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Review on Environmental Impact of Unsafe Dairy Waste Disposal in Maychew Town of Southern Zone of Tigray Ethiopia

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Abstract
In Ethiopia, a number of dairy farms are major suppliers of milk and milk products to the customers. However, the dairy farming management practice was a big challenge to the environment of the residents due to unsafe dairy waste disposal management practice and weak enforcement practice of Gov. Though, most of the households obtained proper trainings about environmental safety and dairy waste disposal management principles, they have not got the proper supports and facility services from the agriculture and municipal office in the areas. Hence, many farm households claimed for enough and appropriate dairy farming sites. The dairy farming surrounding environment was commonly observed with the sully and manure wastes on the roadside and walkways, in runoff and sewerage canals and nearby open spaces, which in turn caused bad smelling and respiratory related problems on the neighboring communities. Furthermore, it also aggravates the local environment pollution and greenhouse gases emissions. Thus, at the dairy farm stage manure management and feed productions were the main causes of the potential greenhouse gases (GHG) emissions of methane (CH_4), Nitrous oxide (N_2O) and carbon dioxide (CO_2). Finally, preparing hole/storage tanker for the sully and manure wastes was the best mechanism to minimize the bad smelling effects, while to overcome the environmental effect relocating the dairy farming business out of the residual sites and then proceeding it with an appropriate management practices and controlling systems is recommended.
Keywords: Dairy wastes, Methane (CH4), Environmental impact, GHGs, mitigation, Maychew town.
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1. INTRODUCTION

Dairy manure means a final digested and undesirable or unused materials release as a feaces or waste products which also contains all 13 of the essential plant nutrients that are used by plants. Plant nutrients originate from the feed, supplements, medications, and water consumed by the animals. Using **dairy manure** as a fertilizer for crops or trees may provide a portion, or all, of the plant requirements.

Waste can be solid, liquid, or gaseous and each type has different methods of disposal and management. Waste disposal management deals with all types of waste, including industrial, biological and household. In some cases, waste disposal can pose a threat to human health. Health issues are associated throughout the entire process of waste disposal management. Health issues can also arise indirectly (through the consumption of water, soil and food) or directly (through the handling of solid waste). Waste disposal is produced by human activity, for example, the extraction and processing of raw materials. Waste disposal management is intended to reduce adverse effects of waste disposal on human health, the environment, planetary resources and aesthetics (In collaboration with the Ethiopia Public Health Training Initiative November 2004).

Ethiopia has a large livestock population. Due to this potential most of its population is depending on the activities of agriculture (www.un.org/---policy.htm). Obviously, the people in the high land of Ethiopia are engaged in mixed farming which comprises both crop production and animal rearing in a traditional way. The most dominant activities of people living in the low land areas of the country are pastoralists. Similarly, many people living in areas also practice farming mostly in dairy farms (Bank November 17, 2017).

In Ethiopia there are many small holding dairy activities ranging from a house cow to milk producers or enterprises for source of additional income in a very traditional way without considering its effect on the environment due to the unmanageable of waste disposal which resulted from dairy farming activities (Livestock Economist June 1996).

In the absence of waste disposal regulations and their rigorous implementation and enforcement, waste disposal will tend to out for the cheapest available course of action. For example, household dairy waste, may be dumped in the street, on the vacant land or in to drains, streams or at the watercourses or it may be burned. The uncontrolled burning of waste disposal creates particulate and persistent organic pollutant emissions or GHGs like methane (CH_4). That is highly damaging or warming locally and globally. These (University of Tennessee March 2010).

The most common environmental concern with animal waste disposal is that it affects the atmosphere with offensive odors. Release of large quality es of carbon dioxide and ammonia contribute to acid rain and the greenhouse effect. It could also pollute water source and be instrumental in speeding infectious disease. Globally,

around 87% of our total energy is generated by fossil fuels, of which 28% comes from coal, 21% comes from natural gas, and the remaining 38% comes from oil. Dairy industry producing 79.4%, 82.5%, and 85.7% of the manure, N, and P excretion, respectively (US January 2020)

According to the Federal Democratic Republic Ethiopia (FDRE) constitution, Environmental protection Authority establishment proclamation No 9/1995 article 55(1), the definition of the environment is given as the totality of the resource whether in their natural state or as modified or changed by man as well as the external conditions and impacts which affects the quality and quantity of solid resources and the welfare of human beings. In some cases, benefits from agriculture would clearly outweigh potential negative consequence, such as environmental pollution, health hazards, water contamination, food safety concerns, etc. particularly related to livestock production.

Based on this, Ethiopia states about environmental protection on FDRE constitution article 55 (2) as environmental protection to mean the protection of land, water, air and similar other environmental resources, factors and conditions which affect the life and development of all organisms including human beings. So, everyone should know about the environmental protection to the people and keeps safely to our live from different problems that life of the people (FDRE 22 J. Ethiopian L. 75 (2008)).

In Maychew town many people are participating in different economic activities of agriculture. One of these is dairy farming which has practiced mostly as a source of livelihoods. However, the main issue is how to protect the environment from the effect of waste, what mechanism should be used dairy farm owners to alleviate the problems. Accordingly, this study will focus on assessing dairy farm waste disposal management practice in Maychew that affect the environment due to farming especially dairy farming which holds many people as source of livelihood in the areas.

OBJECTIVES

General objective

- ❖ To review the environmental impacts of the unsafe dairy waste disposal management in Maychew town.

Specific objectives:

- ☑ To review the problems related to the unmanageable dairy wastes disposing
- ☑ To review the health impacts of the dairy waste disposal management
- ☑ To review sustainably maintaining the dairy for versatile energy sources

2. LITRATURE REVIEW

2.1 Environmental effect of wastes

2.1.1 Livestock and the Environment

Livestock interact with the environment in many ways. Livestock can damage global natural resources in a number of ways, but there are also many examples of environmental balance and positive contributions. Livestock interact on a global scale with land, water, air, plant and animal biodiversity (Lutz, 1998). About 34 million square kilometers, or about 21% of the world's land area, are used for grazing livestock. In addition, 3 million kilometers, or 21 %of the world′s arable area, are used for cereal production for livestock feed. Livestock produce 13 billion tons of waste disposal a year. A large part of this is recycled, but where animal concentrations are high, poses an enormous environmental hazard (Lutz, 1998). Livestock and livestock waste disposal cause gaseous emission that has important local and global impact on the environment. Livestock grazing can affect the water balance in certain areas.

All food production systems have an impact up on the environment, regardless of how and where the food is produced. The effects that agricultural practices have upon environmental parameters are increasing well – known, not only to the global and national industries, but also to policy-makers and consumers. Increased public awareness of these issues underlines the critical need to adopt dairy production systems that reduce the environmental impact of agricultural production.

This may be achieved through the use of management practices and technologies that encourage conservation and environmental stewardship at the farm – level, as well as improving processing and transportation operations to reduce the eventual environmental and economic cost to the consumer. In the following sections we discuss the potential for improved production to act as a tool to mitigate the environmental impact of dairy production.

Globally, animal agriculture is estimated to contribute approximately 18% of total greenhouse gas emissions (Seinfeld et al., 2006) and the dairy industry is therefore often targeted as being particularly detrimental to the environment.

Manufacturing operations can result in a number of emissions to the atmosphere. Boiler stacks result in emissions of carbon dioxide, Sulphur oxides and nitrogen 244 B.V. Raghunath et al. oxides to the atmosphere. Methane may be emitted from anaerobic waste disposal treatment systems and nitrous oxide (N2O) is emitted

from the soil at wastewater irrigation sites. Carbon dioxide, methane and nitrous oxide are very important greenhouse gases, and it is likely that the consequences of these emissions will need to be considered in the future. Agricultural sources of water pollution (InstituteNamakkalIndia 22 March 2016)

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. (Wikipedia, the free encyclopedia)

On a worldwide basis, agriculture probably contributes more to water pollution that does any other single activity. In the United States, agriculture is estimated to be responsible for about two-thirds of stream pollution (Barrow, 2006). Agriculture runoff carries three main types of pollutants: fertilizers, biocides and wastes.

Agriculture is a chief contribution of excess nutrients to water bodies. Pollution occurs when nitrates and phosphates that have been used in fertilizers and that are presents in animal manure drain into streams and rivers, eventually accumulating in ponds, lakes and estuaries. Livestock waste disposal generates methane, ammonia, and hydrogen supplied, which cause nuisance smells, damage vegetation downwind because of the ammonal and act of greenhouse gases. If such slurry escapes, it can cause serious stream, lake or ground water pollution (Barrow, 2006). Water pollution is a major global problem which requires ongoing evaluation and revision of water resource police at all levels. It has been suggested that it is the leading world wind cause of deaths and diseases, and that it accounts for the deaths of more than 14,000 people daily. An estimated of 580 people in India die of water pollution related illness every day. Around 90% the water in the cities of China is polluted, and as of 2007, half a billion Chinese had no access to safe drinking water.

In addition to the acute problems of water pollution in developing countries, developed countries continue to struggle with pollution problems as well. In most recent national report on water quality in the United States, 45 percent of assessed stream miles, 47% of assessed lake acres, and 32 percent of assessed bays and estuarine square miles were classified as polluted, The head of Chinas national development agency in 2007 said 1/4th the length of China′s seven main rivers were so poisoned the water harmed the skin (Wikipedia, the free encyclopedia). Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, such as drinking water, or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water. (Wikipedia, the free encyclopedia) The herbicide and pesticides used in agriculture are another source of the chemical pollution of water bodies. Runoff from farms where such biocides have been applied contaminates both ground and surface water one of problems connected with the use of biocides is that the long term effect of such usage are not always immediately known DDT, for example was used for many years before people discovered is effect on birds, fish and water plant life.

Whereas technology exists to use energy content of manure, biogas plants of all sizes and levels of sophistication not only recover the energy contained in measure but also climate most of the animal and human health problem associated with contamination of waste disposal by micro-organisms. Other method of controlling the waste disposal load is the purifying and drying of manure.

Animals generate waste. While many traditional crop and livestock operations use manure as a fertilizer, letting animals roam on roam on land after harvest to build up organic matter. Industrial operations have for too much waste disposal (and for too linle land) to use this method. Most industrial operations store waste disposal in massive lagoons that can hold millions of gallons of liquid manure. They may spread or spray some of the manure on available land. When it is spread in excessive quantities or when the lagoons leak, problems result.

There are numerous examples of pollution problems originating in cattle feedlots and industrial dirties more waste disposal than is produced by dairy industry. A state-wide study in California conducted by the environmental protection agency (EPA) estimates that each dairy cow produces almost 44,000 pounds of manure per year. California is now home to over 1.5 million dairy cows. Many of the operations are located in the SanJoaquin valley, which is struggling to deal with the manure problem and related pollution issues (Wikipedia, the free enclopedia).

Nitrogen and other pollution become an even greater public concern when the effects of manure contamination spread from the operation outward into the community and beyond. Manure contamination can spread in ground water on products washed with contaminated water. In an era of national and even global food distribution, we are all risk when the rural environment is compromised.

Promising approaches exist to reduce emissions from manure logons by recovering machine and using it for energy. Large confined animals' operations allow such technique to be profitable. This machine can be used for on-farm energy electriareas and the slurry effluent can be used as animal feed, agriculture supplements, or as crop fertilizer. The controlled bacterial decomposition of the volatile solids in manure reduces the potential for Contamination from runoff, significantly reduces pathogen levels, removes most noxious odors, and retains the organic nitrogen content of the manure (Authority 15 January 2018).

2.1.2 Waste disposal from milk processing

Dairy factory wastewaters are increasingly being considered a valuable resource. However, these waters may also contain contaminants, natural or artificial, that may adversely affect the land to which they are applied. This review investigates dairy wastewaters, factors affecting their composition, some probable effects on land and compounds that may be used to trace the migration of pollutants.

Dairy factory wastewaters differ depending on the types of products made by the factory and the treatment afforded wastewaters. In addition to milk and milk by-products, dairy factory wastewaters contain cleaning chemicals that contribute to the salt load, and synthetic compounds.

From the limited studies where the effects on dairy processing wastewaters on land have been measured, the consensus of the literature results acknowledges the utility to agriculture can be highly variable and depends on the land to which it was applied and wastewater characteristics including concentrations of phosphorus, nitrogen, carbon and sodium. Excessive applications of nutrients such as nitrogen and phosphorus have resulted in runoff to nearby watercourses.

Even fewer studies have investigated the use of organic marker compounds in the dairy industry. Lipids, terpenes and sterols found in the plants consumed by livestock would be useful for identifying pollutants from the dairy industry.

However, a library of biological marker compounds and their likely sources is needed before such a technology could be applied more widely (Department of Primary Industries, 2010).

The concentration of organic compounds in waste disposal leads to oxygen demand, usually expressed as Biological Oxygen Demand (BOD). Waste water contains fat, oil, protein, carbohydrates, and other biodegradable compounds. Degradation of these organic substances requires oxygen. In addition, waste water usually contains insoluble organic and inorganic particle called suspended solid.

In most developing countries, tannery effluent is discharged through sewer into inland surface water, or irrigated on the land (Verheijen, 1996). High concentration of salt and hydrogen sulphide present in tannery waste water greatly affects the quality of water. Suspended matter such as lime, hair and fleshing make the surface water turbid and settle to the bottom, thereby affecting fish.

2.1.3 Gaseous Emission of Livestock and Waste

Livestock and livestock wastes produce gases. Some are local such as ammonia. Others such as carbon dioxide (CO_2), methane (CH_4), ozone (O_3), and nitrous (N_2O), affect the world′s atmosphere, by causing global warming or global climate.

The main sources of livestock – related carbon dioxide emissions, is the result of all domesticated animals emit carbon dioxide as part of their metabolic function or respiration, estimated at a total of 2.8 billion metric tons annually. Carbon dioxide is released in relation to livestock – related consumption of fossil fuel for heating, manufacturing, machinery, and producing feed (Meteorology 12 February 2007).

Methane gas is much more aggressive 24 times than carbon dioxide in causing global climate change. It is the product of animal production and manure management, rice cultivation, production and distribution of oil and gas pipelines, coal mining, and landfills. Livestock production and manure management contribute about 16% of total annual production of 550 million tons. Methane gas is produced mainly as a by-product of the feed digestion of ruminants (U.S. Environmental protection Agency, 1995).

It is evident that questions relating to livestock and the environment cannot be solved in environmental terms only. A comprehensive perspective is needed to ensure an enabling police framework in which effective technologies can be introduced. Technology remains the key component because future development, including that of the livestock sector, will depend on technology to substitute for natural resources.

Piling up too much stuff in one place causes problems. If you spread out the animals and let manure lay where it falls in a pasture, it doesn′t bother anyone very much. But if you start collecting it, flushing it spreading and spraying it around all normal practices in confinement operations it becomes air pollution. (John, 2001)

2.2 Dairy farm waste disposal and its problem

Dairy farms make awful neighbors. As anyone who is endured the nauseating stench of manure constructed right beside her/ his home. When a dairy farm moves in, the surrounding community deteriorates the local economy stagnant, property values plummet and the oppressive odor permeates everything furniture, carpets, clothes, drapes blankets, beds etc. Grace Communications Foundation (GCF, 2015). Livestock wastes contaminate both surface and ground water and it has a considerable effect on climate (Charles, 2005).

2.3 Manure management

Most methane emissions from manure management are related to storage and anaerobic treatment. Although manure deposited on pasture can produce nitrous oxide emissions, the mitigation measures are often difficult to apply because of the manure dispersion on pasture. Therefore, most mitigation practices involve shortening storage duration, improving timing and application of manure, used of anaerobic digesters, covering the storage,

using a solids separator, and changing the animal diets. Anaerobic digestion can reduce methane emissions while producing biogas (UniversityKalapetIndia September 2011). Anaerobic digesters are lagoons or tanks that maintain manure under anaerobic conditions to capture biogas and combust it for producing energy or flaring. This process reduces the potential of GHG emissions by converting methane into CO2. Unfortunately, anaerobic digesters are costly for producers; the best approach for implementing digesters is through policies that create enough incentive for adaptation.

The solids separator is mostly used in confinement systems to remove solids from manure streams that are entering the treatment or storage systems. By removing the solids from manure streams methane emissions are reduced, the time between storage systems cleaning is increased, and crust formation is prevented. These practices, compared to anaerobic

2.4 Reducing enteric methane production

A set of nutritional strategies proved efficient in reducing methane emissions in ruminants.

- ☑ Replacing roughages with concentrates results in increased proportion of propionate in the rumen, thus less hydrogen available for CH4 production
- ☑ Feeding legume forages results in less emission of CH4 than grass-based diets.
- ☑ Feeding ensiled forages reduces methanogenesis.
- ☑ Improving pasture management is associated with decreased CH4 emissions due to improved livestock productivity and a reduction of dietary fiber.
- ☑ Administering plant extracts (condensed tannins, saponins, and essential oils) reduces CH4 emissions. Tannins have a direct effect on methanogenesis and indirect effect on hydrogen production due to lower feed degradation. Saponins, glycosides available in many plants, have direct effect on rumen microbes. They decrease protein degradation and favor at the same time microbial protein and biomass synthesis. Saponins induce protozoa suppression. Essential oils contain many biologically active molecules which have antimicrobial properties. Some compounds in essential oils are toxic to methanogens.
- ☑ Supplementing ruminants with lipid sources (fat or oils) impacts negatively on methanogenesis by toxiareas to methanogens, causes defaunation thus suppresses protozoa associated methanogens and decreases fiber digestion.
- ☑ Administering ionophores like monensin in the diet results in a shift of bacterial population from gram positive to gram negative organisms with a concurrent shift in the fermentation from acetate to propionate.

2.5 Impact of Dairy Cattle on Climate Change

Dairy production plays a part in greenhouse gases (GHGs) emissions, particularly methane, which contributes to climate change. Livestock sector as a whole is responsible for 18% of total anthropogenic GHG emissions measured in carbon dioxide (CO2) equivalent, and global dairy production accounts for 4% of the total global anthropogenic GHG emissions. Very high carbon footprint (CF) of milk in Sub-Saharan Africa is due to a particularly low milk yield (less than 500kg per cow and year) and a high age of cows when having their first calf. GHG emissions from raw milk production at farm level have a dominating influence (70-90%) on the carbon footprint (CF) of dairy products. CH4 (from enteric fermentation and manure management) and N2O (from production and use of fertilizer) are the main sources of emissions making up about 70-90% of total GHG emissions at the primary production stage. CH4 is produced naturally by microbial fermentation in the rumen of dairy cows. More than 95% of the CH4 comes from belching, while only a minor proportion is produced in the large intestine and passed out as flatulence. Thus, CH4 is a natural process and a condition affecting ruminants that convert grass and other plants, not digestible to humans, to valuable products such as milk and meat. CH4 production is an energy loss for the animal, and loss of CH4 (or 'CH4 conversion factor') is dependent on the type and quality of the feed and is typically between 4% and 10% of the gross energy intake for ruminants (Press 25 March 2020).

2.6 Benefits of dairy farm waste

Dairy waste manure is used as nutrients for farmers, gardeners, landscapers, and others commonly **use** livestock **manure** as a **fertilizer** to provide nutrients needed for crop production. **Manure** nutrients have real value as **fertilizer**.

Dairy wastes are good for soil conditioners improving land productivity (Herman son, 2005). Dairy wastes are used as fuel source either by direct combustion or converted to biogas (Jones et al., 2005). Dairy cow manure is the resource to generate renewable energy. The manure is collected and heated, creating the natural byproduct of methane gas. That biogas is the fuel used to power the generators and creates electriareas. (www.dairynetcom//animalphp) (thor contentAll content in this area was uploaded by Richard Lowrance on Apr 17, January 1998).

3. CONCLUSION AND RECOMMENDATIONS

3.1 CONCLUSION

Industrial waste disposal management is nowadays one of the main issues for ensuring a sustainable environment. Dairy waste disposal management in particular, is very crucial in view of the high organic matter and high nutrient levels contained in dairy effluents. Dairy waste disposed can be effectively treated either with aerobic or anaerobic processes.

Anaerobic digestion is a microbiological process that converts biodegradable organic material into biogas, consisting primarily of methane and carbon dioxide. Anaerobic digestion technologies have been integrated into wastewater treatment facilities nationwide for many decades to increase the economic viability of the treatment process by converting a waste disposal stream into two valuable products: biogas and fertilizer or as organic compost. Thus, anaerobic digestion offers potential economic and environmental benefits of organic waste disposal diversion and renewable energy generation (Environment and Resources April 2003).

The dairy farming practices and experiences is common in Maychew town for long period of time. Dairy farms can have huge benefits for a community or they can be a nightmare. Dairy farms require some form of effluent management system. A range of site-specific factors, such as herd size, proximity to creeks, gullies and underground aquifers, climate, soil type and availability of labor, should be considered when selecting the most appropriate system for a particular farm. In most situations, pond systems are more desirable than continuous application systems. However, well designed and managed continuous application systems may be quite acceptable and even more suitable than pond systems in some situations. They are generally better 248 B.V. Raghunath et al. able to protect the environment, and enable farmers to make the most effective use of the nutrient and water value of the effluent.

3.2 RECOMMENDATIONS

- The agriculture practice has a significant share in supplying different products food related products to the market and the surrounding communities due to the production potential. Due to this a number of farm households were also ignorance to the enforcement of the environmental legislations of the country. Thus, Areas Municipal authority should regularly follow up the application of the environmental principles and take measures timely. So inappropriate waste disposal practices due to the lack enough site and storage. Thus, the areas municipality should provide appropriate facilities and also enough spaces deserve the services somewhere out of the residual plots. **Therefore, to mitigate the climate change: -**
- The Bureau of agricultural development (BoAD) professionally and technically should develop as a green developmental strategy by supporting and initiating the introduction and utilization of biogases as alternative power energy source for dairy farm households as well as production of organic fertilizers for sell to generate income and its utilization rates per ha.
- Awareness creation/training on climate change, and improved cap areas of herders/dairy producers to understand and deal with climatic changes
- Should be develop or improve the habit of feeding concentrates, legume forages and improving pasture management, supporting scientifically by research institutions.
- Native breeds should be developed to improve more adaptable to the climate change
- Should be administering some ionophores and bacteriocin in the diet of dairy cows.

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