

The Impact of Household Waste Management on The Operation of Street Surface Water Drainage Inlets in Ho Chi Minh City of Vietnam and Improvement Solutions

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Abstract - Flooding in Ho Chi Minh City specifically, and in major cities in Vietnam generally, is always a pressing societal issue, causing numerous human and infrastructural consequences. Proposed solutions for improving water flow to reduce flooding have been suggested but have not fully resolved the problem. The issue of water congestion at the city's rainwater collection inlets frequently occurs due to waste blocking the drains. This article analyzes the impact of household waste management on the functionality of surface water drainage inlets in Ho Chi Minh City and proposes improvement solutions to enhance water flow. Methods of document collection and analysis are used to synthesize the current status of the problem and the proposed solutions. The study shows that the clogging of drainage inlets persists due to the limitations of current household waste management solutions. A comprehensive household waste storage system is proposed to sustainably address this issue.

Keywords - Flooding, Water flow, Drainage inlet, Household waste, Management

I. INTRODUCTION

Climate change has become increasingly severe, leading to extreme weather phenomena (1). Flooding is a major concern, particularly in recent times, due to its severe consequences. In cities across Vietnam, a heavy rainfall event can lead to flooding due to various factors (2). The main causes of flooding in Ho Chi Minh City include natural factors such as climate change and rising sea levels, as well as human-related factors like urban planning, the state of the drainage system, management capabilities, and public awareness. Several anti-flooding solutions have been proposed for Ho Chi Minh City (3–5). These include human-focused approaches like improving the quality of planning, implementation, and management by urban management officials, as well as raising public awareness. Technical measures include enhancing urban planning, upgrading the city's infrastructure and drainage system, clearing canal systems, and constructing smart anti-flooding pump systems.

To improve the drainage system at its source, the Ho Chi Minh City Urban Drainage Company Limited has proposed a "Drainage Pipe Cover - Debris and Odor Blocker" solution (6). This system meets the following criteria:

- Optimized design to make the most of curb space for water collection.
- Prevention of sediment, soil, and stagnant water at the drainage inlets, while blocking odor from the drainage system.
- Blockage of large debris from entering the drain.
- Compatibility with curb and sidewalk geometry to enhance aesthetics and traffic safety.

When rainwater flows into the inlet, large debris is held back by a mesh filter, allowing only water, mud, and smaller waste particles to pass through into the collection chamber. From there, the water flows into the system through a one-way valve that prevents odors from escaping (Fig. 1). The cover also features a message to raise public awareness: "Do not litter here; litter clogs the drain and causes flooding."



Fig. 1. Improved drainage inlet

This system prevents large debris from entering the drain but does not address the issue of waste accumulating at the drain inlet, which leads to clogging. Instances of debris blocking drainage inlets and causing flooding have occurred in multiple locations, without a comprehensive solution in place (7–9), as illustrated in Fig. 2.



Fig. 2. Debris blocking drainage inlet (8)



Fig. 4. Household waste bin (13)

To address the issue of clogged inlets, self-cleaning drain covers have been proposed and tested (10). When water flows into the inlet, a raking mechanism is activated to clear the passage (Fig. 3). The raking cycle continues until there is no standing water at the inlet. This solution is currently a research project within the framework of a provincial science and technology competition for high school students organized by Bac Ninh Province. But it's not yet feasible for practical application due to limitations.



Fig. 3. Self-cleaning drain cover (10)



Fig. 5. Waste sorting bin in Japan (16)

To prevent debris from clogging drain inlets, some localities have launched specific initiatives to sort and store waste, aiming to curb littering. For instance, in Yen Bai Province, Ward 2 of Dong Tam Commune has created dual-colored waste bins for sorting waste, which are distributed to residents for free (11). In Tan Phu District, Ho Chi Minh City, residents are provided with dual-compartment bins to facilitate waste sorting at home (12). In Tien Thanh Ward, Dong Xoai City, Binh Phuoc Province, the “Household Waste Bin - Joining Hands to Protect the Environment” model is widely adopted (13). Waste is placed in sealed bags and stored in covered bins, keeping the environment clean and making it easier for sanitation workers to collect waste (Fig. 4). Many other localities have adopted similar models, which remain local and lack a unified system. Consequently, the presence of waste on sidewalks depends on local management and public awareness.

In France, household waste is sorted and stored in individual bins for private homes, communal bins for apartment buildings, or in public bins installed by local authorities. Bins are distinguished by lid colors or labels indicating different types of waste, and they are usually provided free of charge by the local government. Before collection, individual bins are placed at designated spots. Based on the announced collection schedule, the bins are collected by city sanitation services and then returned to their original positions. For public bins, residents bring sorted waste to collection points. Large waste items are collected on a schedule or can be directly taken to local collection points. Public littering is illegal and punishable by law (17, 18). Clearly, these measures significantly reduce waste on sidewalks or in public spaces. During rain, the problem of waste washing into drainage inlets and clogging them is nearly nonexistent. Alongside technical solutions, regulations and human factors are also prioritized.

Flood mitigation efforts in Vietnam have shown some effectiveness. However, flooding continues to occur due to certain bottlenecks, especially with clogged drainage systems. Therefore, solutions to this issue must be further developed and implemented to ensure safety for people and infrastructure.

This paper analyzes the impact of household waste management on the operation of street surface water drainage inlets in Ho Chi Minh City and proposes improvement solutions to reduce flooding during heavy rains. First, the research methods used are presented. Then, survey results on household waste storage and its impact on drainage inlets at specific locations are discussed. Finally, proposed waste storage management solutions before collection are discussed, and conclusions are presented.

II. METHOD

Documents were collected from both domestic and international sources, based on criteria ranging from general to detailed content relevant to the research topic, which includes the causes and solutions for flow obstruction at drainage inlets. The information is updated to reflect the most current data available. Analytical and evaluative methods were used to examine the documents to clarify the current situation, advantages, and challenges in flood reduction efforts related to drainage inlet obstructions.

III. RESULTS

The survey revealed that the clogging of drainage inlets by waste is due to the current waste collection and management practices, which are still inadequate. Although waste collection procedures in major cities include various methods, such as collecting waste directly from households using tricycles, collecting at doorsteps with compacting trucks, and collecting and transporting waste bins with bin-lifting vehicles, there are still many shortcomings in the staging and packaging of waste awaiting collection. This leads to waste commonly floating around during rainy weather.

The Environmental Protection Law of 2020 officially came into effect on January 1, 2022. Several new regulations related to household waste collection were established, with two key points being “starting to charge waste collection fees based on the volume or weight of classified waste” and “refusing to collect unclassified waste” (19). Although these regulations have been issued, there remain many shortcomings in the management and technical systems, leading to limited practical implementation. Waste classification remains experimental, inconsistent, and lacks sustainability.

Regulations regarding the staging of household waste awaiting collection are clearly outlined in Government Decree No. 45/2022/ND-CP (20). Specifically, point d, Article 25 states: "Fines ranging from 1,000,000 VND to 2,000,000 VND will be imposed for actions such as dumping, discarding, or abandoning waste on sidewalks, streets, or into urban wastewater systems or surface water drainage systems; improperly disposing of wastewater on sidewalks or streets; and dumping plastic waste generated from household activities into ponds, lakes, canals, rivers, streams, or seas."

According to these regulations, residents must store waste within their premises and stage it at a designated location and time for collection. Staging waste on sidewalks or in public areas outside of the designated times is a violation. However, in practice, there is a lack of consistency, and the phenomenon of waste awaiting collection on sidewalks is common and widespread across the country. Controlling this issue has proven ineffective due to insufficient resources and personnel for enforcement, low public awareness, and a lack of effective solutions.

Waste piled up on sidewalks has numerous adverse effects on both daily life and economic development. These impacts include environmental pollution, foul odors, diminished urban aesthetics, traffic disruption, and the spread of disease. Additionally, improper waste staging significantly impacts the tourism economy (21). However, placing waste bins outside faces issues such as theft, tampering, and vandalism (22). In some areas, residents have resorted to securing waste bins with locks for protection.

Currently, in Ho Chi Minh City, although staging waste on sidewalks or in public spaces is prohibited, it is still common to see waste placed in bags for collection (Fig. 6). Waste bins with lids are used in only a few localized areas, and their capacity varies according to the owner's preference. It is not unusual to see waste bins overflowing with bags left beside them.



Fig. 6. Waste staged in public areas (23)

IV. RECOMMENDATIONS

In addition to the Environmental Protection Law of 2020 (19) and Government Decree No. 45/2022/ND-CP (20), Ho Chi Minh City has also issued Decision No. 12/2019/QD-UBND, which regulates the management of household solid waste within the city to specifically implement the law and decree (24). According to this decision, after being sorted at the source, household waste must be stored in sealed packaging (bags) or storage containers (bins) with tight-fitting lids, marked to indicate the type of waste and meeting technical requirements such as safety, waterproofing, leak prevention, appropriate size, and odor control.

In practice, however, these bags are often unsuitable for conditions in Vietnam as they lack sufficient odor control and fail to remain secure due to animals like dogs, cats, and rats, as well as insects that tear into them for food. Furthermore, during rainy weather, waste from unsecured or loose bags can be carried by water to drainage inlets, causing blockages.

To improve the current situation, the author suggests that each household should be equipped with two types of tightly-lidded bins to store two categories of sorted waste. The shape and size of the bins should be designed to ensure proper waste storage, convenience, and compatibility with collection vehicles. The number of bins required should be calculated based on the daily waste volume. The technical services of the waste collection unit would assess the waste volume according to the number of residents in a specific household. Waste bins should be placed within the property's premises. Where this is not feasible, they may be neatly placed on the sidewalk in front of the house to facilitate easy collection by the waste service, with minimal impact on traffic and urban aesthetics. For effective implementation, relevant government authorities must mandate the use of tightly-lidded bins rather than merely recommending them. Funding for these bins can come from local government budgets, residents, or joint efforts between citizens and local authorities. The bins should have a specific shape and label to prevent theft or misuse for other purposes. This proposed solution is illustrated in Fig. 7. Currently, purchasing waste bins is not very costly, and they are easily accessible, with sizes suitable for urban space conditions. These bins, particularly, ensure environmental cleanliness and enhance the landscape. Implementing this model helps raise public awareness in residential areas, creating a clean and beautiful environment, while also contributing to environmental protection efforts. This model should not be limited to pilot projects; it needs to be widely implemented, standardized, and made mandatory to thoroughly address the main cause of flow obstruction at drainage inlets. Additionally, this solution enhances urban aesthetics and fosters conditions for the local tourism economy to develop.

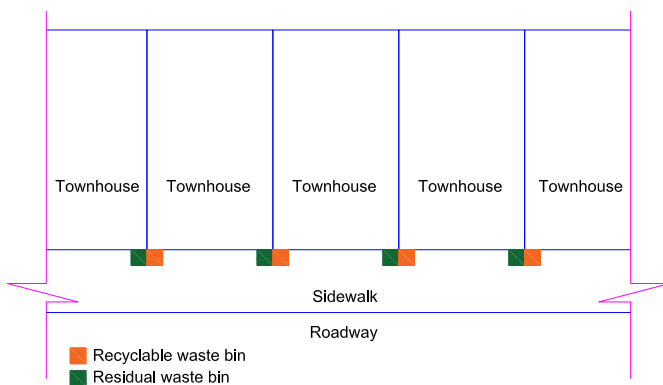


Fig. 7. Proposed waste bin layout plan for urban areas

V. CONCLUSIONS

The study synthesizes the current flood situation in Vietnamese cities, along with the existing causes and solutions. It further delves into issues related to drainage inlets, a critical component of the city's drainage system. Proposals to improve drainage inlets, such as blocking waste and odors while enhancing water flow, have been widely implemented. Additionally, the idea of a self-cleaning mechanism at the drainage inlet remains in the model stage due to various limitations. However, the primary cause of clogged drainage inlets-waste being carried and accumulating at the inlet-has not been thoroughly addressed. In developed countries, the issue of

waste blocking drainage inlets is managed effectively from the stage of waste storage prior to collection.

In the country, waste management to prevent it from drifting into drainage inlets has not been a primary focus. Policies have largely concentrated on promoting waste sorting at the source, with little consideration given to how waste is stored before collection. According to regulations, sorted waste should be stored in sealed bags or bins. Bags and bins are not allowed to be placed on sidewalks. However, using waste bags without placing them in sealed bins raises many issues, such as clogging drainage inlets due to drifting during rain, as well as negatively impacting aesthetics, cleanliness, environmental pollution, and the spread of diseases.

Some localities have recognized the issue mentioned above and have proposed using bins with lids to fully protect waste bags. However, the implementation has been on a small scale, as a spontaneous movement, lacking systematic organization and sustainability. Therefore, the author suggests mandating the use of tightly-lidded bins instead of bags or sealed containers as currently used. Each household should be equipped with two types of tightly-lidded bins for sorted waste, with size, shape, and quantity specifically calculated. The bins should be placed in designated locations to facilitate collection and minimize the impact on traffic and urban aesthetics. Implementing this system does not require a large budget and can be carried out in various ways.

The proposed solution not only addresses the root cause of flow obstruction at drainage inlets due to drifting waste but also helps protect urban aesthetics, maintain cleanliness, reduce environmental pollution, and prevent the spread of diseases, while also facilitating the development of the tourism economy.

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