INOSR Experimental Sciences 13(1):15-19, 2024.
©INOSR PUBLICATIONS
International Network Organization for Scientific Research
https://doi.org/10.59298/INOSRES/2024/1.15.1910

ISSN: 2705-1692
INOSRES1.15.1910

Addressing Technical and Environmental Obstacles in Livestock Management for Enhanced Drinking Water Quality

Bitikoro Rita D.
Biological Sciences Kampala International University Uganda

ABSTRACT

Water is a vital nutrient for livestock, constituting 60 to 70 percent of their body composition. It plays a crucial role in maintaining body fluids, ion balance, digestion, nutrient absorption, waste elimination, and temperature regulation. Additionally, water serves as a lubricant and cushion for joints, spinal cord, and tissues, ranking second only to oxygen in essentiality for life. Despite its importance, water can also serve as a vehicle for transmitting pathogenic organisms, posing a significant concern for livestock health. Access to safe water remains a challenge, as the cost is prohibitive for many, leading to reliance on available water sources regardless of their quality. Given the presence of pathogenic microorganisms in freshwater bodies, routine assessment is essential to prevent future disease outbreaks among livestock populations.

Keywords: Livestock Management, Drinking Water Quality, Pathogenic Organisms, Freshwater Bodies, Disease Outbreaks

INTRODUCTION

Water ranks second only to oxygen in terms of its essentiality for life, with more than half of the human body weight comprised of water. Human survival is limited to just a few days without water due to its crucial role in every cell of the body. Water facilitates the transportation of nutrients, oxygen, and waste to and from cells and organs, regulates body temperature, and acts as a lubricant and cushion for joints, spinal cord, and tissues, easing discomfort from conditions like arthritis [1]. Adequate hydration aids in maintaining a healthy weight, as water lubricates the digestive system and helps control appetite. The body loses 2-3 quarts (8-12 cups) of water daily through sweat, urination, and evaporation, highlighting the need for replenishment. Proper hydration supports kidney function, preventing kidney stones, and enhances cognitive function, including focus, alertness, and short-term memory. It is recommended to consume at least 8-10 cups of water daily for optimal health. Water replenishment can be achieved by drinking plain water or consuming water-rich foods such as fruits and vegetables like cucumbers, watermelon, lettuce, grapes, oranges, bell peppers, broccoli, and tomatoes. Access to clean drinking water is crucial for overall health, particularly for infant and child health and survival [2]. Globally, an estimated 1.8 million people die annually from diarrheal diseases, many of which are linked to the consumption of contaminated water and seafood [3].

Livestock, like dairy cattle, require a balanced intake of water, carbohydrates, fat, protein, vitamins, and minerals for optimal performance. Among these nutrients, water is the most critical for all classes of livestock, constituting 60 to 70 percent of their body composition. Water plays numerous essential roles in livestock physiology, including maintaining body fluids and proper ion balance, aiding in the digestion, absorption, and metabolism of nutrients, eliminating waste material and excess heat from the body, and transporting nutrients to and from body tissues [4]. For dairy cattle specifically, water is crucial as it constitutes a significant portion of their body weight (56 to 81%) and is the primary component of milk and waste products [5]. Consequently, dairy cattle have substantial daily water requirements, and reducing free water intake can lead to decreased milk production, compromised health, and reduced profitability for producers. Additionally, the mineral content of water can contribute substantially to the mineral requirements of dairy cows. Water is vital for regulating body temperature, supporting growth, reproduction, lactation, and digestion, lubricating joints, maintaining eyesight, and serving as a

cleansing agent. It is indispensable for all metabolic processes essential for life, growth, and reproduction, particularly during periods of heat stress.

In many parts of the developing world, there has been a decline in the proportion of households using unclean drinking water sources. However, it remains highly unlikely that all households will have access to clean drinking water sources in the foreseeable future [6]. According to [7], in 2015, 672 million people worldwide used unimproved drinking water sources, while [8] estimated that nearly 900 million people lacked access to safe water globally. The majority of individuals with unimproved drinking water and inadequate sanitation reside in rural areas, with over 80 percent relying on unimproved water sources and 70 percent lacking improved sanitation. In Nigeria, a significant portion of the population residing near water bodies continues to utilize rivers, streams, and other natural water sources for drinking without any form of treatment, regardless of the water quality. These natural water sources harbor a diverse array of microbial species, many of which remain unidentified due to limited culture methods. The microbial load varies across different water types, with sewage-polluted surface waters typically containing higher bacterial counts than unpolluted waters. Polluted surface waters can harbor various pathogenic microorganisms, including viruses, bacteria, and protozoa [10]. These pathogens, often originating from fecal sources, may stem from point sources such as municipal wastewater treatment plants and livestock handling areas, as well as non-point sources like domestic and wild animal feces, malfunctioning sewage systems, stormwater drainage, and urban runoff [11]. Fecal contamination of water is widely acknowledged as a leading cause of waterborne diseases.

The risk of drinking water transmitting microbial pathogens and causing subsequent illness is well-documented across countries of all economic levels. Numerous reported outbreaks worldwide highlight the significant role of drinking water transmission in causing illness. These outbreaks involve pathogens affecting various organisms, although many cases go undocumented as affected individuals often resort to self-medication rather than seeking professional medical attention. In Nigeria, common waterborne diseases include Cholera, Dracunculiasis, Hepatitis, and Typhoid [12]. Cases of waterborne diseases linked to drinking water contamination with pathogens have been reported in several towns. Waterborne enteric disease outbreaks occur when public drinking water supplies are inadequately treated after contamination with surface water, or when contaminated surface waters are used for recreational or domestic purposes. This paper aims to investigate the technical and environmental challenges impacting the quality of drinking water.

Evaluation of the Quality of Drinking Water

Water quality is a critical factor in dairy cattle production and health. Restricting water access for cattle can lead to rapid and severe declines in production. Monitoring water quality, particularly during periods of reduced production or undetermined illnesses, is essential for maintaining herd health and addressing production issues. The five key properties considered in evaluating water quality for livestock include organoleptic properties (odor and taste), physiochemical properties (pH, total dissolved solids, total dissolved oxygen, and hardness), presence of toxic compounds (heavy metals, toxic minerals, organophosphates, and hydrocarbons), presence of excessive minerals or compounds (nitrates, sodium sulfates, and iron), and presence of bacteria. Contamination of cattle drinking water by feces and urine can lead to decreased water consumption and animal weight gain [8].

Symptoms of Water-borne illness

Waterborne illnesses typically present with common symptoms, although the specific characteristics of each symptom may vary depending on the type of bacteria, viruses, or pathogenic microorganisms involved [9]. These symptoms include:

- Abdominal discomfort or cramping
- Fever
- Vomiting
- Diarrhea and
- Loss of weight and fatigue may accompany several of the viral illnesses.

Water Supply and Development: The International Development Perspective

Decades ago, there was a significant push for improved health through better water supply and sanitation. The UN Water Conference in Mar de Plata (1977) marked the beginning of concerted international efforts in this area, while the Alma Ata International Conference on Primary Health Care emphasized the importance of integrating water and sanitation into healthcare strategies. Throughout the 1990s, water remained a key issue on the political agenda, with the UN Conference on Environment and Development setting a goal of achieving universal access to water and sanitation by the year 2000 in Agenda 21.

Economic Feasibility

[14] observed that the disciplines of health, environment, and economics have not sufficiently complemented each other's efforts. Economic analyses have primarily focused on costs rather than benefits, while health analyses have emphasized solutions within the healthcare system rather than preventive measures outside of it. Infrastructure investments, such as water supply projects, are often justified based on economic and social benefits rather than health considerations. While ensuring water quality is mainly justified for health reasons, the additional cost of incorporating quality aspects into water supply projects is typically minimal compared to the total investment. The economic feasibility of achieving universal access to clean water depends on both sustaining existing supply systems and extending coverage to the significant population without access to safe drinking water. Although technically feasible, achieving universal access by the year 2000 would have required substantial investment, estimated at around US$ 50 billion per year compared to the actual investment rate of US$ 13 billion per year. In developing countries, there is often a prioritization of constructing new facilities over maintaining existing systems, leading to the collapse or underutilization of many water supply facilities.

External financial assistance, though influential in directing national finances, primarily supports the development of new facilities rather than maintaining existing infrastructure. This reliance on external funding places stress on systems intended for continued infrastructure functioning and poses challenges to management, potentially increasing the risk of water-borne diseases. It is crucial to increase focus on the sustainability of water supply service provision, particularly in terms of operation and maintenance, to address these challenges and learn from past experiences [15, 16].

Technical and Environmental Challenges

Surface waters, including rivers and lakes, are commonly used as drinking water sources worldwide, with their contribution varying depending on the availability of safe ground waters. However, surface waters are prone to contamination and exhibit wide variations in quality, subject to rapid changes. While over-exploitation of surface waters is possible, it is often more reversible compared to ground waters. Nonetheless, the dependability of surface waters for drinking may decrease due to predicted global climate changes. Drinking water treatment typically follows the principle of "multiple barriers," with the level of treatment depending on the quality of the water source. More polluted water sources require more costly treatment, and increased reliance on degraded water resources is expected to raise supply costs. Protozoa like Giardia and Cryptosporidium are increasingly recognized as water-borne pathogens, with Cryptosporidium often used as a benchmark for treatment efficiency evaluation, despite not accounting for variations in health outcomes.

Microbiologically safe drinking water entering distribution systems can deteriorate due to recontamination or re-growth, although the extent and health impact of these phenomena are poorly understood. While the concept of safe water has traditionally focused on drinking water, recent decades have shown that effective water management cannot be compartmentalized, especially concerning specific uses with conflicting demands on water quality and quantity. Managing water for health requires ensuring the overall health of water resources in terms of quality and quantity, emphasizing integrated management of freshwater resources. Freshwater is viewed as a finite and vulnerable resource, and management actions should align with national economic, social, and environmental policies for sustainable water management. Current water use patterns across much of the globe are unsustainable deriving from two principal types of pressures:

- Quantitative: relating to increased demands, poor allocation and water wastage.
- Qualitative: relating to the use of freshwater resources as a means for carriage, treatment and final disposal of society's wastes.

Among natural resources devoid of elemental properties, natural waters emerge as the sole replenishable and recyclable asset. The perpetual rise in water consumption stems from a blend of burgeoning population figures and heightened individual utilization. Strides in industrial economy, particularly in the adoption of water-efficient technologies and reclamation methods, hold promise for curbing demand. There remains substantial scope for curtailing wastage in potable water distribution, where approximately half of the water supply may evade accountability, and in agriculture, which accounts for roughly 70 percent of total water extractions.

Nevertheless, projections suggest that by 2025, up to two-thirds of the global populace will reside in regions grappling with water scarcity, encompassing a diverse array of nations such as Mauritius, India, Iran, Zimbabwe, Togo, and Poland. Water pollution in freshwater systems poses a hindrance to beneficial uses like potable water provision, irrigation, and aquaculture, either impeding their utilization or

inflating associated costs. Waterborne diseases may imperil human health, facilitated by the transmission of pathogens through aquaculture, irrigated agriculture, or the consumption of shellfish and marine fish. Moreover, both inland freshwater bodies and coastal regions serve as recreational hubs, with the mounting recognition of the health risks posed by sewage pollution in recreational waters [17].

CONCLUSION

Addressing technical and environmental obstacles in livestock management is crucial for enhancing drinking water quality. Livestock, constituting 60 to 70 percent water in their bodies, rely heavily on water for various physiological functions. However, water can also act as a vehicle for transmitting pathogenic organisms, posing significant health concerns. Access to safe water remains a challenge in many regions, leading to reliance on potentially contaminated sources. Routine assessment and monitoring of water quality are essential to prevent disease outbreaks among livestock populations. This underscores the importance of implementing sustainable practices and investing in infrastructure to ensure the provision of clean drinking water for livestock, thereby safeguarding both animal health and human wellbeing.

REFERENCES

1. Popkin, B. M., D'Anci, K. E., & Rosenberg, I. H. (2010). Water, hydration, and health. Nutr Rev., 68(8):439-58. doi: 10.1111/j.1753-4887.2010.00304.x. PMID: 20646222; PMCID: PMC2908954.
2. Vidyasagar, D. (2007). Global minute: Water and health - walking for water and water wars. of Perinatology, 27:56–58.
3. World Health Organization (2003). Heterotrophic Plate Counts and Drinking-water safety. Edited by J. Bartram; 2003.
4. Ashraf, M. A., Maah, M. J. Yusoff, I. & Mehmood, K. (2010). Effects of Polluted Water Irrigation on Environment and Health of People in Jamber, District Kasur, Pakistan, International Journal of Basic & Applied Sciences, 10(3), pp. 37-57.
5. Ganguly, S. (2013). Increasing incidences of water pollution imposing hazardous influence on aquatic fauna and flora: A grievous environmental concern. The Science Observer,1(1):7.
6. Mintz, E., Bartram, J., Lochney, P., & Wegelin, M. (2001). Not just a drop in the bucket: Expanding access to point-of-use water treatment systems. American Journal of Public Health, 91:1565-70.
7. United Nations Children's Fund (2010). Progress on Sanitation and Drinking Water. New York: UNICEF; 2010
8. United Nations Department of Economic and Social Affairs (2009). Millennium development goals report. United Nations Department of Economic and Social Affairs, New York; 2009.
9. Servais, P., Billen, G., Goncalves, A., & Garcia-Armisen, T. (2007). Modelling microbiological water quality in the Seine River drainage network: past, present and future situations. Hydrology and Earth System Science, 11:1581–92.
10. Chigor, V. N., Umoh, V. J., Okuofu, C. A., Ameh, J. B., Igbinosa, E. O., & Okoh, A. I. (2012). Water quality assessment: Surface water sources used for drinking and irrigation in Zaria, Nigeria are a public health hazard. Environ Monit Assess; 184:3389–3400.
11. Adeyinka, S.Y., Wasiu, J., Akintayo, C. O. (2014). Review on prevalence of waterborne diseases in Nigeria. Journal of Advancement in Medical and Life Sciences, 1(2):1-3.
12. Ramírez-Castillo, F. Y., Loera-Muro, A., Jacques, M., Garneau, P., Avelar-González, F. J., Harel, J., & Guerrero-Barrera, A. L. (2015). Waterborne pathogens: detection methods and challenges. Pathogens, 4(2):307-34. doi: 10.3390/pathogens4020307. PMID: 26011827; PMCID: PMC4493476.
13. Listorti, J. A. (1999). Is Environmental Health Really a Part of Economic Development or Only and Afterthought. Environment and Urbanisation 11, 89±100 (1999).
14. Gibbons, L. M., Jones, A., & Khalil, L. F. (1996). Manual for the 8th international training course on identification of helminth parasites of economic importance. CAB International, Wallingford, 1996.
15. Taylor P. (1993). Global Perspectives on Drinking Water: Water Supplies in Africa. In: Safety of Water Disinfection: Balancing Chemical and Microbial Risks (Craun, G. F., ed.) pp. 21±28, ILSI Press, Washington, USA, 1993
16. WHO (1998). Guidelines for Drinking-Water Quality. 3rd Edition, Vol. 1, World Health Organization, Geneva, Switzerland.

CITE AS: Bitikoro Rita D. (2024). Addressing Technical and Environmental Obstacles in Livestock Management for Enhanced Drinking Water Quality. INOSR Experimental Sciences 13(1):15-19. https://doi.org/10.59298/INOSRES/2024/1.15.1910