

Distance-Based Assessment of Suspected Microplastic Particle Abundance in Agricultural Soils Near a Dumpsite in Central Luzon, Philippines

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Abstract - Microplastic contamination in terrestrial environments has emerged as a growing environmental concern, particularly in agricultural soils that may act as sinks of plastic particles. This study assessed the abundance and characteristics of suspected microplastic particles in agricultural soils near a dumpsite in San Isidro, Cabanatuan City, Nueva Ecija, Philippines, and examined how their distribution varies with distance. A quantitative descriptive design with a distance-based approach was used. Soil samples were collected from four zones located at 150 m, 300 m, 450 m, and 600 m from the dumpsite using composite sampling. Samples were processed through air-drying, sieving, density separation using sodium chloride (NaCl), and visual identification with hot needle testing. Results showed that suspected microplastic particles were present in all zones, with the highest abundance at 150 m (62 particles/kg) and the lowest at 600 m (5 particles/kg), indicating a decreasing trend with distance. Irregular plastic-like particles and fragments were the dominant forms, while smaller particles (0.9–<2 mm) were slightly more abundant. The findings suggest that proximity to the dumpsite may influence microplastic distribution in agricultural soils. This study demonstrates the usefulness of low-cost methods for preliminary assessment and highlights the need for improved waste management and further research using advanced analytical techniques.

Index Terms - Agricultural Soils, Dumpsite, Microplastics, Soil Contamination, Spatial Distribution

I. INTRODUCTION

Microplastic pollution has emerged as a significant environmental concern due to the persistence and widespread distribution of plastic particles smaller than 5 mm. These particles originate from the fragmentation of larger plastics or from primary sources such as industrial microbeads. While research has traditionally focused on aquatic environments,

recent studies indicate that soils—particularly agricultural soils—can act as important reservoirs of microplastics, potentially affecting soil structure, water retention, and biological activity.

In the Philippines, existing studies have primarily examined microplastics in aquatic systems, with limited investigation into terrestrial environments. However, recent findings have reported the presence of microplastics in agricultural soils, suggesting that farmland may also be vulnerable to contamination. Agricultural regions located near waste disposal sites are of particular concern, as dumpsites may serve as potential sources of plastic debris that can undergo fragmentation and environmental transport.

Nueva Ecija, a major agricultural region in the Philippines, plays a crucial role in national food production. The presence of dumpsites near agricultural lands raises concerns regarding possible soil contamination. Despite this, there is still limited information on how microplastic abundance in soils varies with distance from such sources.

This study aims to assess the abundance and characteristics of suspected microplastic particles in agricultural soils at varying distances from a dumpsite in San Isidro, Cabanatuan City, Nueva Ecija, and to examine how their distribution changes with proximity to the source.

II. RESEARCH ELABORATIONS (METHODOLOGY)

A. Study Area and Design

The study was conducted in an agricultural area near a dumpsite in San Isidro, Cabanatuan City, Nueva Ecija,

Philippines. A quantitative descriptive design with a distance-based approach was employed to assess how suspected microplastic abundance varies with proximity to the dumpsite.

Four sampling zones were established at distances of 150 m, 300 m, 450 m, and 600 m. In each zone, three subsamples were collected and combined into one composite sample, resulting in four composite soil samples representing each distance.

B. Soil Sampling and Preparation

Soil samples were collected from the topsoil layer (0–10 cm) using a clean shovel after removing surface debris. Samples were air-dried under ambient conditions for approximately 24 hours to remove moisture and stabilize the material. Dried samples were then subjected to sieve analysis to facilitate particle separation.

C. Microplastic Extraction and Identification

Microplastics were extracted using density separation with a sodium chloride (NaCl) solution, which isolates lighter particles from soil matrices. Recovered particles were visually sorted and classified according to shape (fragment, fiber, irregular) and size (0.9–<2 mm and 2–5 mm).

A hot needle test was used for verification. Particles that melted or deformed upon contact with a heated needle were considered suspected microplastics.

D. Data Analysis

Microplastic abundance was expressed as particles per kilogram (particles/kg) of dry soil. Descriptive statistics, including frequency counts and percentages, were used to summarize particle distribution by shape and size.

A scatter plot with a linear trendline was used to examine the relationship between distance and particle abundance. Spearman rank correlation was applied to assess the direction of the relationship; however, due to the limited sample size ($n = 4$), the analysis was considered exploratory.

E. Limitations

The study relied on low-cost screening methods and did not include polymer-level confirmation using

advanced techniques such as FTIR or Raman spectroscopy. Density separation using NaCl may not recover higher-density polymers, and sampling was conducted during a single period. Therefore, results should be interpreted as a preliminary assessment.

III. RESULTS AND FINDINGS

A. Microplastic Abundance by Distance

Suspected microplastic particles were detected in all sampling zones. Table 1 presents the abundance of particles expressed as particles per kilogram (particles/kg) of dry soil.

Table 1. Abundance of Suspected Microplastic Particles by Distance from Dumpsite

Zone	Distance (m)	Particle Count	Particle/kg Dry Soil
A	150	62	62
B	300	30	30
C	450	9	9
D	600	5	5

The highest abundance was recorded at 150 m (62 particles/kg), followed by 300 m (30 particles/kg), 450 m (9 particles/kg), and 600 m (5 particles/kg). A consistent decreasing trend in particle abundance was observed with increasing distance from the dumpsite, with an overall reduction of approximately 92% from 150 m to 600 m.

B. Trend with Distance

To visualize the variation in abundance, a bar graph is presented in Fig. 1.

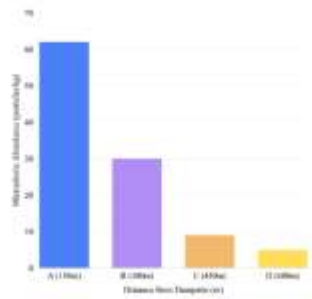


Fig. 1. Abundance of Suspected Microplastic Particles by Distance from Dumpsite

The figure shows a clear decreasing pattern in suspected microplastic abundance as distance from the dumpsite increases. The sharp decline between 300 m and 450 m may indicate a limited transport range or the influence of site-specific environmental factors.

C. Relationship Between Distance and Abundance

A scatter plot with a linear trendline is shown in Fig. 2 to examine the relationship between distance and particle abundance.

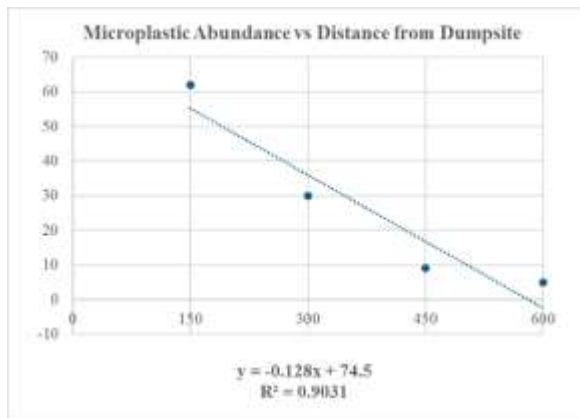


Fig. 2. Relationship Between Distance and Suspected Microplastic Abundance

The trendline ($y = -0.128x + 74.5$) indicates a negative relationship between the variables, while the coefficient of determination ($R^2 \approx 0.90$) suggests a strong linear pattern within the observed data. Spearman rank correlation ($\rho \approx -1.00$) further supports a strong negative association between distance and particle abundance.

However, due to the limited sample size ($n = 4$), these results are considered exploratory and should be interpreted with caution.

D. Shape Distribution

The distribution of particles based on shape is presented in Table 2.

Table 2. Shape Distribution of Suspected Microplastic Particles

Shape	Frequency	Percentage (%)
Fiber	1	0.94
Fragment	29	27.36
Irregular plastic-like particles	76	71.70

Irregular plastic-like particles were the most dominant, accounting for 71.70% of the total, followed by fragments (27.36%) and fibers (0.94%). The dominance of irregular particles suggests advanced fragmentation of plastic materials. However, due to reliance on visual identification, some particles may include non-plastic materials.

E. Size Distribution

Table 3 presents the size distribution of suspected microplastic particles.

Size Class	Frequency	Percentage (%)
0.9-<2mm	56	52.83
2-5mm	50	47.17

Table 3. Size Distribution of Suspected Microplastic Particles

Particles in the 0.9-<2 mm size range comprised 52.83% of the total, while particles measuring 2-5 mm accounted for 47.17%. The slightly higher proportion of smaller particles indicates ongoing fragmentation of plastic materials.

F. Interpretation of Findings

Overall, the results indicate that suspected microplastic particles are present across all sampling zones, with higher abundance observed in areas closer to the dumpsite. The decreasing trend with distance suggests that proximity to the dumpsite may influence particle distribution.

The presence of particles even at farther distances indicates that secondary transport mechanisms such as wind or surface runoff may contribute to their dispersal. Other possible sources, including agricultural plastics and general litter, cannot be excluded.

These findings should be interpreted as a preliminary assessment due to methodological limitations and the absence of polymer-level confirmation.

IV. CONCLUSION

This study identified the presence of suspected microplastic particles in agricultural soils near a dumpsite in San Isidro, Cabanatuan City, Nueva Ecija. Particles were observed across all sampling zones, with higher abundance recorded in areas closer to the dumpsite and a consistent decreasing trend noted with increasing distance. This pattern suggests that proximity to the dumpsite may influence the distribution of suspected microplastics.

In terms of characteristics, irregular plastic-like particles and fragments were the dominant forms, while smaller-sized particles were slightly more abundant, indicating ongoing fragmentation of plastic materials.

The use of low-cost screening methods was effective for preliminary identification; however, the findings should be interpreted with caution due to the absence of polymer-level confirmation. Therefore, the results represent an initial field-based assessment rather than definitive evidence of microplastic composition or source attribution.

Overall, the study highlights the potential presence and spatial variation of suspected microplastics in agricultural soils near waste disposal areas. Further research using advanced analytical techniques and expanded sampling designs is recommended to validate and extend these findings.

APPENDIX

Suspected microplastics in Zone A (150m)



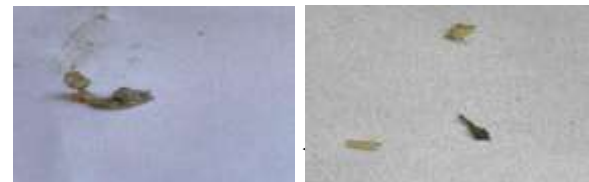
Suspected microplastics in Zone B (300m)



Suspected microplastics in Zone C (450m)



Suspected microplastics in Zone D (600m)



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