

# ENVIRONMENTAL IMPACTS OF UNTREATED DOMESTIC WASTEWATER

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## ABSTRACT

Untreated domestic wastewater poses significant environmental and public health challenges, particularly in urbanized areas like Davao City. This study examines the characteristics, impacts, and mitigation efforts related to untreated domestic wastewater in the Philippines, with a focus on its contribution to water pollution, eutrophication, and disease transmission. A systematic review methodology integrates both quantitative and qualitative information focusing also on the weaknesses of the current systems, regulations and public awareness. The results show that there is a great need for proper management plan for sewage disposal that should include provision for sewerage treatment facilities, small scale decentralized systems, legislation and community education. Recommendations aim to enhance policy frameworks and promote sustainable practices to reduce the detrimental impacts of untreated wastewater.

## 1. INTRODUCTION

Rapid urbanization and population growth in the Philippines have significantly increased the generation of domestic wastewater, leading to severe environmental degradation and public health concerns. In the country, wastewater contributes to 33% of water pollution, surpassing agricultural, industrial, and non-point sources (DENR-EMB, 2020)<sup>[8]</sup>. Domestic wastewater, which includes effluents from activities such as cooking, cleaning, and sanitation, contains a mix of organic and inorganic pollutants, includes nutrients, pathogens, and hazardous chemicals. When discharged untreated into water bodies, it degrades water quality, harms aquatic ecosystems, and contributes to the spread of waterborne diseases like cholera and schistosomiasis (Pilgonde, et. al, 2017)<sup>[11]</sup>. Despite its potential for resource recovery, over 80% of wastewater globally is discharged untreated, with treatment rates significantly lower in developing nations—only 8% in low-income countries compared to 70% in high-income nations (EIB, 2022)<sup>[6]</sup>. In the Philippines, this issue is compounded by inadequate wastewater treatment infrastructure, as evidenced by Metro Manila, where only 10% of the population is connected to sewage treatment facilities, and the majority relies on rudimentary systems like septic tanks (World Bank Report, 2023)<sup>[16]</sup>.

In Davao City, as elsewhere in the Philippines, observed patterns show that there remains a high level of untreated wastewater gushing out especially from kitchens which pose a risk to water bodies and public health systems in place. The source of additional organic loads and chemical pollutants is mainly domestic which in turn puts water quality under strain, hence the emphasis on wastewater management. This study assesses the issue of environmental degradation caused by domestic untreated wastewater being poured into the water bodies in Davao City, and uses this information to prepare for policy measures to help with wise water management strategies.

This systematic review combines the findings of primary and secondary sources, particularly focusing on the concept and the environmental impacts resulting from the absence of treatment of domestic wastewater effluents. Also, existing policy regarding wastewater management is appraised, particularly the successfulness of application of such policies, with a discussion on existing challenges and gaps. By drawing compliance from these findings, the review set out a very detailed roadmap on length and breadth of effects untreated sewage has on both the environment and human beings targeting long term and short term solutions to better Philippines' waste management strategies.

## 2. METHODOLOGY

The impact assessment and policy evaluation of untreated domestic sewage has been studied through the lens of systematic review methodology involving both primary and secondary data sources. Data collection consisted of obtaining appropriate literature from governmental reports like DENR-EMB, academic journals, international environmental guidelines, reports from international agencies, and even international esteemed media houses in order to understand the environmental and other policy factors affecting untreated sewage. Several parameters related to water quality including BOD, COD, TSS, Oil and Grease and coliform were used to measure the effects of untreated sewage on the water bodies. The analysis framework was twofold: first, quantitative data on water quality indicators were synthesized to evaluate the environmental consequences of untreated wastewater. Second, policy documents, such as the Philippine Clean Water Act and local interventions in Davao City, were reviewed to assess the effectiveness of existing wastewater management strategies and identify gaps in their implementation.

### 3. RESULTS AND ANALYSIS

#### Characteristics of Domestic Wastewater

Household sewage has a shared dimension which is when it is left untreated and this combination involves numerous physical, chemical and bacteriological parameters that are detrimental and degrading of water quality, aquatic life and even human life. The most important features of household sewage, when left in its untreated form include the following.

**Physical Parameters.** The average pH of domestic wastewater especially when treated is between 6 and 8.5 as indicated in Syukor et al 2020<sup>[1]</sup>. This indicates a slightly acidic or even neutral condition. In spite of the outlet for a good percentage of the pH level being tolerable for aquatic life, frequent disturbances such as massive disposal of wastewater effluents can be extremely detrimental to the aquatic ecology. When untreated, domestic wastewater effluent also contains high levels of Total Suspended Solids (TSS), this will help filter sunlight to reach the water body causing photosynthetic activity to lower and the growth of aquatic vegetation to be stunted (Bilotta & Brazier, 2008)<sup>[3]</sup>. This chain reaction, the disturbance of natural equilibrium will unfavorably alter the entire aquatic trophic structure.

**Chemical Parameters.** The environmental concern of high BOD in wastewater is often noted during its treatment processes, because it suggests that significant amounts of organic matter exist which leads to the consumption of oxygen by microorganisms in order to decompose such organic matter. Apart from contributing to the BOD levels of receiving water bodies, this leads to oxygen starvation for aquatic organisms potentially leading to their death (Bajpai, 2017)<sup>[2]</sup>. High levels of BOD are an evidence of biological oxygen demand that is organic pollution responsible for the pollution of the environment due to untreated waste water disposals. The presence of Chemicals Oxygen Demand (COD) at high levels in wastewater means that there are pollutants that have no biological application as they cannot be removed (Rekrak et al., 2020)<sup>[13]</sup>. Such compounds are hard to degrade biologically thus such pollutants can also cause an irreversible effect to water bodies, and this is a threat to marine species and humans. At present, domestic waste such as produced from the kitchen is the most common pollutants produced in urban daily life, and it includes starchy foods, plant fibers, animal proteins and fats, and other organic substances. These substances degrade water and environmental quality if left untreated due to their high contents of oils, salts, and moisture, which easily corrode surfaces and generate foul odors. Oil and grease causes blockage due to solidification (He, et. al., 2013)<sup>[9]</sup>.

**Bacteriological Parameters.** Coliform Bacteria and Escherichia coli are the indicators of feces contamination in wastewater which have not been sufficiently treated. The generation of such bacteria in wastewater (E. coli) is a water treatment problem (Swistock et al., 2022)<sup>[15]</sup>. These pathogens transmit various disease like diarrhea, cholera and dysentery.

#### Environmental Impacts of Untreated Domestic Wastewater

Untreated domestic wastewater is a major source of water pollution and environmental degradation, particularly in urbanized areas such as Davao City and other parts of the Philippines. The impacts of untreated wastewater are diverse, affecting water quality, aquatic ecosystems, and public health.

**Water Quality Degradation.** BOD and COD are indicators of the oxygen deficit in water and untreated wastewater threatens aquatic life specifically owing to its high BOD and COD levels (Bajpai, 2017; Rekrak et al., 2020)<sup>[2][13]</sup>. Research indicates that in a number of regions in the Philippines, major rivers have been extensively polluted as a direct result of untreated water being dumped into them. That is the case for BOD where it has been established that sewage waste goes untreated for the most part and that with commercial and domestic waste aggregate contribute roughly to more than sixty percent of the total BOD discharge to these rivers including the Pasig in Metro Manila (Chan et al., 2016). Increased turbidity as a result of TSS cuts off sunlight from reaching the photosynthetic planktons, an essential part of the aquatic ecosystems resulting in their deficiency (Some et al., 2013)<sup>[14]</sup>.

**Eutrophication and Coastal Degradation.** Untreated water augments nutrient pollution whose nitrogen and phosphorous components if unchecked only strengthen the degree of eutrophication. This will then create the perfect conditions for algae to grow in abundance which in turn shrinks the amount of oxygen in the water while also harming many forms of life. Philippines nutrient pollution caused by domestic wastewater in particular is now putting coastal areas of Metro Manila, Cebu and Davao regions at risk. Eutrophication in these regions contributes to the degradation of coral reefs, which are vital to marine biodiversity and local economies (Carlson et al., 2021)<sup>[4]</sup>. In particular, high phosphate levels from wastewater contribute to harmful algal blooms and the depletion of dissolved oxygen, further exacerbating the damage to aquatic ecosystems (USEPA, 2024).

**Public Health Impacts.** The problem regarding the waterborne diseases is one occurring due to the pathogens contained in the domestic wastewater that includes bacteria such as E. coli, viruses and a number of parasites. Due to this, people in the Philippines have contracted diseases such as cholera, dysentery and even typhoid fevers. Guerrero et al in 2016 mentioned about the 2015 cholera outbreak in Batangas and how they predicted it was due to the untreated wastewater

being dumped into the water channels. When looking at the health statistics one can conclude that lacking proper treatment of waste pretty much guarantees an outbreak of many waterborne diseases. According to DENR-EMB, 2020, an estimate of around 5,058 cases were recorded each year as of 2010 to 2019 which is a clear indicator that these regions have a poor sanitation system<sup>[1]</sup>. When looking specifically into Metro Manila, a heavy case of untreated wastewater led to the significant increase of cases of Diarrhea which exceeded 10,000 as recorded as of 2018 according to the reports of DOH of 2018.

**Ecosystem and Biodiversity Loss.** When untreated sewage and wastewater is released into oceans or other water bodies, it can result to alteration of the ecosystem which includes biodiversity loss in freshwater as well as coastal regions. The combination of excess nutrients, low oxygen levels, and organic matter pollution worsens the state of these ecosystems. For example, in Laguna de Bay and Manila Bay, the effluents discharged retain a huge concentration of pollutants leading to water pollution and poor water quality (DENR, 2019). More than 50% of the country's reefs are destroyed, mostly due to untreated effluents impacting not only aquatic life but also communities which rely on these environments for income (DENR, 2019).

**Data and Evidence.** Primary evidence includes field data collected in 2017 by the National Water Resources Board (NWRB) which revealed high fecal coliform concentrations in Pasig, Marikina, and Tullahan, which are rivers exposed to shock amounts of sewage waste. In total microbial counts for fecal coliform bacteria in these rivers were established as at most 10000 MPN/100mL higher than the recommended interstitial water standards. Secondary data from international organizations, such as the World Bank (2020), emphasize that over 80% of wastewater worldwide is released untreated, exacerbating global water scarcity, health issues, and environmental damage. In the Philippines, about 43% of major rivers are polluted due to untreated domestic wastewater (DENR-EMB, 2020).

**Overall Environmental and Health Impacts.** The untreated sewage effluent that is directly discharged by households is centrally located to the problem of aquatic pollution. DENR-EMB (2020) states that roughly 43% of water pollution in the major rivers in the Philippines can be attributed to untreated sewage. Our rivers and lakes are subjected to nutrient overloading in the form of wastewater, the end result of over a decade of poor effluent disposal sanitation practices. As the algal blooms are suffocating and depleting oxygen from the aquatic biosphere, USEPA (2024) notes that it is in fact through advanced sanitary practices that these processes can be averted. Speaking of which, over 50, woman infected with water borne diseases as a result of unsanitary and contaminated water were reported to have been cited in the world health organization's report (WHO, 2024) in order to ensure clean water access we need to eliminate or restrict effluent that has not been treated. Untreated effluent if sufficiently mishandled poses a serious threat to soil degradation, which has a negative impact on agricultural productivity and yield as well.

#### Mitigation Efforts and Policy Frameworks

Policymaking has shown plenty of promise in this area which joins the conversation of reducing untreated Domestic waste, while policymakers have been active at both the national as well as local levels to ensure the right set of policies are in place for improving sanitation. However, there are still areas where improvements need to be made, one such example is coverage in areas that are significantly urbanized as they are considered a key source of untreated domestic waste.

**Philippine Clean Water Act (RA 9275).** The Philippine Clean Water Act of 2004 (Republic Act No. 9275) is the primary piece of legislation governing water quality management in the Philippines. It mandates the regulation of wastewater discharges from various sectors, including domestic, industrial, and agricultural sources. The Act promotes the establishment of sewage treatment plants (STPs) in urban areas and requires local governments to implement wastewater management systems. Additionally, the Clean Water Act encourages a multi-sectoral approach to pollution prevention, focusing on the protection of water bodies from pollution and promoting integrated water quality management.

However, while the Act provides a comprehensive legal framework, it lacks sufficient enforcement mechanisms for residential wastewater sources. Residential areas, where a significant proportion of untreated wastewater originates, are not comprehensively addressed under the law, leaving a critical gap in efforts to manage domestic wastewater effectively.

**Local Level Initiatives.** At the local level, several cities in the Philippines have taken steps to address untreated wastewater discharges, although challenges remain. For instance, in Davao City, Executive Order No. 39 (2018) mandates that businesses such as shopping malls, hotels, and restaurants submit sewerage treatment plant designs for permit renewals. While this policy applies to commercial establishments, residential areas are largely excluded, meaning that significant sources of wastewater remain unaddressed. This policy gap highlights the need for a more inclusive approach that incorporates residential areas into wastewater management efforts.

Moreover, the Septage Treatment Plant Project, initiated in 2021, aims to establish five treatment facilities in Davao City. However, as of 2024, these facilities are still non-operational, delaying crucial interventions in wastewater management. This delay underscores the governance and operational challenges faced in implementing infrastructure projects on time.

**International Standards.** The United Nations' Sustainable Development Goal (SDG) 6 emphasizes the need for clean water and sanitation for all, urging governments worldwide to ensure access to wastewater treatment solutions. The SDG calls for countries to improve wastewater management and infrastructure to protect water bodies and ensure the availability of clean water for all populations. In this context, the Philippine government is encouraged to align national efforts with global standards, particularly in the development of advanced wastewater treatment facilities, to meet international expectations for clean water access.

**Policy Gaps and Investment Deficits.** While national policies such as the Clean Water Act and local initiatives like Executive Order No. 39 are steps in the right direction, there are still significant gaps in policy implementation. Residential areas, a major source of untreated wastewater, are not comprehensively addressed under current policies. The exclusion of residential areas from initiatives like Executive Order No. 39 means that the full extent of untreated wastewater pollution is not mitigated.

Furthermore, inadequate investment in wastewater treatment systems remains a critical challenge. Only 3% of the water and sanitation budget in the Philippines is allocated to sewage treatment (DENR-EMB, 2020), limiting the capacity of government agencies to build and maintain sufficient wastewater treatment infrastructure. This lack of investment contributes to the persistence of untreated wastewater in the environment, exacerbating water pollution and health risks.

**National and Local Policy Alignment.** To improve wastewater management, there is a need for stronger alignment between national and local policies. While the Clean Water Act provides a comprehensive legal framework, local-level initiatives, such as the Metro Manila Sewerage System (MMSS) and the Pasig River Rehabilitation Program, have had some success in addressing wastewater treatment but still face significant challenges in implementation. Local initiatives in Cebu, such as decentralized wastewater treatment systems in residential areas, demonstrate the potential for smaller-scale, community-based solutions to complement national efforts.

## 4. DISCUSSIONS AND RECOMMENDATIONS

### Current Practices and Challenges in Wastewater Management

In the Philippines, the management of household wastewater remains a significant challenge, particularly in urban areas like Metro Manila, Davao City, and other densely populated regions. Current practices involve the direct discharge of untreated household wastewater into canals and drainage systems, which are often connected to rivers, lakes, and coastal waters. This lack of treatment leads to severe environmental and health risks, including water pollution, eutrophication, and the spread of waterborne diseases.

**Infrastructure Deficits and Insufficient Sewage Treatment.** A key challenge in addressing untreated wastewater is the limited investment in sewage treatment infrastructure. Despite the growing need for wastewater management, only 3% of the water and sanitation budget in the Philippines is allocated to sewage treatment, leaving a large gap in the resources necessary to build and maintain adequate treatment facilities (DENR-EMB, 2020). This infrastructure deficit contributes to the discharge of untreated wastewater into the environment, which severely affects water quality in urban and rural areas alike.

In Metro Manila, for example, only 10% of households are connected to a sewage system, far below the connection rates in other major Asian cities (World Bank, 2020)<sup>[16]</sup>. Similarly, in cities like Davao, wastewater treatment facilities remain insufficient, and projects such as the Septage Treatment Plant face significant delays, highlighting governance and operational challenges in wastewater management. These deficiencies not only contribute to water pollution but also exacerbate the risk of waterborne diseases, as untreated wastewater often contains pathogens such as *E. coli* and other harmful bacteria.

**Lack of Comprehensive Policies and Policy Enforcement.** Existing policies and regulations, while addressing wastewater management, often fail to effectively target the contributions of residential areas to wastewater pollution. Many urban households still rely on inadequate or non-existent septic systems, and regulations typically focus more on industrial and commercial waste rather than domestic wastewater. As a result, the residential sector, which contributes significantly to water pollution, is largely overlooked in policy design and implementation.

Moreover, weak enforcement of existing wastewater management laws and limited local government capacity hinder the effective implementation of these regulations. This results in low compliance and insufficient monitoring of wastewater discharge from households. The lack of comprehensive policies and the insufficient enforcement



mechanisms mean that untreated wastewater continues to be released into waterways, with little oversight or consequence.

**Public Awareness and Education Deficits.** Another critical challenge is the lack of public awareness regarding the environmental and health risks associated with untreated wastewater. Many residents remain unaware of the direct consequences of improper wastewater disposal, including its role in the spread of diseases such as cholera, typhoid, and dysentery, and its harmful effects on aquatic ecosystems. Public awareness campaigns on the importance of wastewater treatment, pollution control, and hygiene are limited, and the need for comprehensive education on these issues is urgent. The lack of understanding of the health and environmental impacts of untreated wastewater also contributes to public resistance to change, particularly in rural and informal settlements, where inadequate sanitation practices are common. Addressing this gap in knowledge is critical to fostering greater public engagement and participation in wastewater management initiatives.

**Delayed Implementation of Infrastructure Projects.** Infrastructure projects aimed at addressing wastewater treatment face delays and challenges in execution. Notable projects, such as Davao City's Septage Treatment Plant, which aims to improve wastewater treatment capacity, have faced significant setbacks. Delays in implementation of these projects reflect governance and operational inefficiencies, which further hinder progress in improving wastewater management. In many cases, local governments lack the technical expertise or funding to expedite the development of sewage treatment systems.

## 5. RECOMMENDATIONS

### Policy Recommendations

**Mandatory Household Wastewater Treatment.** Amend the Order to have the same coverage region as applicable to other areas extending the jurisdiction over the household waste water.

**Infrastructure Development.** Expedite the completion of the Davao City Septage Treatment Plant and prioritize its implementation. Build up waste water management infrastructure, particularly in the suburbs and in the sites of housing projects.

**Public Awareness Campaigns.** Implement actions to increase the awareness of societies about the adverse effects pollution caused by the absence of treatment of waste water. Mainstream environmentally sound practices of management of wastewater through community campaigns and forums.

**Regulatory Enforcement.** Discharge the responsibility by the Department of Environment and Natural Resources - Environmental Management Bureau (DENR-EMB) to strengthen the supervision and ensure that the General Effluent Standards are observed (DENR 2016)<sup>[5]</sup>. Furthermore, policies such as EOS 39 should be amended to include specific guidelines on the control of household wastewater.

**Decentralized Treatment Technologies.** Promote decentralized solutions for the treatment of waste water especially in the rural areas and the less resourced.

### Future Research Directions

**Cumulative Impact Studies.** Undertake broader and longitudinal studies to understand the environmental and sociological impacts of the discharge of treated waste on the eco-systems and human populations.

**Policy and Technology Integration.** Investigate the integration of advanced wastewater technologies into existing infrastructure for scalability and efficiency.

**Community-Centric Solutions.** Explore culturally appropriate and sustainable wastewater management practices tailored to specific localities.

## 6. CONCLUSION

One of the main challenges faced in the Philippines is water pollution as a result of untreated domestic wastewater. By causing eutrophication, the untreated domestic wastes further lead to the loss of biodiversity and the spread of water borne diseases among the public.

The effects of legislation such as the Clean Water Act in the Philippines are still not felt because there are many loopholes when it comes to dealing with waste in residential areas and communities. Furthermore, the lack of investment in waste management and minimal public interest increases the severity of the problem. As part of the solution, measures such as improving waste water treatment systems and constructing rural sanitation systems, as well as educating the public on these problems should be put in place, while at the same time enforcing local and national standards for waste management.

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