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A Study Based On Environmental Impacts Due To Dairy Effluents

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ABSTRACT
Due to its high water use, the dairy business is one of the most environmentally damaging of all food industries. One of the main industries contributing to water contamination is dairy. Given the rising demand for milk, the dairy industry in India is predicted to expand quickly, and waste generation and associated environmental issues are also given more weight. The dairy business may perform a number of activities, such as pasteurisation, cream, cheese, milk powder, etc. The dairy industry is accountable for numerous forms of environmental pollution, including sizable emissions of greenhouse gases that contribute to climate change, thanks to its industrial-scale farms housing thousands of cattle. The industry not only harms the environment, but it also causes a great deal of animal suffering. The limited number of businesses that have grown to control the sector are also substantially to blame for driving out smaller, family-run farms. Smaller farms struggle to make milk at the low prices that large farms, which are frequently supported by subsidies and other financial incentives.
Keywords- *Dairy industry, Environmental pollution, Greenhouse gases etc.*

I. INTRODUCTION

Large amounts of milk are handled by the dairy sector, and water is the main processing byproduct. Minerals and organic milk products in significant concentrations can be found in the water that was extracted from the milk. Additionally, plant cleaning produces caustic effluent. When released to the surface of the land or water, poorly treated wastewater with high levels of contaminants produced by subpar design, operation, or treatment systems causes significant environmental issues. Highly putrescible organic elements are present in dairy waste water. Prior to being disposed of into the environment, the waste water must be promptly and adequately treated. The majority of the organic materials in dairy waste are quickly biodegradable. The effluent can therefore be treated biologically, either aerobically or anaerobically.

More greenhouse gas emissions are produced by livestock production than by any other source in the food industry. According to the Food and Agriculture Organisation of the United Nations, the worldwide dairy cow herd expanded by 11% while milk output increased by 30% between 2005 and 2015. 2.9 percent of all human-induced greenhouse gas emissions come from the dairy industry. In addition, dairy production in intensive agricultural systems significantly contributes to soil erosion and deforestation, as well as air and water pollution. 92 of the 195 nations committed to achieving the goals of the Paris Climate Agreement have recognised their respective livestock industry as a potential area for climate action to reduce national emissions.

II. ENVIRONMENTAL IMPACTS OF DAIRY

In addition to the damage that expanded dairy production causes to the environment, utilising cattle to produce dairy in such massive amounts has detrimental effects on both the animals utilised and the humans who interact with them or live nearby.

2.1 Air Pollution

In the United States, the dairy industry plays a significant role in greenhouse gas emissions. One fifth of the nation's estimated total greenhouse gas emissions are attributed to dairy farms. Other types of air pollution are also brought on by dairy farms, including an estimated 19 to 24% of the nation's total ammonia emissions. Pollution from dairy farms and other livestock production facilities can be fatal. In fact, the number of fatalities linked to livestock air pollution has surpassed the number of fatalities linked to coal power stations. Aproximately 12,700 Americans perish each year in the US as a result of exposure to pollutants from animal husbandry operations. Emissions from dairy farms are responsible for about 2,000 fatalities.

2.2 Water Pollution

The nearby communities' local rivers are contaminated by intensive dairy farming operations, rendering them risky if not outright unsafe. Large vats are used to store the manure before it is spread on surrounding crop fields from thousands of dairy cow kept in factory farms. But because there is just too much manure to safely and effectively apply to the field, nitrogen and phosphorus frequently leak into the neighbouring waterways. Over time, these vats may also develop cracks and tears that permit their contents to leak out, contaminate nearby bodies of water, and reach the groundwater.

2.3 Deforestation

Land must be cleared in order to grow the cow's food, which contributes significantly to deforestation when cattle are raised for agricultural purposes, notably to generate milk for use in dairy products. The consumption of milk in the US necessitates the usage of over 44,000 square miles of land—roughly the size of Virginia.

2.4 Soil Health

Dairy farming degrades soil health in a variety of ways. Soil clogging is one instance, which happens when the earth is overly damp. The earth becomes more compacted as a result of the cows' movement, which hinders plant growth. Using or moving heavy equipment over too-wet soil can result in the same issue.

2.5 Animal Health

The cows kept for milk production regularly experience a variety of health problems. The most prevalent ones include mastitis, lameness, and infertility. Mastitis is a painful mammary gland inflammation that can be brought on by an infection or trauma. Mastitis is such a widespread malady that it is generally acknowledged that all dairy herds will have cattle who are afflicted, albeit the proportion of the herd infected might range from 5 to 75 percent.

2.6 Animal Welfare

Dairy cattle experience physical and mental pain in addition to major health difficulties on a daily basis for the purpose of producing milk. Dairy cows are nearly constantly expecting calves, yet once they give birth, the calves are frequently hauled away and sold as veal within hours.

2.7 Worker Health

One risky component of working on a dairy farm is coexisting with animals that can weigh a tonne or more. The dangers of working on a dairy farm are not limited to the cows. Additionally, manure storage facilities and large machines are potential to hurt workers. The risks of working on a dairy farm are increased by the fact that in the United States, labourers of Hispanic descent make up the majority of the workforce and frequently lack prior agricultural work experience. Due to the language difficulties created by this circumstance, receiving adequate training is more challenging.

III. Effects of Effluents

3.1 Effects on Environment

Dairy production ranks among the most polluting industries, both in terms of the amount of wastewater it produces and in terms of its general makeup. On average, 2.5 L of wastewater are produced per litre of processed milk, ranging from 0.2 to 10 L of effluent per litre of processed milk. Effluents from dairy processing are produced sporadically, and their flow rates fluctuate a lot. The type of product being processed, the production plan, operating procedures, the design of the processing plant, the level of water management being used, and subsequently how much water is conserved, all affect the volume, concentration, and composition of the effluents produced in the dairy industry. Due to its biochemical composition, which is rich in organic matter (lactose, protein, phosphate, nitrates, and nitrogen), sweet whey is between 60 and 80 times more polluting than household sewage. Large levels of casein and other milk components, as well as inorganic salts and detergents and sanitizers used for washing, can be found in dairy waste water. Their high biological oxygen demand (BOD) and chemical oxygen demand (COD) are mostly caused by all of these components. which is significantly higher than the limits established by the Indian Standard Institute (ISI), now known as the Bureau of Indian Standard (BIS), for the discharge of industrial effluents; As these wastes are typically released to the nearby stream or land without any prior treatment, it is reported to cause serious pollution issues. Dairy effluents quickly break down and reduce the dissolved oxygen in receiving streams, which instantly causes anaerobic conditions and the emission of potent foul odours as a result of nuisance conditions. The receiving water turns into a breeding ground for mosquitoes and flies that spread diseases including dengue fever, yellow fever, and chikungunya as well as malaria. Additionally, it has been found that certain fish and algae species are harmful when dairy wastes are present in higher concentrations. Dairy waste is shown to be hazardous to fish due to the casein precipitation that forms from manure and decomposes further into a foul-smelling, black sludge at certain dilutions. Soluble organics, suspended solids, and trace organics are present in dairy effluent. They cause taste and odour, increase gas release, contribute colour or turbidity, and encourage eutrophication. The main environmental issues associated with milk production have an impact on biodiversity, air, and water pollution. They frequently lead to an increase in algae and bacteria, which deplete the water's oxygen supply and eventually suffocate rivers, causing fish populations to slowly decline. Consequently, it is required to treat dairy effluents using a variety of techniques.

3.2 Effects on Water

3.2.1 The Organic Components

Proteins, lactose, and fat are the three categories for the organic substances found in wastewater from dairy manufacturing processes. Depending on how easily they dissolve in water and how easily they biodegrade, these will have a variety of environmental effects.

3.2.2 BOD and River Oxygen Levels At 15–25 °C, fully aerated rivers have oxygen concentrations of at least 8 g/m3. Because of this, it's imperative that discharges into rivers maintain an oxygen level of at least 6 g/m3. This requires that the discharge to the river not raise the river's BOD level by more than 3 g m3 (depending on the river's re-aeration characteristics). Dairy production waste has rare, highly biodegradable organic components. Bacteria will eat the waste's organic components in streams.

3.2.3 Sewage Fungus

Certain filamentous slimes in rivers are encouraged to proliferate by low molecular weight chemical substances. Sewage fungus is present in these bacterial colonies. Sphaerotilusnatans is the most prevalent bacterial species in this classification. Lactose, a low molecular weight sugar that is known to encourage the growth of sewage fungus, is one of the main components of dairy plant wastewaters.

Despite the possibility of genuine colour emerging following various sorts of treatment, dairy factory wastes likely contain little soluble colour. The waste's colloidal and particle components reflect light back to the viewer. It is referred to as apparent colour. This phenomenon is closely related to the idea of turbidity. Large amounts of stuff found in milk wastes will cause discharges to become turbid.

3.2.4 The Inorganic Components (Mainly Nitrogen and Phosphorus)

Recovering the waste's protein (the organic nitrogen component) and turning it into marketable goods is one of industry's primary goals. As a result, nitrogen plays a crucial role in the wastewater from dairy factories. There will be some protein lost to the waste streams. Protein nitrogen is converted by bacteria to inorganic forms such ammonia, ammonium, nitrite, and nitrate ions. These inorganic nitrogen forms all have various effects on the environment. High quantities of nitrate ions are harmful to both people and livestock. Nitrate can be transformed into nitrite in early newborns, taken into the bloodstream, and used to change haemoglobin into methaemoglobin. Oxygen cannot be transported by haemoglobin. Because they lack the enzyme needed to convert methaemoglobin back to haemoglobin, infants less than six months are more susceptible to methaemoglobinaemia. Methaemoglobinemia can also affect livestock. Methaemoglobinaemia can cause death because ruminants have a more neutral stomach pH and rumen microorganisms that convert nitrates to nitrite. Although a restriction of 30 g m3 nitrate-nitrogen on drinking water for stock has been advised, this typically occurs from the intake of nitrate-rich feed. Inorganic phosphates and nitrogen in the forms of nitrate, nitrite, and ammonium ions serve as plant nutrients in rivers. It has been recommended that total inorganic nitrogen concentrations in receiving waters be kept to a minimum of approximately 30 to 100 mg m3 or that dissolved reactive phosphorus (inorganic phosphorus) concentrations be kept to a minimum of about 15 to 30 mg m3.

3.3 Effects on Land

Wastewater application to soils is a common method of waste treatment in the dairy industry

3.3.1 Nutrients (Nitrogen and Phosphorus) the major mechanisms for nutrient removal in soil based treatment systems are

•Plant uptake and incorporation in animal products
•Adsorption and immobilization in the soil
•Losses to the atmosphere
•Losses to groundwater (leaching).

Nitrogen absorption by plants can reach 500 kg/ha per year. There are roughly 30 kg of phosphorus present. Up to 90% of the nitrogen and phosphorus in the pasture are recycled if animals eat it later. Nitrogen is lost to the atmosphere both through denitrification and the volatilization of ammonia from dung and urine patches. Microorganisms convert nitrate to either nitrous oxide or dinitrogen gas during the denitrification process. When an appropriate organic carbon source is available for energy and there are anoxic circumstances (i.e., low oxygen levels), this happens. At places where waste water irrigation is used, denitrification rates can be fairly high. Depending on how much nitrogen is removed by other methods, some irrigation locations may experience nitrogen losses (mostly in the nitrate form) to groundwater. The nitrate pollution of ground fluids that are subsequently used as water supplies for people or livestock is the factor that typically restricts the disposal of wastes containing nitrogen to soils. Under these conditions, it is typical to apply standard drinking water recommendations. Because phosphates are highly retained and immobilised in soils, phosphorus normally does not present an issue via leaching to groundwater.Salt and Other Minerals, Section 3.3.2 The cation exchange sites on soil colloids and clays are occupied by sodium, potassium, calcium, and magnesium, which are all immobilised by soils.

3.4 Effects on the Atmosphere

3.4.1 vaporised emissions The atmosphere may be exposed to a variety of emissions as a result of manufacturing processes. Carbon dioxide, sulphur oxides, and nitrogen oxides are released into the atmosphere by boiler stacks. Anaerobic waste treatment systems have the potential to release methane, while wastewater irrigation sites have the potential to release nitrous oxide (N_2O) from the soil. Since nitrous oxide, methane, and carbon dioxide are three of the most significant greenhouse gases, it is likely that the effects of their emissions will need to be taken into account in the future.

3.4.2 Dust/Odors Boiler stacks, powder dryers, and other devices can emit particulate pollutants. Other production operations may also result in particle material losses. In addition to being unsightly, dust and powder that coats nearby buildings when particulate emissions are high can also be corrosive. Factory smoke and steam plumes could potentially be categorised as visual pollution. At industrial processing locations, it is necessary to take into account the emission of offensive odours. Unfavourable odours can be produced by several waste treatment facilities.

IV. CONCLUSIONS

This review article included wastewater treatment, ways to reduce the amount of organic and inorganic material in the wastewater, and the effects of wastewater discharged into the environment. Characterization of waste water, treatability studies, and development of appropriate units and processes for effluent treatment are absolutely important in order to have proper processes in the effluent treatment plant. Water Waste and its Sources Wastes from the production of milk-based products include milk solids due to their variable concentration and diluted state. Nearly all of the operations produce waste that contains these substances. Generally speaking, the wastes produced by the dairy sector are as follows:

After each processing cycle, it is customary to wash and rinse out any product that was left in the tank, trucks, cans, pipelines, tanks, and other equipment.Spillage is caused by leaks, overflows, freezing-on, boiling over, and careless handling. Processing losses consist of sludge discharge from settling tank, discharges from bottles and washers, splashing, and container breakage in automatic packaging equipment.

4.1 Large Dairies Destroy Local Economies

Many dairy farmers are struggling financially as a result of the transition away from family farms and towards huge corporate dairy operations, which limits their capacity to support their local economies. As a result, less money is spent in their own neighbourhood, which results in decreased profitability for the neighbourhood companies that farmers would normally support.

4.2 Is it Ever Environmentally Friendly to Eat Dairy?

As just 24% of the calories consumed by calves are turned into milk, dairy is actually a poor source of nutrition. Therefore, a gallon of milk requires four times as many calories to produce as there are in the finished product. Because of this gap, nutritional alternatives like soy milk provide a comparable nutritional benefit while having a smaller negative impact on the environment.

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