

The Causal Link Between Anthropogenic Activities, Water Pollution and Health-Related Quality of Life from Residents' Perspective: A Review

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ABSTRACT

Ghana has an abundance of water. However, these resources are constantly polluted due to poor management and oversight. Human activities such as household, industrial, and agricultural operations have contaminated freshwater resources with various toxins. These have increased the water-related health risk throughout the country, especially among the elderly and children. This review therefore adopts the DPSIR model to examine the drivers, pressures, state and health impact of Ghana's fresh water resource. The study ultimately seeks to discover responses related to water quality management systems in order to minimize the causes of water pollution as well as its impact on human health and quality of life. The data for analysis focused on the water and health impacts of anthropogenic activities in Ghana.

Keywords: Water Pollution, Health Impact, DPSIR, anthropogenic activities, Ghana

I. INTRODUCTION

According to Aznar-Sánchez, Velasco-Muñoz, Belmonte-Ureña, and Manzano-Agugliaro (2019), water quality is becoming increasingly important in

worldwide water resource management. A shift in emphasis toward economic development demands a change in attention toward other sectors, such as the transition from agriculture to industrial, which demands land use modifications (Scoones et al., 2020).

This is due to the enormous changes in land use, such as industrial expansion, modern agriculture, and urbanization.

Ghana generally has sufficient water resources to meet current and future demands as long as they are properly managed and allocated. Considering Ghana's enormous surface water resources, preservation against contamination by harmful pollutants, which are primarily produced by human activities, are essential for the efficient management of the water resources (Aktürk & Dastgerdi, 2021; Martínez-Santos, 2017). The six (6) Sustainable Development Goals (SDG) are to protect water resources from pollution and untreated wastewater emissions (Ho, Alonso, Forio, Vanclooster, & Goethals, 2020). Surface water quality has become one of Ghana's most pressing issues over the last decade. According to (Beck, Harris, & Luker, 2016; Enqvist & Ziervogel, 2019), Ministry of Water Resources Works and Housing (MWRWH) and Water Resource Commission (WRC) consider portable water to be a fundamental human right and a prerequisite for public health protection. Therefore, significant efforts have been made to increase the share of the country's population with improved water sources (Yates & Harris, 2018).

Although water is a key resource for human health and quality of life, most of the water resources have degraded beyond treatment levels for consumptive and non-consumptive use due to the prevalence of heavy pollutants (Okumah, Yeboah, & Asante-Wusu, 2020). Therefore, water-related illnesses are common in the country today, creating a public health risk (Daley, Castleden, Jamieson, Furgal, & Ell, 2015). To the researcher's best knowledge, no research has been done to review the drivers, pressures, status, and health impacts of water pollution in Ghana, especially after adopting the DPSIR model. This review therefore examines the anthropogenic causes and health impact of the deterioration of Ghana's fresh water resources using the DPSIR model. The study ultimately seeks to discover responses and policy

alternatives related to water quality management systems in order to minimize the causes of water pollution as well as its impact on human health and quality of life.

II. METHOD

The research search was performed between January and March 2021 and was limited to Google Scholar and the Web of Science databases. The sources of literature consulted were those done within the setting of Ghana. Articles were limited to those that were done within the setting of Ghana and published in English-language journals. The following keywords and keyword combinations were used: water pollution, health*, impact, anthropogenic activities, policies, Ghana.

Furthermore, article titles and abstracts were independently examined to determine whether they were eligible for inclusion. If there was any doubt, the complete text of the article was obtained. This review covered primary publications on water pollution and human health outcome studies as the subjects of this review. Although Google Scholar produced an output of 19,200 articles, a total of 163 articles were retrieved from the web of science core collection database. Thirty-six (36) publications by different authors met the inclusion criterion. The anthropogenic activities considered for the present review were domestic (municipal), agriculture, and industrial operations.

III. AN OVERVIEW OF WATER POLLUTION IN GHANA

In Ghana, both human and natural activities contribute to water pollution. The majority of Ghana's freshwater resources are used for domestic, industrial, irrigation, and animal watering (P. A. Owusu, S. Asumadu-Sarkodie, & P. Ameyo, 2016a). According to Ghana's water utility agency, pollution has contaminated water sources throughout the country with bacteria, chemicals, and heavy metals,

increasing the expense of treating and distributing it (Ayandiran, Fawole, & Dahunsi, 2018; Joseph, Jun, Flora, Park, & Yoon, 2019).

Ghana's surface water resources are polluted as a result of poor waste management from domestic, agricultural, and industrial operations. According to the Ghana Statistical Service (2015), insufficient logistics and a lack of effective waste disposal education have contributed to the country's expanding garbage problems (Samuel K Abanyie, Ampofo, & Douti, 2017; Baah-Boateng, 2015; Douti, Abanyie, & Ampofo, 2017). Moreover, the amount of water waste disposed through sewage lines linked to treatment plants is only about 5% (Tsai, Bui, Tseng, Wu, & Recycling, 2020).

The waste management system is insufficient to accommodate the rising population, resulting in an environmental calamity. According to the Ghanaian Environmental Protection Agency (EPA), poor countries like Ghana have limited capacity for treating their effluents, resulting in significant quantities of untreated effluents being released into water bodies and open sewers (US Environmental Protection Agency, 2002)(Samuel K Abanyie et al., 2017).

Long-term drought and aridity, water pollution, water scarcity, and growing water costs are all issues that many urban and rural areas face. Furthermore, they are confronted with the challenges of an increasing population and urbanization. This puts a great strain on the water supplies, resulting in water contamination and scarcity that adversely affects the environment and human health (Malik, Hsu, Johnson, & de Sherbinin, 2015).

Twerefou, Tutu, Owusu-Afriyie, and Adjei-Mantey (2015) asserted that the treatment facilities for most rivers are outdated and the rivers have been diverted and completely ruined, to the point where the canals cannot be seen. Moreover, water bodies around the Koforidua and new Juaben settlements have been polluted as a result of fishing activity. The majority of the population therefore lacks access to clean drinking

water (Amoah, Asiama, Korle, & Kwablah, 2021). Similarly, illegal mining activities have polluted several water bodies in the country (Mantey, Owusu-Nimo, Nyarko, & Aubynn, 2017).

According to Ghana's Water Resources Commission, about 60% of the country's surface water resources are polluted or in critical condition, implying that many more water treatment plants will be closed. These pollutants have serious consequences for health-related quality of life (E. Yeleliere, S. Cobbina, & A. Duwiejuah, 2018a). As predicted by the former minister of lands and natural resources, "we may be importing drinkable water from adjacent countries by 2030 (Gerbens-Leenes, Van Lienden, Hoekstra, & Van der Meer, 2012)." Despite the gravity and urgency of the water situation, our response to massive pollutant emissions has been slow.

Although water pollution practices continue to be common causes of death and morbidity in the country, mortality and morbidity attributable to water pollution in children and adults is stabilizing.

IV. THE DPSIR MODEL IN WATER RESOURCE MANAGEMENT

The European Environmental Agency (EEA) originally introduced the Drivers, Pressures, States, Impact, and Responses (DPSIR) model in 1999, and they adopted it as a framework for evaluating environmental quality (Gari, Guerrero, Bryann, Icely, & Newton, 2018). Its goal was to create a framework within which indicators could be discovered to provide feedback to politicians and conservation managers on the state of the environment and its implications for current and future political decisions (Apostolaki, Koundouri, & Pittis, 2019). In many cases, this framework has been used to comprehend the cause-and-effect links that exist between humans and their interactions with the environment (Mathetsa, 2015). This framework guided the reviewer's study (Fig.1). The different pillars of the interlaced, spatial and temporal chain of cause-and-effect that manifests

the interconnections between human civilization and the environment are contextualized in this framework.

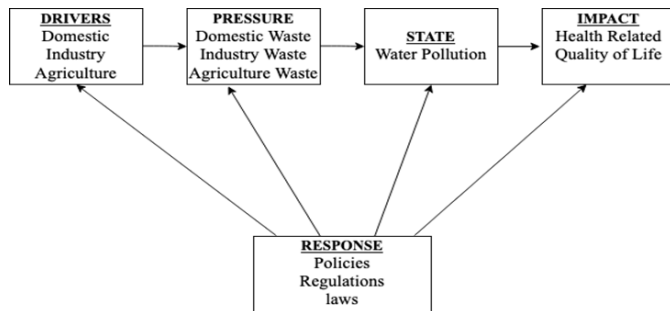


Figure 1: Integration of water quality in the DPSIR framework. Source: Mathetsa (2015) modified..

Despite the benefits and applications of freshwater resources, human activities are contaminating them at an alarming rate, endangering their life-sustaining qualities. Each anthropogenic driving force provides a separate pool of pressure that affects the physiochemical and biological features of water resources. The state of the water resource is based on its biological, physical, and chemical diversity as well as its selective sensitivity (flow, substrate, dissolved material, temperature, light, pH, turbidity) (Ho et al., 2020). In Ghana, freshwater contamination has an impact on livelihoods and human health. To eradicate this threat, appropriate mitigation measures are required (Zango, Sunkari, Abu, & Lermi, 2019).

V. DRIVERS OF WATER POLLUTION IN GHANA

Driving forces are human actions that have a positive or negative effect on the environment. Within a community, social and economic motivations emerge as strategies to meet basic human needs. These have been defined as the required circumstances and materials for a decent existence, good health, good social interactions, security, and freedom (Gebremedhin, Getahun, Anteneh, Bruneel, & Goethals, 2018; Oesterwind, Rau, & Zaiko, 2016).

Water supplies are being strained as a result of an increasing population and urbanization. Freshwater consumption and the outflow of wastewater are required for washing, bathing, cooking, and other

household activities. In urban areas, household wastewater is blended into downstream water bodies. Human feces and animal dung are mixed together in a pressure cocktail that promotes the movement of antibiotic resistance genes to other microorganisms (E. Boelee, G. Geerling, B. van der Zaan, A. Blauw, & A. D. Vethaak, 2019a). Moreover, dumping solid waste, liquid waste, and open defecation into freshwater resources due to poverty, inequity, and poor housing conditions places enormous pressure on the water system (Duarte, Oldenkamp, & Ragas, 2019).

Agricultural intensification, which demands a lot of water, has been fueled by increased food production. Irrigation systems, fertilizers, and pesticides are used to enhance agricultural productivity in Ghana and around the world because of the increasing demand for vegetables and cash crops (Pretty et al., 2018). Huge irrigation dams, for example, are extensively used in the northern part of Ghana, where the majority of the country's vegetables are cultivated, particularly during the dry season. Pesticides are also used to keep pests at bay in these fields, while fertilizers are utilized to increase yields.

Industrial operations such as natural resource extraction and processing, energy generation, product manufacturing, and transportation all contribute to water pollution (Albert, Kvennefors, Jacob, Kera, & Grinham, 2017). These industries mostly discharge waste directly into water resources without the required treatments. Most industrial activities, by their very nature, deplete, divert, and pollute water supplies. Therefore, almost all water resources surrounding industrial sites have been extensively deteriorated. Small-scale mining, for example, pollutes the local food chain by releasing silt and mercury into the water. This has become a constant concern for the key stakeholders (Mortazavi, Mortazavi, & Paknahad, 2016; Yevugah, Darko, & Bak, 2021).

VI.PRESSURE FROM WATER POLLUTANTS IN GHANA

Pressure refers to the purposeful or unintended forces that various drives apply on the environment (Mathetsa, 2015). Human actions that are derived from the functioning of social and economic drives that cause changes in the environment are referred to as pressures (Mathetsa, 2015; Spanò, Gentile, Davies, & Laforteza, 2017). Land-use changes, physical harm to ecological resources, as well as acts that ameliorate environmental conditions, are all examples of environmental pressures (R. J. W. Vannevel, 2018). These occur due to excessive water resource extraction as well as the direct and indirect emissions of household, agricultural, and industrial waste (Blettler et al., 2019; Kasker, 2018).

According to a recent assessment in Ghana, approximately 12,710 tons of residential garbage are created daily, with just about 10% of this being discharged at approved disposal sites (Nyarko, Yeboah, Yeboah, Larbi, & Osei-Bonsu, 2020). This is because most residential structures in the country lack a connected sewage treatment system, and waste treatment facilities are rare throughout the country (Monney, Antwi-Agyei, & Development, 2018).

Moreover, water contamination in metropolitan areas, particularly those adjacent to water resources, are usually caused by waste from residential houses, sewage, and other developing contaminants (E. Boelee, G. Geerling, B. van der Zaan, A. Blauw, & A. D. J. A. t. Vethaak, 2019b). Human excrement, animal waste, carbohydrates, proteins, urea, lipids, and other biodegradable pollutants, as well as inorganic nitrates and phosphates from detergents, all contribute to water pollution. The excessive accumulation of detergent in water resources renders it dangerous for consumption and non-consumption use (Organization, 2017a)(Srinivasan, Nature, & Space, 2021).

Pesticides and fertilizers, which reach water through runoff and leaching, are the most common agricultural contaminants that pollute water. Water

contamination is also caused by sediments and farm animal excrement (Gonçalves, Pires, & Simões, 2017). When pesticides, insecticides, and inorganic fertilizers are sprayed on agricultural farms and then carried away by irrigation, drainage, or rainfall, they end up contaminating rivers, streams, and even underground water (Oberholster, Botha, Hill, & Strydom, 2017). Despite the health risks, the use of pesticides on fields in Ghana contributes significantly to the country's development as an agriculture-dependent country. Because the majority of farmers in the country are illiterate and lack the essential training, protective equipment, and safety information, these chemicals have a propensity to be misapplied.

Furthermore, farmers typically wash their knapsack sprayers and garments in water bodies after spraying, exacerbating the problem. Meanwhile, the majority of rural populations get their drinking water from lakes, streams, and rivers, making chemical contamination exposures common. Pesticide residues, such as organochlorines and organophosphates, have been discovered in both terrestrial foods and aquatic habitats.

According to Afroz, Masud, Akhtar, Duasa, and ASIA (2014), any liquid or solid material released from any premises utilized for carrying on any industrial activity, as well as any treatment and disposal facility other than domestic sewage, is defined as industrial waste or trade effluent. The discharge of waste water into rivers by a large number of businesses located along river banks is a common practice that degrades water resources. Mercury, lead, cadmium, and copper, among other elements, are found in industrial effluents and are detrimental to aquatic species as well as human health (Saravanan et al., 2021).

In terms of water pollution in industrial areas, industrial effluents are the main source. When these pollutants are dumped continuously into the water systems, the water becomes very contaminated in the long run(Keiser & Shapiro, 2019). Thermal pollution is caused by the surplus heat created by thermal power plants that use water to cool their generators.

Excessive heat has a negative impact on biochemical reactions, which is harmful to human health and aquatic life (Rouillard et al., 2018). Contaminants released from industrial areas have the potential to spread to large areas downstream.

In Ghana, small-scale miners commonly labor along riverbanks, eroding riverbanks and exposing them to overflowing during heavy rains. This situation has resulted in floods at mining sites recently. Water pours unrestrained into neighboring homes and neighborhoods, destroying property and claiming human life. Most rivers and streams' natural pathways are altered and, in some cases, impeded in order to make room for mining operations. In addition, illegal mining operations in Tarkwa, Sekondi-Takoradi, and Konongo have led to the closure of drinking water treatment plants (Monney et al., 2018).

In general, untreated domestic, agricultural, and industrial waste ends up in water resources and open spaces around the country (Appiah-Effah et al., 2019). Meanwhile, Ghana has had an Environmental Protection Agency (EPA) since 1994, which is responsible for ensuring that wastewater is cleaned before being discharged into the environment. The majority of these facilities, however, are either damaged or in poor functioning order due to a lack of capital, inefficient technologies, and poor policy implementation (Taweesan, Koottatep, Polprasert, & Development, 2015).

VII. THE STATE OF FRESH WATER QUALITY IN GHANA

The state assesses water quality and quantity as well as how anthropogenic activities and pressures affect it. Water supplies are fast diminishing and becoming scarcer by the day, putting Ghana's freshwater resources in peril. Several treatment plants have closed as a result of extreme water contamination (E. Yeleliere, S. Cobbina, & A. J. A. W. S. Duwiejuah, 2018b). The best way to measure freshwater quality is to compare biological, physical, and chemical

constituents to national and international standards, such as those established by the Ghana Standards Authority (2013) and the World Health Organization (WHO 2017). The physicochemical properties of water can affect the proliferation of biological life forms in it, affecting water quality (Jang et al., 2020).

According to WHO norms, the water temperature should be between 15 and 25 degrees Celsius. Aquatic life, solid solubility, taste and odor, dissolved oxygen (DO), and other aspects are all affected by water temperature. The pH of the water was also set to be between 6.5 and 8.5. In the majority of investigations, the pH of water sources was found to be within a safe range. In several investigations, total dissolved solvent (TDS) levels were discovered to be above the permitted range. Minerals can be detected by measuring water conductivity. Neither the Ghana Standard Authority nor the World Health Organization has put a price on this guideline. A wide range of conductivity values can be found in various water sources (Akoto, Gyamfi, Darko, & Barnes, 2017). Akoto et al. (2017); (Bedu-Addo, Palekhov, Smyth, & Schmidt, 2019) opined that the mean turbidity levels in the Densu, Ayensu, and Birim basins exceeded WHO requirements, which were attributed to mining activities. Notwithstanding, Gyimah, Gyamfi, Anornu, Karikari, and Tsyawo (2021) ascribed the high levels of turbidity to poor farming methods that resulted in river saltation during runoff. Attiogbe, Mohammed, and Kingslove (2020) stated that surface water pH values ranged from 6.57 to 7.14 pH units, while electrical conductivity levels varied from 451.67 to 774.72 S/cm. Gyimah stated that, the pH of the surface water was in the range of 7.20–7.48 pH units, and seasonal change had little effect on the water (Gyimah et al., 2021). This attests to the effect of anthropogenic activities on water resources from 2017 to 2020. According to the study, river water was moderately soft to slightly hard (hardness of 91.20–111 mg/l CaCO₃). The study blamed agricultural, residential, and industrial activities for the excessive nutrient loads reported in the basins. Activities such

as fertilizer usage, household waste, and other human induced point sources all contributed to chloride dominance over sulphate (P. A. Owusu, S. Asumadu-Sarkodie, & P. J. C. E. Ameyo, 2016b). The analysis revealed that the rivers had little metal contamination due to low trace metal concentrations.

Nutrients and pathogens from open defecation, unsanitary waste disposal, malfunctioning latrines, septic tank overflows, and home sewage leakages contaminate groundwater and surface water. Microbial pollution of freshwater in Ghana is one of several hazards to human health, and stakeholders must take the required steps to limit this concern (Owusu et al., 2016b; Yeleliere et al., 2018b). Moreover, faecal coliform counts in water samples recorded at all locations were above the WHO limits of 0/100 ml for household use, as stated by (Twumasi, Jiang, Ameyaw, Danquah, & Acheampong, 2020). Most of the bodies of water had high microbial counts, indicating substantial bacterial pollution and rendering the water unsafe for direct human consumption. The presence of microorganisms in water implies the presence of disease-causing organisms such as pathogens that contaminate freshwater resources. The WHO's drinking water standard for coliforms, whether faecal or total, is 0 counts per 100 mL (Eerkes-Medrano, Thompson, & Aldridge, 2015; Kay et al., 2018).

Surface water has become unsafe for residential use as a result of the impurities that have accumulated in it (Organization, 2017a). Poor industrial activities such as heavy small-scale mining, which result in significant amounts of top soil ending up in the rivers, contributed to the excessive turbidity reported in the basins. The basins have also been reported to be opaque brown in hue, which the respondents claim was not the case previously. Due to the pure color of the water prior to its state change over the years, residents and farmers used it without treatment (Bansah, Dumakor-Dupey, Kansake, Assan, & Bekui, 2018).

In addition, the large quantities of plastic garbage

found in river sediments and floodplains have an influence on the ecosystem and human health (Paredes, Castillo, Viteri, Fuentes, & Boderio, 2019). However, the water resources have become extremely polluted over the years, and locals are no longer able to use it for residential or irrigation purposes. These changes lead to a high cost of water treatment and distribution.

VIII. THE IMPACT OF WATER POLLUTION OF HEALTH-RELATED QUALITY OF LIFE

Water contamination generally affects the environmental quality, human health, and quality of life, both directly and indirectly. It also obstructs proper sanitation and hygiene, resulting in a significant incidence of water-borne infections. It therefore poses a threat to livelihood, public safety, and quality of life in the short and long-term (Boelee et al., 2019b; Evans, Mateo-Sagasta, Qadir, Boelee, & Ippolito, 2019). The short-term health consequences appear after a brief exposure to polluted water supplies, whereas the long-term effects appear after months or years of regular contact. Water contamination is the leading cause of death worldwide, especially in poorer nations (Organization, 2017). Diseases like diarrhea, typhoid, and hepatitis are spread by human waste in water (Blettler, Abrial, Khan, Sivri, & Espinola, 2018). Moreover, evidence reveals that children who frequently played in rivers were at risk of catching cholera, typhoid, diarrhea, and skin and eye infections.

The Ghana Health Service has agreed on various occasions throughout the years that bacteriological pollution of drinking water is the leading cause of waterborne infections, particularly among consumers of surface water (Ababio & Lovatt, 2015; S. K. Abanyie, E. D. Sunkari, O. B. Apea, S. Abagale, & H. M. J. S. W. R. M. Korboe, 2020b). This is consistent with existing literature, which indicates that Ghana's drinking water is highly contaminated with bacteria (Samuel Kojo Abanyie et al., 2020b). In contaminated

water sources, *E. coli*, *Salmonella typhi*, and heterotrophic bacteria were found, all of which have the potential to cause serious health problems (Samuel Kojo Abanyie et al., 2020b). Boreholes, rivers, dams, and wells are the primary sources of water in Ghanaian communities, and they are all under threat from bacterial pollution.

Although bacteriological contamination is small at the source, it increases significantly during the course of water supply due to leaks and unlawful multi-layer pipe networks (Violet-Chabrand et al., 2017). Moreover, bacteriological contaminants are rarely purified by treatment processes prior to distribution to consumers. Several waterborne diseases, such as cholera, typhoid, gastroenteritis, and dysentery, are linked to bacteriological contamination of drinking water sources, according to WHO (S. K. Abanyie, E. D. Sunkari, O. B. Apea, S. Abagale, & H. M. Korboe, 2020a). Children and the elderly with weakened immune systems are the most vulnerable populations.

Agrochemicals, on the other hand, have been found to pose substantial risks to human health. Particularly pesticides, they have been found to influence the human endocrine and immunological systems, as well as encourage cancer growth. Also, excessive fertilizer use can lead to contamination of surface water, which is harmful to human health. It pollutes surface water through runoff and has been linked to diseases such as hemoglobinopathies, Alzheimer's disease, and diabetes mellitus. These fertilizers have major consequences for human health, both in terms of direct toxicity and indirect nutritional density reduction in the plants consumed (Alengebawy, Abdelkhalek, Qureshi, & Wang, 2021). These findings were later confirmed by other studies, proving the role of chemical fertilizers via water pollution in Alzheimer's disease. The presence of high levels of cadmium and aluminum in the soil as a result of chemical fertilizer use has also been connected to Alzheimer's disease development and pathogenesis (Huat et al., 2019).

Organophosphate insecticides have become more

popular as they are less persistent and damaging to the environment than organochlorine pesticides. However, they are linked to acute health issues such as abdominal pain, dizziness, migraines, nausea, vomiting, and skin and eye issues. Insecticides, which are used on vegetables, eventually accumulate in the human body and have been linked to cancer (Sharma & Singhvi, 2017).

The exposed population living in the catchment of polluted basins has revealed higher amounts of hazardous metals such as arsenic and mercury in their blood, milk, hair, and urine (Chowdhary, Bharagava, Mishra, & Khan, 2020). These heavy metals have been identified in both groundwater and surface water. Although most heavy metals are important for human health, their persistent accumulation through the consumption of unsafe water supplies negatively impacts health-related quality of life (Bortey-Sam et al., 2015).

IX. ENVIRONMENTAL LEGISLATION IN GHANA AND THEIR EFFECTIVENESS (RESPONSE)

Actions made to prevent, amend, or minimize the effects of the changes in the status of the environment are referred to as responses. Governments, communities, NGOs, and scientists could respond by regulating, preventing, or mitigating the drivers or pressures in order to maintain or restore the environment's state. Legislation to safeguard fresh water resources, for example, could be a response to the negative effects of water pollution (Gebremedhin et al., 2018).

Protective and remedial measures are included in the DPSIR framework, in addition to environmental interventions, to reduce human exposure and damage (Boelee et al., 2019a; Wantzen et al., 2019). These ideas are incorporated into the proposed framework so that responses can be tailored to influence individual behaviors that directly affect human health or compensate for the social and economic effects of human activities on human health (de Sousa-Felix et

al., 2017; R. Vannevel, 2018).

Due to the increasing demand for freshwater from the agricultural, industrial, and domestic sectors on a daily basis, despite the fact that waste emissions from these same sectors are degrading accessible water resources directly or indirectly (Samuel Kojo Abanyie et al., 2020a). Fresh water resources must be routinely monitored to ensure that they are fit for both consumption and non-consumption. Ghana's water resources are controlled and managed through a variety of policy instruments, laws, and regulations. However, inadequate execution and a lack of political will have left water resources in a dangerous situation. In light of this, the following legislation for promoting sustainable water resource management in Ghana is presented.

Ghana has established policies (2007) and plans (2007–2013) at national and basin levels. There is a regulatory framework to some extent, though enforcement by district authorities needs to be strengthened. The WRC and several river basin management boards generally have sufficient capacity to facilitate cross-sector collaboration and high levels of stakeholder participation.

The major Acts made in the pursuit to manage water resources in Ghana are: Dam safety regulation 2016 (LI 2236), Land Use and Spatial Planning Act, 2016 (Act 925), National Fertilizer Policy, 2013, National Water Policy, 2007, Drilling license and groundwater regulation 2006 (LI 1827), Water use regulation 2001 (LI 1692), Community Water and Sanitation Act, 1998 (Act 564), Water resource commission Act, 1996 (Act 522) and the 1992 Constitution of Ghana, National Environmental Policy, 1991. The Water Resources Commission (WRC), the Environmental Protection Agency (EPA), the National Environmental Action Plan (NEAP), and the Public Utilities Regulatory Commission (PURC) are just a few of the agencies in charge of water quality supervision and management.

According to Nkansah, Ofosuah, and Boakye (2010), there is relatively low-level water development in

Ghana. Although a budget is generally allocated to disbursed but funds are typically insufficient for planned activities. Water resources management instruments exist for many elements, but stakeholder and geographic coverage generally need to be increased. Increased budgeting and ensuring funds are distributed are critical to ensure that water resources management activities on the ground are effective.

Strengthen stakeholder participation in the fight against water contamination, particularly illegal small-scale mining, which is the single most destructive human activity influencing Ghana's freshwater resources' physical, chemical, and biological makeup. The government's "Operation Hult" (a joint team of security professionals dispatched to mining sites) is yielding positive results and should be granted more funds. In addition to eliminating the practice, the government must take active steps to provide alternative and lasting livelihood alternatives for the tens of thousands of unemployed people who participate in it.

Furthermore, personal awareness is one of the most important tips for safeguarding water from contamination. There are comprehensive water-related policies that, if adopted, might help Ghana manage its water resources sustainably. Actions such as banning specific types of plastic materials from the market should be given due consideration in order to help reduce the amount of plastic waste that ends up in water bodies. People can also avoid the use of environmentally hazardous goods, for example, encouraging stores to use biodegradable materials rather than unnecessary packaging. In the fight against environmental deterioration, it is a good idea to review some old habits. The government's recent one-month moratorium on all fishing activities in the country, which began in August 2018, should be renewed and sustained to help marine life's reproductive system (Nolan, 2019). In addition, to avoid the harvesting of fingerlings, legislation prohibiting the use of unlicensed fishing nets should be rigidly implemented without fear or favor (Ofori-

Danson, Asiedu, Amponsah, & Crawford, 2019). Moreover, education and awareness-raising efforts about water resource contamination and its implications should be made more widely known. To embed sustainable environmental practices as civic obligations, robust and ongoing engagement between the media and state entities such as the Ministry of Information, local governments, and the National Commission for Civic Education would be required. A public awareness campaign is required to influence public attitudes, behaviors, and expectations. Increasing public understanding of environmental cleanliness and pollution control regulations would be beneficial.

Notwithstanding, efforts to reduce water pollution would be stalled if drains are built and suitable waste disposal systems are supplied but the regulations are not strictly followed, including arrests and convictions. Some residents would shamelessly disregard the rules because individuals are well aware of their actions that contribute to pollution and any intervention that merely teaches people would fail to achieve its goal.

Investment in recycling plants is heavily reliant on waste sorting technologies both during and after collection. Domestic waste sorting (into components such as plastics, glass, metals, and organic) education at the household level, using electronic and social media, is a critical step toward sustainable waste management in Ghana. To make it relevant and helpful to promote the nation's sustainable growth, this must be accompanied by good and sustainable waste collection, disposal, and landfill management methods.

Furthermore, in improving Ghana's water management, a great deal of research and money must be put into waste-water treatment, as well as assurances given to the public that it is safe and usable; this would increase groundwater usage and reduce water shortages in the long run. Alternatively, enhancing water management infrastructure design and operation can minimize the flow of pollutants

(Boelee et al., 2019a). It is also vital to have a unified set of metrics to track drinking water supply improvements.

Investment in pollution early warning systems, advanced water treatment technology, and increased water operator skills can help deal with unexpected pollutants. Access to other water bodies, such as irrigation canals and reservoirs, can also enhance hygiene and reduce health concerns, especially in places with limited household water supplies, as long as the water does not transport substantial pollutants from upstream areas (Boelee et al., 2019a).

It is past time to revisit the methods for safeguarding the human right to safe and clean water. There is a need, among other things, to design national laws to encourage widespread adoption of this international standard, which should be complemented by a comprehensive learning agenda that will guide the development of relevant measures.

X. CONCLUSION AND RECOMMENDATIONS

Water pollution's health effects and mitigation strategies are undeniably important in the twenty-first century, especially as Ghana's water resources are rapidly dwindling, generating a shortage. Water pollution is a major issue in Ghana, posing a threat to the country's water resources, economy, human health, and quality of life. This study reviews the drivers, pressures, and state of Ghana's fresh water resources using the DPSIR model. This research ultimately seeks to discover water pollution remedies and policy choices in Ghana that will improve human health and quality of life.

The research focused on anthropogenic contaminants in Ghana's fresh water resources and their impact on health-related quality of life. Domestic, industrial, and agricultural activities are the key anthropogenic contributors to fresh water contamination in Ghana. Water has clearly been a source of national concern in Ghana for quite some time, since it is the most severely polluted natural resource. Having enough

water is critical for a developing country like Ghana's overall economic progress. Polluted water has a harmful impact on the human heart and kidneys, blood circulation, diarrhea, skin rashes, vomiting, and the nervous system.

The quality and quantity of the fresh water resource are critical for the continual provision of clean and safe water. Treatment of raw water for consumptive and non-consumptive uses has become increasingly complex and expensive, resulting in the closure of certain treatment plants. Moreover, people living near these fresh water resources have a lower quality of life because these resources are no longer sustainable for home use.

Water supply operations necessitate ongoing assistance from a variety of organizations. All stakeholders must work together to achieve a common goal. Participation in organizations is becoming more important as a means of contributing to and supporting local and national organizations that seek to tackle environmental issues at the institutional, national, and worldwide levels. Everyone must have enough knowledge and be able to participate in public hearings, serve on advisory committees, and speak before review boards.

In Ghana, the most serious threat to water resources is pollution. Water contamination caused by massive amounts of untreated wastewater discharge has wreaked havoc on the environment, lowering the efficiency of water sources and limiting the amount of water available for usage. Due to an increase in environmental pollution, Ghana's percentage of polluted water is increasing, owing primarily to anthropogenic activities. Despite the abundance of water, there is currently a water deficit in the Pra River, the Birim River, the River Ankobra, and their tributaries.

Improved systematic planning, with more specific health impact tools accessible, as well as interdisciplinary collaboration between public health and water managers, would help to reduce negative health effects from water use. Water management

responses that target disease vectors and agents such as mosquitoes, crustaceans, and snails, as well as bacteria, viruses, and parasites, and extend to improved solid waste management, particularly plastic and green chemistry, can help improve people's public health, in addition to wastewater and water quality management. When water resource management is designed with human health in mind, it can help to prevent a wide range of infectious diseases and other health issues.

According to the study, efforts should be made to limit the mixing of poisonous and dangerous compounds into aquatic water bodies. To address the threat of water pollution, an effective approach must be developed that falls within technological, sustainable, economic, and policy constraints in order to fulfill desired treatment standards. This can be addressed by treating these wastes on site before they are discharged, or by replacing these chemicals with less dangerous substances. Industry should focus on developing new chemicals that are less harmful to the environment. In addition, better and more advanced wastewater treatment technologies should be implemented.

Furthermore, decentralized wastewater treatment systems should be preferable to centralized systems since they allow for local reuse of water and nutrients. For wastewater and water quality evaluation, a rapid, cost-effective, and reliable detection technique for micro contaminants and pathogens should be developed.

XI. REFERENCES

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