - The normal renewal of lake water, free of common tidal vacillations, is influenced conceivable by the utilization of pumps which to draw water from the source even at low tide.
   - Rate of water change important for medium-to high thickness aquaculture, semi-concentrated culture frameworks generally change water at the rate of 10% day by day for a proportional aggregate substitution of water each ten days or three times each month.
   - Concentrated lakes/tanks for the most part need to accommodate air circulation offices/hardware to counteract anoxia that may prompt mass mortalities.
   - Oxygen exhaustion in high-thickness lakes comes about not just from the quicker rate of usage of broke up oxygen for respiratory exercises.
   - Lake water is additionally consistently tested and estimations taken of fundamental/basic parameters especially broke down oxygen, pH, and saltiness.
   - This is critical to determine the requirement for restorative/healing activity to convey water quality to ideal levels and get great yields.

Answers to Check Your Progress 5

Your answers should include the following points:

1. - Manure from tie slow down or neck chain dairy tasks is regularly taken care of as a strong because of liberal measures of sheet material blended with the compost.

- These horse shelters regularly have a drain cleaner for gathering and after that either a transport or pump to exchange the compost outside to the capacity territory. -Customary cleaning of the horse shelter is additionally vital to an effective fly control program.
- Compost from most sorts of hamburger activities is taken care of and put away as a strong, for the most part on a chunk or on the ground.
- The compost and bedding amasses in the stable until the point when it is occasionally evacuated.
- Front-end loaders are typically utilized to expel the compost from the stable and exchange it to the capacity region.
- Pigs are for the most part housed in stables with a pen framework in light of cement floors.
- Hoard compost can be taken care of as a strong on account of the bedding blend yet business activities, by and large, utilize a fluid compost framework.
- Fur cultivates by and large house fox and mink reproducers in outside pens with a wire base or inside little structures or horse shelters.
- The fertilizer falls through the work to the ground beneath.
- The excrement is then physically took care of also, taken to the fertilizer stockpiling zones, which is for the most part outside.
- Excrement created in indoor frameworks is taken care of in a comparable manner.

2. - Manure frameworks with the expectation of complimentary slow down dairy horse shelters are typically intended for semi-strong or on the other hand fluid fertilizer.
   - These frameworks don't include the utilization of any sheet material.
   - Excrement is either gathered under slatted floors or with the utilization of scrubbers.
   - It is then held in a pit under the floor or is exchanged to long haul capacity using transports, gravity stream pits or pumps.
   - Refer Table 2

Answers to Check Your Progress 6

Your answers should include the following points:

1. - Composting the soil creature composts has a few focal points over applying new excrement to the dirt.
   - In spite of the fact that the way toward treating the soil involves more work and capacity zones, the advantages to the dirt exceed these elements.
   - The point of making manure is to deliver the dull, brittle substance called humus from materials that would some way or another be considered as 'squander' on the smallholder cultivate.

- Humus is found on woodland floors and is the aftereffect of regular procedures that separate plant and creature trash and is loaded with advantageous microorganisms and plant supplements.
- Fertilizing the soil is the way toward accelerating this separate of materials, which would somehow happen all the more gradually if the individual materials were added to the dirt specifically.
- Treating the soil empowers the way toward separating plant materials to be controlled and the fertilizer would then be able to be connected where required.
- The humus coming about because of treating the soil significantly adds to soil richness and product nourishment.
- Compost can be made both with and without creature compost
- Fresh compost is acidic.
- Diminishes misfortunes of nitrogen by making this key product supplement more steady and accessible over a more drawn out timeframe.
- The procedure of treating the soil excrement.
- It will likewise diminish the smell of crisp fertilizer, making it more pleasant to deal with.

2. - Having very much planned and built storeroom will spare you time and cash.
   - The key is great arranging and working with the opportune individuals.
   - The advantages of an all-around planned capacity framework
   - Significant serenity
   - Expanded adaptability around watering
   - Successful use of supplements and water
   - Decreased danger of emanating rebelliousness
   - Natural security
   - Refer table 3

Answers to Check Your Progress 7

Your answers should include the following points:

1. - Biogas is created when microscopic organisms debase natural material without oxygen, in a procedure known as anaerobic processing.
   - Anaerobic assimilation is fundamentally a straightforward procedure completed in various advances that can utilize any natural material as a substrate.
   - It happens in stomach related frameworks, bogs, squander transfer destinations, septic tanks and the Arctic Tundra.

- Biogas is produced exclusively through the action of microorganisms, not at all like treating the soil in which parasites and different animals are likewise engaged with the debasement procedure of organic material.
- It has a tendency to happen normally wherever high centralizations of wet natural issue aggregate, most usually in the base dregs of lakes and lakes, in swamps, peat marshes, digestive organs of creatures and in the anaerobic insides of waste transfer destinations.
- Biogas is a blend of methane (otherwise called bog gas or petroleum gas), carbon dioxide and various follow components.
- Promotion can happen over a wide temperature go from 4 to in excess of 100 °C and an assortment of dampness substance from around 60% to over 99%.
- Ordinary anaerobic digesters are generally intended to work either in the vicinity of 35 and 40 degree Celsius or in the range in the vicinity of 52 and 57 degree Celsius.
- There are two purposes behind these high temperatures. To begin with, higher temperatures increment yield for a given digester limit, and second they increment the decimation of pathogens exhibit in crude excrement.

2. - Manure can be thought of as a blend of water, minerals, and natural segments.
   - A portion of the minerals will be solvent and break down in the water, while the rest will tend to settle to the base or buoy to the highest point of the excrement stockpiling.
   - The thickness of the natural segments will decide if they settle to the base of the capacity unit, stay in suspension, or shape a gliding outside.
   - The measure of water, wellspring of compost, and excrement dealing with framework will decide the degree of these patterns.
   - More on strong fluid detachment's part in compost storage.
   - The absolute most critical factor influencing the propensity to isolate is the measure of water in the compost.
   - With low dampness (strong) compost, next to no evident partition happens.
   - As the dampness content expands the inclination for division additionally increments.
   - While describing fertilizer's physical attributes it is regularly thought of just like a strong, semisolid, slurry, or fluid.
   - From a useful point of view partition is restricted to fluid, slurry, and once in a while semisolid compost.
3. - Regardless of whether transportation separation and phosphorus application rates are not a worry utilizing solids division preceding

capacity decreases the solids amassing in holding lakes and tidal ponds.

- This expands the time between muck expulsion tasks and amplifies the fluid stockpiling limit of the holding lake or tidal pond.
- Another potential advantage is the diminishment in smells.
- Under the anaerobic conditions found in holding lakes and tidal ponds microorganisms deliver musty mixes.
- Lessening the measure of accessible fertilizer with solids partition has a tendency to diminish the generation of questionable smells.
- In creature constrainment frameworks where water from holding lakes and tidal ponds are utilized to flush fertilizer from the outbuildings, solids partition can bring about a superior quality reuse flush water.
- The isolated excrement solids have a diminished dampness content and expanded
- supplement fixation both of which increment its incentive as a manure source.
- Contingent upon the subsequent dampness content it turns into a potential manure fixing.
- Compost partition is likewise prone to assume a basic part in planning excrement for change in into vitality.
- Distinctive vitality change advances will require the compost to have diverse physical and substance properties.