



THE ROLE OF LIVESTOCK PRODUCTION AND AQUACULTURE IN WATER POLLUTION AND PUBLIC HEALTH IN NIGERIA

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Abstract

Due to the growing demand for food by ever increasing human population especially in Nigeria, the most populous nation in Africa has led to increase intensification of livestock and aquaculture resources. However, animal agriculture is not properly regulated. With greater proportion of livestock population reared on extensive system with the commercial rearing of livestock and fishes produce liquid and solid effluents that cause environmental and water pollution with public health consequences. Water pollution by animal agriculture includes microbial, chemical and solid waste contaminations that find their way along the course of rural and urban surface and ground water used for domestic activities. This paper includes data from previous and ongoing studies of detection and characterization of zoonotic pathogens, antibiotic resistance genes, and residues in Nigerian water bodies including treated dam water for drinking by human beings in Nigeria. Also, other anthropogenic dissemination of antibiotic residues including pharmaceutical and hospital effluents distribution into the water course occur in Nigeria with implications in water microbial ecology, resistance and disease transmission. Biochemical risk analysis and mitigations for sustainable animal agriculture will ensure safe water resources for domestic and agricultural purposes.

1 Introduction

Livestock production in Nigeria, like other parts of Africa is not properly regulated, and animals are reared in both intensive and extensive systems to meet animal protein need of the growing population, thereby generating huge volumes of solid wastes and liquid effluents [1]. Enormous wastes are generated in most cases as litters and heaps of untreated and improperly managed ones, thereby constituting nuisance, environmental and water pollution with attendant public health consequences [2]. Several factors such as lack of knowledge of hygienic and safe treatment and disposal of livestock waste by Nigerian farmers contribute to environmental and water pollution, thereby posing health risks to terrestrial and aquatic habitats in Nigeria.

Intensive agriculture, peri-urban and urban livestock production activities generate huge volumes of biosolids and bioliquid wastes [3]. Livestock effluents comprise majorly organic



materials laded with microorganisms, also provide good medium for growth and multiplication of pathogenic and non-pathogenic microorganisms [4]. Also, accumulation of animal wastes consisting very high levels of nitrogen, phosphorus and other likely toxic materials constitute serious environmental threats from farms and pastures [5]. Heavy metals such as cadmium (Cd) and lead (Pb) as well as other elements found in animal wastes, nitrogen (N), phosphorus (P), and potassium (K) are of social and public health concern because they pollute air, soil and water. Also, drugs and chemical residues used for livestock production are excreted in the effluents, thereby constituting biological and chemical pollution of environment and surface water with attendant public health risks.

In Nigeria, treatment facilities are unavailable, and collection, packaging, transportation and distribution of livestock waste used as manure is not properly coordinated and monitored. The most common means of livestock waste disposal methods in Nigeria include: outright dumping in bushes, garbage sites or open wastelands; sun-drying and burning; and flushing as slurry into nearby streams and rivers. Zoonotic pathogens could spread at the dung hills and along the course of the discharge [4], while scavenging man and animals could also contribute to epidemiological events through these routes [6]. Also the streams and rivers used for drinking water and other domestic activities are prone to pollution by effluent dumping and discharges. Livestock waste contribute directly and indirectly for emission of about 8.0 to 51% of global greenhouse gases (GHG) causing global warming and disruption of biodiversity [7].

However, in Nigeria, livestock wastes are utilized as manure for urban and rural crop farming as alternative to synthetic fertilizer and as ingredient for improving soil and production output [8]. Also, they are used by some aquaculture farmers for feeding fish. Improper utilization of untreated wastes implies spread of microbes and chemicals into environment, crop and fish [9]. The disposal methods in practice could constitute hazards for the environment, livestock and public health, and there is an obvious need for impact assessment studies that quantify the magnitude of these risks.

This paper illuminates the contributions of Nigerian livestock production and aquaculture to water pollution and public health challenges in line with the objectives of Exceed SWINDON project for learning and motivating collaborations of experts from Africa and Germany on technological innovations suitable for livestock waste management in developing countries. This in turn will become veritable tools to further impart on stakeholders including veterinarians and farmers for safe and sustainable biowaste management and utilization.

2 Data and Facts

2.1 Food Security, Water, Environment and Sustainable Development Goals

Food security is a major global challenge to meet the demand by increasing world population and it is also a critical nexus to sustainable development. Nigeria with human population of



about 200 Million is engaged in subsistence, large scale and integrated agriculture. Commercial production involving large scale and intensification of crops and animals production is on the rise, thereby placing high demand on water resources. The UN Global 2030 Agenda for Sustainable Development proposed several Sustainable Development Goals (SDGs) that deal directly and indirectly with the issue of water resources [10]. According to FAO, 2016 [11], the Sustainable Development Goals provide a vision of a fairer, more prosperous, peaceful and sustainable world, in which no one is left behind. The way food is grown, produced, consumed, traded, transported, stored and marketed include the fundamental connection between people and the planet, and the path to inclusive and sustainable economic growth. Without rapid progress in reducing and eliminating hunger and malnutrition by 2030, the full range of Sustainable Development Goals cannot be achieved. At the same time, reaching the other SDGs will pave the way for ending hunger and extreme poverty (11). The achievement of SDGs targeting number 2, 3, 4, 6, 12, 13, 14, and 15 requires effective and sustainable management of water resources. The thematic of the SDGs involving water resources include:

- **SDG #2: Food security, nutrition and sustainable agriculture:** Water is required for food production, processing and consumption.
- **SDG #3: Health and population:** Improved water supply and sanitation has long been targeted as a priority for health and national development.
- **SDG #6: Water and sanitation:** There is a need for adequate drinking water, sanitation, and hygiene as essential ingredients to ensure human health.
- **SDG #12: Chemicals and waste:** Efficient and proper wastewater management is a basic prerequisite for environmental health.
- **SDG #13: Atmosphere, climate change:** A greater proportion of the atmosphere is occupied by water; water cycle is a major determinant of atmospheric climatic conditions [12].
- **SDG #14: Oceans and lakes:** The oceans and lakes provide the basic elements of life; they produce half of the oxygen in the air the organisms breathe, and it is an essential part of the water cycle, helping to provide the drinking water.
- **SDG #15: Biodiversity and ecosystems:** Freshwater holds over 10% of all life on the planet and 35% of all vertebrates. A well-functioning watershed with its forests, grasslands and soils, and wetlands, including watercourses, lakes, swamps and floodplains, provides water storage, clean water, flood flows management and many other benefits. The loss and degradation of biodiversity compromise ecosystems and all the services they deliver, including the supply of clean water.



2.2 Agricultural Animal production in Nigeria

Food security is a global challenge to meet the demand by increasing world population and critical targets in sustainable development goals. The increase in animal food demand has led to large scale and intensification of crops and animals production. Global food security policies are geared towards the production and supply of adequate, nutritious, high quality, safe and wholesome food to the consumers (13). Agriculture is the main stay of Nigeria's Economy accounting for about 75% non-oil export. Livestock production contributes 6-8% of Nigerian Gross Domestic Products (GDP) and 20-25% of the Agricultural GDP. Nigeria is endowed with estimated 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs, 278,840 camels, 145 million chickens, 11.6 ducks, 2.1 million turkeys, and 974,499 donkeys [13] making the nation the topmost livestock producer in West Africa. Cattle, poultry and fish are the widely acceptable animal protein sources in Nigeria. The bulk of cattle in Nigeria are reared by traditional nomadic and pastoralist herdsmen on extensive system, while the integrated poultry and aquaculture farms are the major commercial animal agriculture in Nigeria.

2.3 The Importance of Water in Animal Agriculture

Water is essential for different types of livestock production, processing and consumption. In extensive systems of livestock production, drinking water is scouted for by domestic animals around different locations along the grazing land, where they search for ponds, streams and rivers. Through such expedition, domestic animals intermingle with animals from different sources including wild animals. While in intensive commercial livestock rearing water is required in large quantity for drinking and cleansing equipment, utensils, facilities and farm premises, municipal tap water and ground water (deep well and bore hole water) are mostly used in commercial livestock production. Also, in aquaculture water is heavily dependent upon the habitat for growth, nutrition, metabolism and excretion. High quality water is critical for effective and efficient livestock and aquaculture production, processing and consumption. For the purposes of utility, potable water (clean water that is free of all objectionable materials, including pathogens, tastes, odors, colors, toxins, radioactive material, organisms, oils, gases) is required for hygienic production and processing of animals. Also for human and animal drinking water [6] a no coliforms contamination is the acceptable quality, while water for fish and wildlife habitat standard is at 5000 fecal coliforms/100 mL and 14 fecal coliforms/100 mL for shellfish.

The production of animal protein requires significantly more water than the production of plant proteins, with substantial quantity as indirect water inputs for livestock production as water required for forage and grain crops. Each year, a total of 253 million tons grain is fed to US livestock, requiring a total of about 25×10^{13} L water. Worldwide grain production specifically for livestock requires nearly three times the amount of grain that is fed to US livestock and three times the amount of water used in the United States to produce grain feed [14]. Animal products vary in the amounts of water required for their production (water foot print): 1 kg chicken requires 3,500 L of water, whereas producing 1 kg sheep (fed on 21 kg grain and 30 kg forage) requires approximately 51,000 L water. Also, cattle reared on open rangeland

and not in confined feedlot production, 120 to 200 kg forage are required to produce 1 kg beef. This amount of forage requires 120,000 to 200,000 L water per kg, or a minimum of 200 mm rainfall per year [14].

2.4 Agricultural Animal and Water Pollution

Large quantity (volume) of wastewater is constantly discharged from agricultural animal production and processing points. The effluents are untreated, animal effluents pollute environment including soil, surface and ground water bodies. Pollution of river waters with deleterious microbes, including bacteria, viruses, parasites as well as fungi, has been on steady increase in the recent past [6]. The impact of river pollution on human health depends mainly on the water uses as well as on the concentration of pathogens in the water. Animal wastes are used untreated as manure for crop production in Nigeria [8].

Table 1: Major waterborne pathogens and associated diseases

Microorganisms	Pathogenic organism	Diseases caused
Bacteria	Salmonella	Typhoid, bacillary dysentery
	E. coli (enterotoxigenic)	Gastroenteritis
	Yersinia	Gastroenteritis
	Campylobacter	Gastroenteritis
	Vibrio	Cholera
	Leptospira	Leptospirosis
Viruses	Polio virus	Paralysis
	Rota virus	Infantile gastroenteritis
	Hepatitis A virus	Infectious hepatitis
	Norwalk virus	Gastroenteritis
	Adenovirus	Conjunctivitis
	Reovirus	Respiratory disease
	Echovirus	Aseptic meningitis
Protozoa, Helminthes and other parasites	Giardia lamblia	Diarrhea, malabsorption
	Entamoeba coli	Diarrhea, ulceration
	Entamoeba histolytica	Amoebic dysentery
	Cryptosporidium parvum	Diarrhea
	Ascaris lumbricoides	Ascariasis
	Ancylostoma	Anemia
	Nectar	Anemia
	Trichuris	Diarrhea, anemia
	Tenia solium	Teniasis
	Trichuris trichuria	Trichuriasis