Engineering and Technology Journal e-ISSN: 2456-3358

Volume 11 Issue 05 May-2026, Page No.-10184-10193

DOI: 10.47191/etj/v11i05.57, I.F. – 8.595

Preliminary Detection of Suspected Microplastics in Soil at Varying Distances from a Dumpsite Using the Hot Needle Test

Precious Domingo[1], Justin Nicol S. Umali[2], Hershey S. Barsaga[3], Jhonlex M. Dela Cruz[4], De Jian DG Pedro[5], Larah J. Derapite[6], Rosel V. Babalcon[7]

[1,2,3,4,5,6,7] Nueva Ecija University of Science and Technology, Sumacab Este, Cabanatuan, Nueva Ecija

ABSTRACT: Microplastic pollution has become an environmental concern because of its persistence and accumulation in ecosystems, including soil. This study assessed the presence of suspected microplastic particles in soil collected at different distances from a dumpsite in Barangay Makabaklay, Gapan City, Nueva Ecija, using low-cost screening methods such as sieving, density separation with sodium chloride (NaCl) solution, and the hot needle test. Soil samples were collected at distances of 0.5 m, 3 m, and 10 m from the dumpsite at a depth of 0.30 m, with two replicates per location. Samples were air-dried, sieved using a 60-mesh (0.3 mm) sieve, and subjected to density separation to isolate lighter particles. Suspected particles were analyzed using the hot needle test, where melting or deformation indicated possible plastic composition. Results showed positive responses in samples from 0.5 m and 3 m, while no positive response was observed at 10 m. Findings suggest that suspected microplastic occurrence decreases as distance from the dumpsite increases. The study concludes that the hot needle test is a practical and cost-effective preliminary screening method for suspected microplastics in soil.

KEYWORDS: Microplastics, Soil Contamination, Dumpsite Pollution, Hot Needle Test, Density Separation, Environmental Monitoring

I. INTRODUCTION

1.1 Background of the Study

Microplastic pollution is increasingly recognized as an environmental issue, particularly in areas where plastic waste is not effectively managed. Microplastics, defined as plastic particles smaller than 5 mm, are formed through the breakdown of larger plastic materials due to prolonged exposure to environmental conditions such as sunlight, heat, and mechanical stress. In soil environments, these particles may affect soil structure, microbial activity, and plant growth (Sajjad et al., 2022).

In the Philippines, waste management continues to pose significant challenges, especially in rapidly growing urban and semi-urban areas. Despite existing policies on solid waste management, improper waste segregation, high reliance on single-use plastics, and inconsistent enforcement of regulations contribute to the accumulation of plastic waste. In some localities, open or poorly managed dumpsites remain in use, allowing plastic materials to persist in the environment and gradually fragment into microplastics.

At the local level, dumpsites in Gapan City, Nueva Ecija, represent a potential source of microplastic contamination in surrounding soils. These sites are often situated near residential or agricultural areas, increasing the as rainfall, surface runoff, and human activities can facilitate the movement of microplastics from the dumpsite into nearby soil environments.

Soil is a critical resource that supports vegetation, regulates water, and sustains various biological processes. However, the introduction of microplastics into soil systems may alter their physical and chemical properties, potentially affecting soil quality and productivity. Furthermore, microplastics may serve as carriers of other pollutants, raising concerns about their possible movement through the environment and entry into food systems.

Despite these concerns, there is limited baseline data on the presence and distribution of microplastics in soils near dumpsites in Gapan City. In particular, information on how microplastic concentration varies with distance from a dumpsite remains insufficient. Addressing this gap is important for understanding the extent of local contamination and for informing future waste management strategies. Therefore, this study aims to detect the presence of microplastics in soil samples collected at varying distances from a dumpsite in Gapan City, Nueva Ecija, using the hot needle test. The findings may serve as baseline data for future environmental studies and support local efforts in improving waste management practices.

likelihood of environmental exposure. As plastic waste accumulates in these dumpsites, it undergoes weathering processes that lead to fragmentation. External factors such

1.2 Statement of the Problem

This study aims to assess the presence of suspected microplastic particles in soil collected near a dumpsite in Gapan City, Nueva Ecija, using sieving, density separation, and hot needle testing.

Specifically, it seeks to answer the following:

1. Are suspected microplastic particles detectable in soil samples collected at distances of 0.5 m, 3 m, and 10 m from the dump
2. How does the occurrence of suspected microplastic particles vary with distance from the dumpsite?
3. Are suspected microplastic particles detectable in soil collected at a depth of 0.30 m?
4. What trend can be observed between proximity to the dumpsite and the detection of suspected microplastics?

1.3 Objectives of the Study

The study aims to achieve the following objectives:

1. To detect suspected microplastic particles in soil samples collected at distances of 0.5 m, 3 m, and 10 m from the dumpsite.
2. To compare the detection results among the selected sampling distances.
3. To determine whether suspected microplastic particles can be detected in soil samples collected at a depth of 0.30 m.
4. To observe the possible effect of distance on the occurrence of suspected microplastic particles.
5. To assess the usefulness of the hot needle test as a low-cost screening method for preliminary microplastic detection.

1.4 Significance of the Study

This study is relevant and will be beneficial to the following:

Local Government Units (LGUs). The findings of this study may assist LGUs in improving waste management planning, establishing appropriate buffer zones around dumpsites, and strengthening environmental monitoring programs to reduce microplastic contamination in surrounding soils.

Community Residents. This study provides awareness regarding the potential presence of microplastics in soil near dumpsites, including possible contamination beyond the surface layer, which may affect their immediate environment.

Environmental Offices and Agencies. The results of this study may serve as baseline data for environmental monitoring and may support further testing and assessment of soil contamination in waste disposal areas.

Engineering and Land Use Planners. The findings may help guide decisions on land use and site suitability in areas near dumpsites.

Future Researchers. This study can serve as a reference for future research on microplastics in soil and may guide more advanced studies using laboratory-based identification methods and detailed analysis.

1.5 Scope and Limitations

This study focuses on detecting the presence of suspected microplastic particles in soil collected from a selected dumpsite in Gapan City, Nueva Ecija. Soil samples are collected at three specific distances—0.5 m, 3 m, and 10 m—from the dumpsite to determine whether suspected microplastics are detectable at each location. Sampling is conducted at a uniform depth of 0.30 m to maintain consistency. The study is limited to soil samples only and does not include other environmental media such as water or air. For sample preparation, a 60-mesh (0.3 mm) sieve is used to separate larger particles from the soil. Only visible particles retained by the sieve are examined. Suspected microplastic particles are identified using the hot needle test, wherein a heated needle is gently applied to the particles to observe melting or deformation, indicating possible plastic material. However, this study has several limitations. It does not determine the exact concentration, size distribution, or specific polymer types of microplastics present in the soil. Particles smaller than 0.3 mm are not detected due to the sieve limitation. In addition, the hot needle test is a preliminary screening method and cannot confirm the chemical composition of the particles. The hot needle test may also produce false positives, as some non-plastic materials may exhibit similar thermal behavior. Furthermore, the study is based on a limited number of samples, which may affect the generalizability of the results. The findings are further limited to the selected sampling distances, a single depth (0.30 m), one dumpsite location, and the specific period during which the samples were collected.

1.6 Conceptual Framework

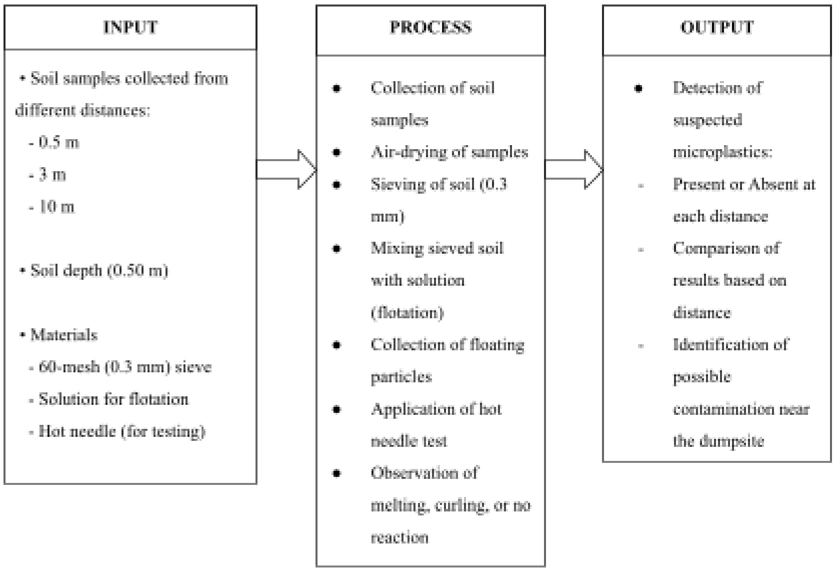

Figure 1. Conceptual Framework

II. REVIEW OF RELATED LITERATURE AND STUDIES

2.1 Microplastics: Definition and Sources

Microplastics are defined as plastic particles measuring less than 5 mm in size and are widely recognized as persistent environmental contaminants due to their durability and resistance to degradation. These particles are distributed across multiple environmental compartments, including aquatic systems, the atmosphere, and terrestrial environments. Studies in the Philippines have identified the presence of microplastics in major water systems, indicating widespread environmental contamination and limited local data in terrestrial environments (Osorio et al., 2021). Microplastics are generally classified into primary and secondary types. Primary microplastics are intentionally manufactured at microscopic sizes and are commonly used in personal care products and industrial applications. In contrast, secondary microplastics are formed through the fragmentation of larger plastic materials as a result of environmental processes such as ultraviolet (UV) radiation, thermal stress, and mechanical abrasion. In dumpsite environments, secondary microplastics are predominant due to the continuous accumulation and degradation of plastic waste. In addition, microplastics may be categorized based on morphology, including fibers, fragments, films, and pellets. These physical characteristics influence their transport behavior, environmental persistence, and interaction with surrounding media such as soil.

2.2 Microplastics in Soil

Soil serves as a major sink for microplastics, given its complex structure composed of mineral particles, organic matter, air, and water. Its porous nature enables the retention and transport of various contaminants, including microplastics. Microplastics have been reported in Philippine agricultural soils, where they may affect soil health, crop

productivity, and food safety (Piñero., 2025). Studies conducted in agricultural areas in the Philippines have confirmed the presence of microplastics in soil, although their distribution and concentration remain insufficiently understood (Bacosa et al., 2024). Microplastics enter soil systems primarily through external inputs such as dumpsites, improper waste disposal, and land-based activities. Once introduced, these particles may become incorporated into the soil matrix through natural processes such as infiltration, bioturbation, and surface mixing. Their distribution within soil is often heterogeneous and influenced by factors including soil texture, structure, and environmental conditions. Soils in proximity to dumpsites are particularly susceptible to microplastic accumulation due to continuous exposure to degrading plastic waste. This makes such areas critical for assessing the extent and spatial distribution of contamination.

2.3 Dumpsites as Sources of Pollution

Dumpsites represent a significant source of microplastic pollution in terrestrial environments. The accumulation of plastic waste in these areas leads to progressive degradation and fragmentation, resulting in the formation of microplastics that can contaminate surrounding soils. Weathering processes play a central role in this transformation. Physical weathering, driven by prolonged exposure to solar radiation, temperature fluctuations, and mechanical stress, causes plastics to become brittle and fragment. Chemical weathering, including oxidation and hydrolysis, further accelerates material breakdown. Biological activity may also contribute to the degradation of certain polymer types. In addition to degradation, several mechanisms facilitate the transport of microplastics into adjacent soil environments. These include mechanical mixing during waste handling, leachate movement, surface runoff during rainfall events, and wind-driven dispersion of lightweight particles. Consequently, soils surrounding dumpsites are subject to continuous input and accumulation of microplastics.

2.4 Detection Methods for Microplastics

The detection of microplastics in this study employs low-cost, screening-based methods suitable for resource-limited laboratory conditions. These methods provide preliminary identification of suspected microplastic particles in soil samples. Visual sorting is conducted to identify particles based on observable characteristics such as color and texture. Sieving is used to separate soil fractions and isolate potential microplastic particles according to size. Density separation involves the use of a saline solution to exploit density differences, allowing lighter plastic particles to float while heavier soil particles settle. The hot needle test is then applied to confirm plastic composition, as suspected particles exhibit melting or deformation when exposed to heat. To enhance reliability, identified particles are subjected to at least two complementary methods before being classified as microplastics. While these techniques do not provide polymer-specific identification, they are appropriate for generating baseline data on microplastic presence.

2.5 Influence of Distance from Source

The spatial distribution of microplastics in soil is strongly influenced by proximity to pollution sources. Areas located near dumpsites typically exhibit higher concentrations due to direct and continuous input of plastic waste. Microplastics have been detected in sediments in the Philippines, demonstrating their ability to accumulate in terrestrial and semi-terrestrial environments and posing potential ecological risks (Gabriel & Bacosa, 2024). The distribution of microplastics varies spatially depending on environmental conditions and proximity to pollution sources, as observed in sediment studies conducted in the Philippines (Andoy et al., 2025). As the distance from the source increases, microplastic concentrations generally decline due to reduced deposition and increased dispersion. However, transport processes such as wind action, surface runoff, and anthropogenic disturbance can redistribute particles beyond the immediate vicinity of the source. As a result, contamination may still be detected at greater distances, albeit at lower concentrations. Variations in distribution patterns are also influenced by environmental factors such as rainfall intensity, soil characteristics, and land use practices. Understanding these spatial trends is essential for assessing contamination gradients and supports the selection of sampling distances in this study.

2.6 Site Investigation Principles

This study adopts a systematic approach to site investigation by integrating structured sampling and low-cost analytical methods to assess microplastic contamination in soil. Sampling locations are established at predetermined distances from the dumpsite to evaluate spatial variation in microplastic presence. The analytical procedures rely on accessible screening techniques, allowing for practical implementation in basic laboratory settings. The use of multiple complementary methods enables cross-validation of results and improves the reliability of particle identification. Although limited to preliminary detection, this approach is sufficient for establishing baseline data on microplastic occurrence in soils surrounding dumpsites in Gapan City. The findings are expected to contribute to local environmental assessment efforts and provide a foundation for more advanced analytical studies in the future.

III. METHODOLOGY

3.1 Research Design

This study employed a descriptive and comparative field-based study design to assess the presence of suspected microplastic particles in soil samples collected at varying distances from a dumpsite in Gapan City, Nueva Ecija. The design is appropriate for determining the occurrence of suspected microplastics in environmental samples using basic field-based screening methods. The study follows a comparative approach, where soil samples collected from different distance zones are examined and compared based on the presence or absence of suspected microplastic particles. This allows the researchers to observe how proximity to the dumpsite may influence the occurrence of suspected microplastic contamination in soil. Microplastic identification in this study is limited to preliminary detection only using low-cost screening techniques such as sieving, density separation, and hot needle testing. These methods are used to distinguish suspected plastic particles from natural soil components based on physical behavior and observable characteristics. Results are presented in a descriptive format, showing the presence or absence of suspected microplastics per sampling location. This approach allows for a clear interpretation of spatial variation in contamination without requiring advanced laboratory quantification or polymer identification. Overall, this research design is suitable for baseline environmental assessment and provides initial evidence of suspected microplastic presence in soil within the study area.

3.2 Locale of The Study

The study was conducted in a dumpsite located in Barangay Makabaklay, Gapan City, Nueva Ecija, where solid waste from nearby communities is collected and disposed of. The area is considered a potential source of microplastic contamination in surrounding soils due to the continuous accumulation and degradation of waste materials, particularly plastics. Soil samples were collected from selected sampling points at varying distances from the dumpsite. These distance-based locations were established to determine the possible spatial distribution of suspected microplastic particles and to observe how contamination may vary in relation to proximity to the waste disposal area. The site was selected due to its active use as a dumpsite and its potential environmental impact on nearby soil conditions. Findings from this study are expected to provide baseline information that may support improved waste management practices and contribute to environmental risk awareness in similar disposal sites.

3.3 Respondents and sampling procedure

This study does not involve human respondents. Instead, the soil samples collected from different locations surrounding the dumpsite served as the primary units of analysis. These soil samples represent the environmental conditions of soil contamination by suspected microplastic particles at varying distances from the dumpsite in Barangay Makabaklay, Gapan City, Nueva Ecija. A systematic and purposive sampling approach was employed in selecting the sampling locations. The dumpsite was first identified as the reference point, and sampling points were established at predetermined distances (0.5 meters, 3 meters, and 10 meters) from the dumpsite to assess possible variations in contamination levels based on proximity. At each sampling location, soil samples were collected at a depth of approximately 0–30 cm using a clean non-plastic tool to minimize contamination. Two replicate samples were obtained per location to ensure consistency and reliability of results. The collected samples were properly labeled according to their corresponding distance and replicate number (e.g., D1-R1, D1-R2, etc.). After collection, all soil samples were subjected to a stepwise screening process involving visual sorting, sieving, density separation, and hot needle testing to identify suspected microplastic particles. The hot needle test was used as a confirmatory step to determine whether the collected particles exhibited plastic-like behavior, such as melting or deformation, upon heat exposure. All procedures were conducted carefully to ensure that samples were not cross-contaminated and that results accurately represent the condition of soil in each sampling area.

3.4 Research instruments

The following instruments and materials were used in the study to facilitate soil sampling, separation, and preliminary detection of suspected microplastic particles. Each item was selected based on its suitability for field-based environmental screening and its relevance to the study objectives.

Table 1. Instruments and Materials Used in Microplastic Detection and Analysis

Instrument	**Material**
Hand Trowel/Soil Auger	Used for collecting oil samples from the designated sampling depth (0.30m)
Weighing Scale	Used to measure and standardized the mass of soil samples (approximately 250g pero sample)
60-mesh sieve (0.3mm)	Used to remove coarse debris and separate finer soil particles for further screening
Glass beaker/Container	Used for the density separation of soil samples in liquid solution
NaCl (salt) 9% solution	Used to facilitate density separation by allowing low-density particles (suspected microplastics) to float)
Needle + Heat source	Used for the hot needle test to indicate possible plastic-like behaviour of suspected particles
Tweezers/Forceps	Used for safe handling and isolation of suspected microplastic particles
Camera	Used for documentation of sampling sites and suspected microplastic particles

3.5 Data Collection Procedure

The data collection procedure was conducted in a systematic and repeatable manner to ensure consistency in the detection of suspected microplastic particles in soil samples collected from varying distances (0.5 m, 3 m, and 10 m) from the dumpsite in Barangay Makabaklay, Gapan City, Nueva Ecija.

Step 1 – Soil Sampling

Soil samples were collected at a consistent depth of 0.30 meters using a stainless steel hand auger. Samples from each designated distance were collected and placed in properly labeled, non-plastic containers to preserve sample integrity.

Step 2 – Contamination Control and Drying

To minimize contamination, all tools were cleaned before and after each sampling. Samples were air-dried for 1 hour at room temperature in clean, covered trays to prevent external contamination such as dust or airborne particles.

Step 3 – Sieving

Dried soil samples were passed through a 60-mesh (0.3 mm) stainless steel sieve to remove coarse debris and isolate finer soil particles that may contain suspected microplastics.

Step 4 – Density Separation

A measured portion of the sieved soil was placed in a glass container, and a sodium chloride (NaCl) 9% solution was added. The mixture was gently stirred and allowed to settle. Due to density differences, lighter particles were expected to float while heavier soil particles settled at the bottom. **Step 5 – Recovery of Floating Particles**

Floating particles were carefully collected using tweezers or filtration techniques. These particles were considered as suspected microplastics and were separated for further screening.

Step 6 – Hot Needle Test

Each suspected particle was subjected to the hot needle test by touching it with a heated metal needle. Observations were made based on the particle’s reaction:

- Melting, curling, softening, or sticking to the needle was recorded as a positive indication of possible plastic-like material.
- No observable reaction was recorded as non-plastic behavior.

Step 7 – Recording of Results

All observations were systematically recorded per sample location. Particles exhibiting plastic-like thermal reactions were classified as suspected microplastic particles detected, while those without reaction were recorded as no positive thermal reaction observed.

Contamination Control Measures

All observations were systematically recorded per sample location. Particles exhibiting plastic-like thermal reactions were classified as suspected microplastic particles detected, while those without reaction were recorded as no positive thermal response observed.

Contamination Control Measures

To ensure data reliability and prevent contamination, the following precautions were strictly implemented:

- Cleaning of all tools before and after each sample collection
- Use of non-plastic, covered containers for sample storage
- Avoidance of synthetic clothing fibers near open samples
- Careful handling of samples throughout the procedure
- Keeping samples covered during transport and processing

3.6 Data Analysis

The analysis of soil samples focused on determining the presence or absence of suspected microplastic particles at varying distances from the dumpsite (0.5 m, 3 m, and 10 m). The analysis was based on results obtained from low-cost screening procedures, particularly density separation using sodium chloride (NaCl) solution and the hot needle test. The use of NaCl solution was applied as a low-cost density separation medium to facilitate the floating of low-density particles, including possible plastic fragments, from the soil matrix. This method is suitable for preliminary screening because it allows the separation of lighter particles without the need for specialized laboratory equipment. The hot needle test was selected as the primary screening technique due to its practicality, affordability, and accessibility for undergraduate-level environmental studies. It is a simple method used to observe the thermal behavior of suspected particles, making it appropriate for preliminary identification of possible plastic-like materials in soil samples. Particles that exhibited melting, curling, softening, or sticking to the heated needle were recorded as having a positive hot needle response, indicating the presence of suspected microplastic particles. Particles that did not exhibit any reaction were recorded as non-plastic materials, or no positive thermal response was observed. A comparative analysis was conducted across the three sampling distances to determine the distribution of suspected microplastic particles relative to the dumpsite. The presence or absence of suspected microplastics in each location was compared to assess whether proximity to the dumpsite may influence the level of contamination. All results were summarized in tabular form, indicating each sampling distance, replicate sample, and corresponding observation (presence or absence of suspected microplastic particles). This approach allowed for clear interpretation and comparison of microplastic occurrence across different spatial locations. Overall, the analysis aimed to establish baseline evidence of suspected microplastic contamination in soil within the study area using a simple, cost-effective, and field-appropriate methodology.

IV. RESULTS AND DISCUSSION

4.1 Presentation of Sampling Information

The soil samples were collected from three different distances (0.5 m, 3 m, and 10 m) away from the dumpsite in Gapan City, Nueva Ecija. All samples were obtained at a uniform depth of 0.30 m, with two replicates per distance. Each sample had a mass of 250 grams to ensure consistency in the procedure **Table 2. Soil Sampling Details**

Sampling Distance	Soil Depth (m)	No. of Replicates	Soil Mass per	Date Collected
			Sample (g)	
0.5 m	0.30	2	250	03/24/26
3 m	0.30	2	250	03/24/26
10m	0.30	2	250	03/24/26

This table shows that a consistent sampling procedure was followed across all locations, ensuring reliability in the comparison of results.

4.2 Detection Results of Suspected Microplastics

The presence of suspected microplastic particles was determined using the hot needle test. The results per replicate are shown below.

Table 3. Detection Results by Distance

Distance	Replicate 1	Replicate 2	Positive Samples	Detection (Fraction)
0.5 m	Positive	Positive	2	2/2
3 m	Negative	Positive	1	1/2
10m	Negative	Negative	0	0/2

The presence of suspected microplastic particles was determined using the hot needle test, with results recorded for each replicate. As shown in Table 2, all samples collected at 0.5 m showed positive reactions (2/2). At 3 m, one out of two samples showed positive reactions (1/2), while one showed no reaction. In contrast, none of the samples collected at 10 m showed a positive reaction (0/2). These results suggest that positive detections were more frequent in samples closer to the dumpsite and decreased with increasing distance.

4.3 Description of Hot Needle Reaction

Observed particle characteristics and their responses to the heated needle are summarized below.

Table 4. Heated Needle Test Results

Distance	Reaction to Heated Needle	Interpretation
0.5 m	Melted/curled	Suspected microplastic
3 m	Melted/softened	Suspected microplastic
10m	No Reaction	Non-plastic suspected

The observed reactions support the identification of suspected microplastic particles based on their thermal behavior.

4.4 Discussion of Objective 1

Suspected microplastic particles were detected in soil samples collected at 0.5 m and 3 m from the dumpsite, as indicated by positive hot needle reactions such as melting, curling, and softening. In contrast, no suspected particles were detected at 10 m under the applied screening method.

These findings suggest that plastic-like particles were present in soils nearer to the dumpsite under the applied screening method.

4.5 Discussion of Objective 2 – Comparison by Distance

The detection rates varied depending on the sampling distance. The highest detection (2/2) was observed at 0.5 m, followed by 3 m (1/2), while no positive reactions were recorded at 10 m. This pattern may indicate that proximity to the dumpsite influences the presence of suspected microplastic particles. These results suggest a possible trend where areas closer to waste accumulation contain more plastic residues, although further investigation is needed to confirm this relationship.

4.6 Discussion of Objective 3 – Depth

All soil samples were collected at a depth of 0.30 m. Suspected particles were detected at the sampled depth (0.30 m); however, vertical movement cannot be assessed due to single-depth sampling. However, since only one depth was analyzed, no conclusion can be made regarding the vertical distribution of microplastics.

4.7 Discussion of Objective 4 – Effect of Distance

Based on the results, the frequency of detected suspected microplastic particles decreased as the sampling distance increased. This suggests a possible relationship between proximity to the dumpsite and the occurrence of microplastics in soil. However, this observation should be considered preliminary, and additional sampling distances are recommended for a more detailed analysis.

4.8 Discussion of Objective 5 – Usefulness of the Hot Needle Test

The hot needle test proved to be a practical and cost-effective method for identifying suspected microplastic particles in soil samples. It allowed for quick screening based on observable thermal reactions such as melting and curling. However, the method is limited in that it does not determine the exact type of plastic material. Despite this limitation, it is suitable for preliminary analysis, especially in studies with limited laboratory resource

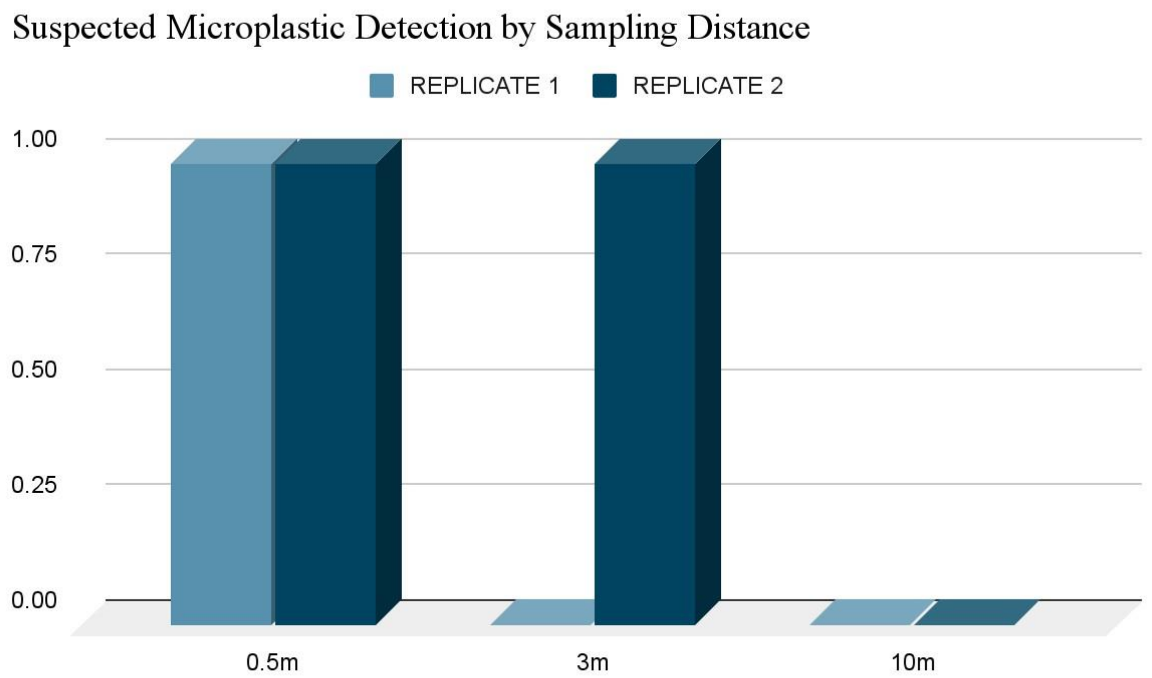

Figure 2. Suspected Microplastic Detection by Sampling Distance

SUMMARY

This study looked into the presence of suspected microplastic particles in soil collected at distances of 0.5 m, 3 m, and 10 m from a dumpsite in Gapan City, Nueva Ecija. The samples were taken at a depth of 0.30 m, then air-dried and passed through a 60-mesh (0.3 mm) sieve. To separate lighter materials, part of the soil was mixed with a saline solution, allowing possible microplastics to float before being tested using the hot needle method. The results showed that soil samples collected closer to the dumpsite (0.5 m and 3 m) produced positive reactions during the hot needle test, such as melting, curling, and sticking, indicating the presence of suspected microplastic particles based on hot needle response. Meanwhile, the sample taken at 10 m showed no reaction, suggesting that no suspected microplastic particles were detected at 10 m under the applied method. Overall, the findings suggest that suspected microplastic contamination is more likely to be found in areas closer to the dumpsite.

CONCLUSIONS

Based on the findings of the study and within the limitations of the methods applied, the following conclusions are drawn:

1. Suspected microplastic particles were detected at varying distances from the dumpsite in Barangay Makabaklay, Gapan City, Nueva Ecija, based on positive hot needle responses. This indicates that plastic-like materials are present in soil samples within the study area under the applied screening conditions.
2. The occurrence of suspected microplastic particles varied across sampling distances, with a higher frequency of positive hot needle responses observed in samples collected at 0.5 m and 3 m compared to 10 m. This pattern suggests a spatial variation in suspected microplastic distribution relative to the dumpsite.
3. Suspected microplastic particles exhibiting plastic-like thermal behavior were identified in soil samples collected at a uniform depth of 0.30 m in selected locations. This indicates that potential microplastic contamination is not limited to surface soil under the conditions examined.
4. The results indicate a decreasing trend in the occurrence of suspected microplastic particles with increasing distance from the dumpsite. This suggests that proximity to the waste disposal area may influence the distribution of suspected microplastic contamination, although this relationship cannot be generalized beyond the study conditions.
5. The hot needle test proved to be a practical and cost-effective method for the preliminary screening of suspected microplastic particles in soil. However, due to its qualitative nature and potential for false positives, the method cannot confirm polymer composition and should be complemented with advanced analytical techniques (e.g., spectroscopic methods) for definitive identification.

RECOMMENDATION

Based on the findings of this study, future researchers are encouraged to include additional sampling distances, multiple sampling directions, and varying soil depths to obtain a more comprehensive understanding of the spatial and vertical distribution of suspected microplastics near dumpsites. The use of microscopes and advanced analytical techniques such as FTIR or Raman spectroscopy is also recommended to improve the accuracy and confirmation of microplastic identification. In addition, conducting seasonal sampling and examining the relationship between suspected microplastics and soil properties may help provide further insight into their environmental behavior and potential impacts. Lastly, strengthening waste segregation, recycling, and proper disposal practices may help reduce plastic waste accumulation and possible microplastic contamination in soil environments.

ACKNOWLEDGMENT

This research, titled "Preliminary Detection of Suspected Microplastics in Soil at Varying Distances from a Dumpsite Using the Hot Needle Test," was made possible through a combination of academic challenges, teamwork, and personal growth experienced throughout the study. The process pushed the researchers to think critically, work consistently, and remain committed despite the difficulties encountered during data collection and analysis.

The researchers express their deepest gratitude to their parents and families for their unconditional love, patience, encouragement, and financial support. Their continuous motivation and sacrifices served as a source of strength and inspiration in completing this research.

The researchers are also sincerely thankful to their research adviser and course instructor, Engr. Rosel Verdadero-Babalcon, for her valuable guidance, patience, and expertise throughout the study. Her constructive feedback and support greatly improved the quality of the work and helped the researchers stay focused and properly directed.

The researchers acknowledge the Nueva Ecija University of Science and Technology, particularly the College of Engineering, for providing the academic environment and resources necessary to conduct this study. The institution played an essential role in the completion of this research.

The researchers also extend their appreciation to the taxpayers whose contributions support public education. Their continued support makes it possible for students to pursue higher education and complete academic requirements that may contribute to future environmental and scientific understanding.

Lastly, the researchers are deeply grateful to their friends and fellow researchers for their cooperation, understanding, and encouragement throughout the process. This study would not have been possible without the teamwork, shared effort, and mutual support that helped them overcome stress, deadlines, and challenges.

REFERENCES

1. Afrin, S., Uddin, M. K., & Rahman, M. M. (2020). *Microplastics contamination in the soil from urban landfill site, Dhaka, Bangladesh. Heliyon*, 6(11), e05572. https://doi.org/10.1016/j.heliyon.2020.e05572
2. Beckingham, B., Apintiloaiei, A., Moore, C., & Brandes, J. (2023). *Hot or not: systematic review and laboratory evaluation of the hot needle test for microplastic identification. Microplastics and Nanoplastics,* 3(8). https://doi.org/10.1186/s43591-023-00056-4
3. Phowan, N., Thongchang, K., Klomkliang, P., Sangpakdee, T., & Jaikaew, P. (2026). *A study on microplastics pollution and contamination from leachate and soil in open dumpsite in Pathum Thani province, Thailand. Journal of Ecological Engineering,* 27(3), 210–225. https://doi.org/10.12911/22998993/213369
4. Sajjad, M., Huang, Q., Khan, S., Khan, M. A., Liu, Y., Wang, J., Lian, F., Wang, Q., & Guo, G. (2022). *Microplastics in the soil environment: A critical review. Environmental Technology & Innovation*, 27, 102408. https://doi.org/10.1016/j.eti.2022.102408
5. Andoy, C. J. M., Ochigue, P. C. D., Romarate, R. A., Rodil, M. S. P., Nakano, H., & Bacosa, H. P. (2025). *Spatial and vertical distribution of microplastics in mangrove sediment in the southern Philippines. Marine Environmental Research,* 209, Article 107223. https://doi.org/10.1016/j.marenvres.2025.107223
6. Piñero, K. P. (2024). *Microplastics in Philippine farmlands. SciData Journal.*

   https://doi.org/10.64591/2werfy85
7. Gabriel, A. D., & Bacosa, H. P. (2024). *Microplastic abundance and distribution in the sediment of Cagayan de Oro River, Philippines. Soil and Sediment Contamination: An International Journal,* *33*(8), 1252–1268. https://doi.org/10.1080/15320383.2023.2301495
8. Osorio, E. D., Tanchuling, M. A. N., & Diola,
9. M. B. L. D. (2021). *Microplastics occurrence in surface* waters and sediments in five river mouths of Manila Bay. Frontiers in Environmental Science, 9, 719274. https://doi.org/10.3389/fenvs.2021.7