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BRAND AUDIT OF SINGLE-USE PLASTICS OF SELECTED URBAN BARANGAYS IN ILIGAN CITY, THE PHILIPPINES

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Abstract: Single-use plastics (SUPs) are products that are widely used by many people; hence, this article focuses on identifying the major contributor of SUPs in Iligan City through a waste analysis and characterisation study and an investigation of the brand names and manufacturers of these plastics. The labels, typically located on the rear portion of the packaging, were used to identify the brands of the SUPs. The findings revealed that the majority of the generated SUPs were branded, with Nescafé and Lucky Me (6.2%) being the most abundant, which are instant coffee powder and noodle products, respectively. Additionally, Nestlé (13.6%) was the manufacturer responsible for the largest share of branded SUPs, followed by Monde Nissin (9.1%), and Jack 'n Jill (8.7%). Moreover, branded SUPs were primarily sachets, while unbranded SUPs were mostly plastic *labo* (i.e., thin plastic film bags without handle). Identifying the leading brands contributing to plastic waste is crucial for holding companies accountable for their environmental and economic impact onto strengthen sustainability efforts, prioritising the reduction of plastic pollution is essential.

Keywords: Brand audit, manufacturer, sachet, single-use plastic, sustainability.

Introduction

Plastics, particularly single-use plastics (SUPs) have been present for decades, proving to be highly convenient for many people. Examples of SUPs include plastic carrier bags, disposable food containers, and disposable plastic utensils, which can be easily discarded or recycled after serving their purpose (Vimal *et al.*, 2020). Single-use plastics are composed of synthetic and semi-synthetic organic polymers, often manufactured using polyethylene (PE) and polypropylene (PP) (Plastics Europe, 2020; Camedda *et al*., 2021). In the plastic economy, more than 31% of plastic production consists of polyethylene while 27% consists of PP, indicating their widespread use (Hutley & Quederni, 2016).

Due to the continuous use and disposal of SUPs, plastic pollution has become one of the most significant environmental issues today and has gained increasing attention in recent years (Brighty *et al*., 2017). By 2050, plastics are projected to outnumber fish in the ocean unless effective reduction measures are implemented (Floyd, 2016; Van Rensburg *et al*., 2020). The Philippines is the third-largest contributor of plastic waste to the marine environment and the leading polluter of plastics in rivers (Meijer *et al*., 2015). Plastics are commonly found on beaches and beach sands (Sajorne *et al*., 2021; Acot *et al*., 2022; Sajorne *et al*., 2022a; Sajorne *et al*., 2022b; Inocente & Bacosa, 2022; Morales *et al*., 2023), in mangroves and mangrove sediments, on the seabed and in seagrass beds (Gaboy *et al*., 2022; Navarro *et al*., 2022; Pacilan & Bacosa, 2022), in riverine and estuarine systems (Requiron & Bacosa, 2022; Escañan & Bacosa, 2022), and even in lakes (Arcadio *et al*., 2022). One of the most commonly used SUPs in the Philippines is the sachet (Rola, 2019). The

country's "sachet culture" is a major contributor to plastic pollution rivers (Meijer *et al*., 2021) and oceans (Jambeck *et al*., 2015), particularly among low-income households (Rola, 2019). It is estimated that 164 million sachets are discarded daily in the Philippines (Rola, 2019).

Marine organisms are severely impacted by plastic pollution. A few affected species include the green turtle (*Chelonia mydas*) found in Davao Gulf (Abreo *et al*., 2016a), the whale shark found (*Rhincodon typus*) in Tagum City (Abreo *et al*., 2019), and Deraniyagala's beaked whale (*Mesoplodon hotaula*) in Maco, Compostela Valley (Abreo *et al*., 2016b). Microbeads, another form of SUPs are also significant pollutants in marine waters due to the lack of effective filtration treatment (Dey *et al*., 2020). Plastic pollution also affects soil health. In China, farmlands (Wang *et al*., 2020) and inland cultivated soils (Huang *et al*., 2021) have been found to contain microplastics. Recent reports indicate that microplastics are prevalent in the atmospheric environment of the Philippines (Romarate *et al*., 2022). Furthermore, plastics are among the most commonly generated household and municipal wastes (DENR-NSWMC, 2004; Bernardo, 2008; Miezah *et al*., 2015).

On a positive note, several organisations are addressing plastic pollution through recycling and upcycling initiatives. "The Plastic Flamingo" is one such organisation that repurposes plastic waste, including sachets, into raw materials for eco-lumbers used in construction (Portugal, 2021). In Iligan City, Holcim Philippines Inc. is one of the companies that upcycle plastics through their *Geocycle* project, using them in co-processing for cement production (Holcim Philippines, 2019).

Due to the rapid increase in SUP consumption in recent years, many countries, municipalities, and localities worldwide have implemented bans on SUP use (Bartolotta & Hardy, 2018; Adam *et al*., 2020; Viera *et al*., 2020; Bezerra *et al*., 2021). Beyond outright bans, effective waste management strategies are essential. Conducting brand audits is one effective method for reducing SUP generation. A brand audit is an important tool for identifying the manufacturers most responsible for SUP waste in a given area (Global Alliance for

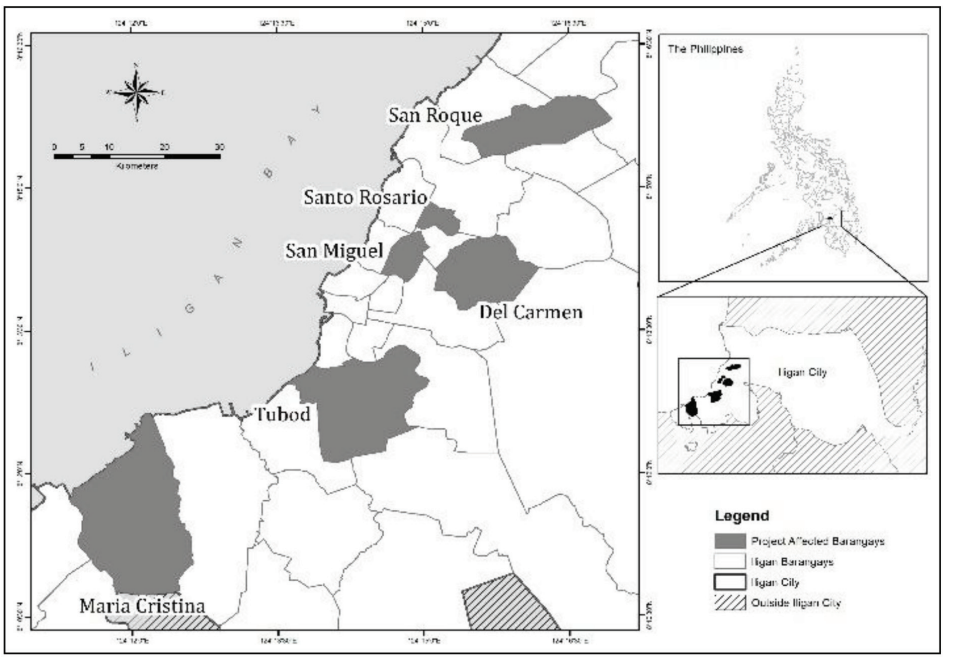

Figure 1: Map of the study area

Incinerator Alternatives Report, 2019). Through brand auditing, companies that produce large volumes of SUPs can be held accountable and encourages to use less plastic, especially in packaging, thereby reducing plastic pollution (Begum Rokeya University, 2019). Many companies continue to use plastics in their brands due to their low cost and versatility (Vanaerschot & Plaisier, 2021). Additionally, brand audits can support the transition from a linear economy to a circular economy, promoting both sustainable economic growth and environmental protection.

This study aims to identify the brand that produces the largest quantity of SUPs in Iligan City. To date, no published study has conducted a brand audit of SUPs in Iligan City, particularly those classified under the city's single-use plastic ban and the Global Alliance for Incinerator Alternatives (GAIA) Report. The objectives of this study are to determine the most commonly consumed brands of SUPs among Iligan City residents and to classify the SUPs as branded, unbranded, or unidentifiable.

Materials and Methods

Sampling Area

The study was conducted in Iligan City (8°14'36" N, 124°14'36" E), which has a total land area of 81,337 hectares (Figure 1). Among the 44 barangays, six urban barangays were selected as sampling sites, namely Santo Rosario, San Miguel, San Roque, Maria Cristina, Tubod, and Del Carmen. The selection criteria for these barangays are presented in Table 1.

Sampling Method

A total of 61 household samples were identified from the six barangays using a two-stage stratified random sampling method. In the Philippines, a barangay is the smallest administrative division, comprising smaller units called purok. The Waste Analysis and Characterisation Study (WACS) was conducted for seven consecutive days in each household as repeated measures data. Table 1 outlines the sampling procedure for each barangay. The first sub-stratum was fixed while the three sub-strata were randomly selected.

Determination of Sample Size

The sample size of 61 households was determined using G*Power software, a statistical power analysis tool for various t-tests, F-tests, χ^2 tests, z-tests, and exact tests. This software also facilitates effect size computations and graphical representations of power analysis results. The sample size calculation was based on the following parameters:

- Paired sampled t-test
- 0.05 level of significance
- 95% power of efficiency
- Type one error

Table 1: Sub-strata and the criteria for the sampling method

Sub-strata Number	Sub-strata	Criteria
1	Selected barangays	Selection was based on the availability of solid waste historical data and the barangay's willingness to collaborate.
2	Selected purok	Random sampling.
3	Selected households	The number of households was determined by dividing the purok population by 4.4, the average household size based on the latest Philippine Statistics Authority census. Households were then selected randomly.
4	Waste characterisation duration	The number of households were divided by seven, as waste characterisation was conducted over seven days.

- 95% confidence interval
- 95% power of the test

The final household sample size was computed and represented by *n*.

Waste Analysis and Characterisation Study

To ensure consistency in data collection, standardised methods were employed for the WACS. The procedures were regularly monitored and evaluated, with adjustments made as needed to minimise potential biases or limitations. To maintain data integrity, households were instructed to consume SUPs and generate waste as they normally would.

One day before the WACS, participating households were provided with garbage bags labelled for non-biodegradable and biodegradable waste. Waste collection took place at 6:00 a.m. on the day of the study, after which the waste was transported to a sorting area. The total weight of waste generated by each household was measured and recorded. The wastes was then categorised into biodegradable and non-biodegradable materials. Non-biodegradable waste was further sorted into three categories: Recyclable waste, residual waste, and special waste. These categories were further classified into sub-categories. Recyclable waste was classified into paper, cartons, plastics, glass, bottles, metals, and usable cloth. Residual waste was divided into residuals with potential for recycling and residuals for disposal while special waste included hazardous waste, healthcare waste, and bulky waste. However, only hazardous wastes was examined in this study. The weight, volume, and frequency of waste generation were recorded.

All plastic waste was identified from the non-biodegradable waste and classified into seven categories based on the plastic codes: Polyethylene terephthalate (PET), high-density polyethylene (HDPE), polyvinyl chloride (PVC), low-density polyethylene (LDPE), polypropylene (PP), polystyrene, and others. When possible, plastic codes were identified directly from the products. The weight and frequency of each plastic category were recorded through a data entry form. SUPs were identified from the plastic waste and categorised based on two classification systems: The GAIA Report and the Iligan City's City Ordinance No. 19-6814, which bans single-use plastics. Under the GAIA Report classification, SUPs included *sando* bags, plastic *labo*, sachets, disposable diapers, and plastic carrier bags. The City Ordinance No. 19-6814 classification included plastic wrappers, plastic cutlery, plastic bags, plastic utensils, plastic straws, plastic cups, and expanded polystyrene packaging.

Following the quantification of SUPs, a brand audit was conducted. SUPs were classified as branded, unbranded, and unidentifiable while maintaining their respective SUP categories (e.g., sachets were grouped by brand). A branded SUP was one that clearly displayed a company logo or name. The manufacturer, brand name, and product identity were recorded. An unbranded SUP had no visible logo or brand while an unidentifiable SUP was too degraded to distinguish branding. The frequency of branded, unbranded, and unidentifiable SUPs was recorded in the data entry form, ensuring that all single-use plastic products were accounted for.

Results and Discussion

Like many other consumer goods, SUPs are produced by a wide range of companies and manufacturers. Some of these plastics may feature branded logos or names while others do not display any branding. In Iligan City, the most widely consumed branded SUPs are Nescafé from Nestlé and Lucky Me, with a total of 219 pieces, accounting 3.3% of all SUPs and 6.2% of the total branded SUPs. This finding suggest that the most commonly consumed branded SUP products in the city are instant coffee sachets and instant noodles (Figure 2). This is followed by Birch Tree by Century Pacific and Bear Brand by Nestlé, with Birch Tree making up for 2% out of all SUPs and 3.5% of branded SUPs while Bear Brand constitutes 2.2% and 3.4%, respectively. These findings align with

Baxter *et al.* (2022), who reported that Nestlé, PepsiCo, Coca-Cola, Tim Hortons, Starbucks, and McDonald's accounted for 39% of branded waste in Canada. Similarly, a study conducted in the Philippines found that branded plastic litter collected on Freedom Island was dominated by Nestlé, Unilever, PT Torabika Mayora, Procter & Gamble, Monde Nissin, and Colgate-Palmolive, which collectively made up for 53.8% of the branded plastic waste (BreakFreeFromPlastic, 2017). Additionally, research on plastic waste found on Indian beaches identified local brands such as Bisleri bottled water and Indian Tobacco Company as major contributors (Owens *et al*., 2022).

Based on these findings, residents of Iligan City appear to prefer instant products such as coffee, milk powder, and noodles. The prevalence of sachets as the dominant type of SUP suggests that small, single-use packaging is a common choice for these products. According to the GAIA Report (2019), approximately 164 million sachets are used daily in the Philippines, amounting to an estimated 59.7 billion sachets annually. This volume of waste presents a significant challenge for barangays, cities, and municipalities in managing residual waste. The widespread use of SUPs may be drived by several consumer behaviours such as: (1) The convenience and accessibility of these products in the market, convenience stores, and *sari-sari* stores; (2) significantly lower prices compared with bulk or large-container alternatives; (3) effective marketing strategies that attract consumers; (4) brand loyalty among customers; and (5) limited awareness among consumers of the environmental impact of SUP packaging.

The manufacturer responsible for the largest share of branded SUPs is Nestlé (13.6%), followed by Monde Nissin (9.1%), and Jack 'n Jill (8.7%), which are all identified as sachets (Figure 3). Nestlé produces goods commonly packed in sachets, including powdered drinks such as Nescafé coffee, Bear Brand milk, and Milo chocolate drink. However, only a small number of Nestlé's sachet-based food packaging was identified. These findings suggest that Nestlé uses sachets for convenience and portion control. Monde Nissin packages food products such as Lucky Me noodles and Nissin wafers, in sachets. Jack 'n Jill most common sachet-packaged products include chips, cake bars, and biscuits. These results align with Nguyen and Bui (2023), who found that plastic litter in the Saigon River in Vietnam was largely from beverage companies such as PepsiCo, Acecook,

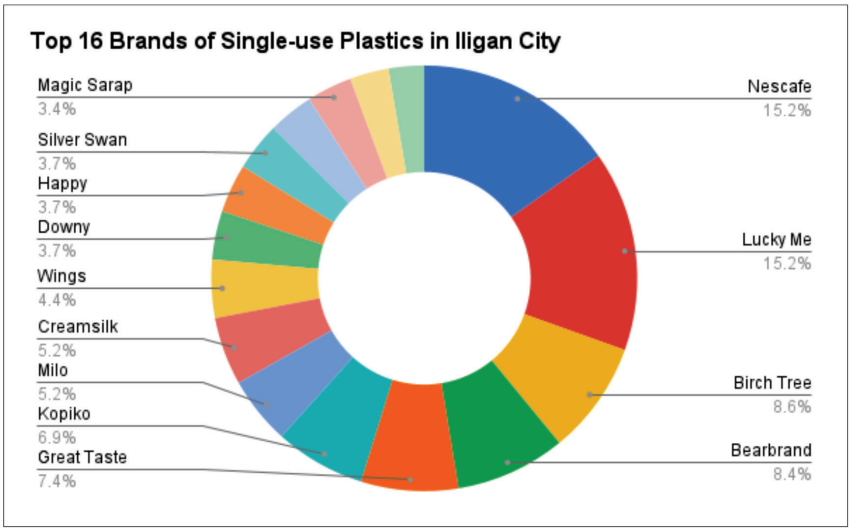

Figure 2: List of the top 16 brands of single-use plastics in Iligan City with their proportion relative to the total branded single-use plastics

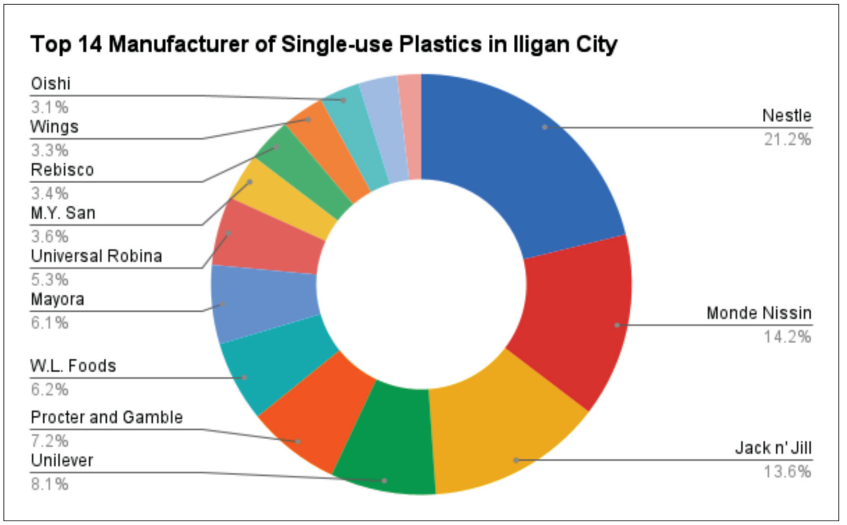

Figure 3: List of the top 12 manufacturers of single-use plastics in Iligan City with their proportion relative to the total branded single-use plastics

Masan, Vinacafe Bien Hoa, and Nestlé. In contrast, the majority of the branded plastic waste in Iligan City comes from coffee sachets and instant noodles. Additionally, AB InBev was identified as one of the largest plastic producers globally, operating in more than 50 countries across Europe, Africa, and Latin America. Their extensive plastic waste footprint stems from their various beverage brands, which use plastic bottles and shrink-wrap for packaging (Vanaerschot & Plaisier, 2021).

In this study, sachets emerged as the most prevalent branded SUPs, followed by plastic wrappers and plastic carrier bags (Figure 4). In comparison, Stanton *et al*. (2022) reported that 38.8% of anthropogenic litter was branded, with the highest contributions from the Coca-Cola Company, AB InBev, and PepsiCo. Coca-Cola's branded waste primarily consisted of metals and plastics. The proportion of branded waste in Stanton's study appears lower because it included all types of waste, not just plastics.

Among the 3,406 sachets collected, 27 sachets (0.8%) were unidentifiable due to poor conditions or labels being illegible. Some of these labels were in foreign language, suggesting that certain products were imported. Of the plastic wrappers, 67.2% were branded while the remaining 32.8% were unbranded. Meanwhile, plastic carrier bags were predominantly unbranded, comprising 63.8% of the total plastic carrier bags collected. The remaining SUP classifications were entirely unbranded.

In the GAIA report dataset, 61.5% of SUPs were branded while 38% were unbranded and 0.5% were unidentifiable. For SUPs classified under the City Ordinance, 7.4% were branded while 92.6% were unbranded. Similarly, the GAIA Report (2019) found that branded residual plastic wastes was more prevalent than unbranded or unidentifiable plastic waste. The report also highlighted that sachets produced by Nestlé were the most frequently generated branded SUPs across various barangays and cities, followed by Unilever and Procter & Gamble.

Overall, a total of 6,649 SUP pieces were collected, of which 52.5% were branded, 47.1% were unbranded, and 0.4% were unidentifiable (Figure 5). These branded items represent a significant portion of SUP waste, highlighting the role of businesses to SUP production. Additionally, the presence of unbranded and unidentifiable SUPs poses challenges for the

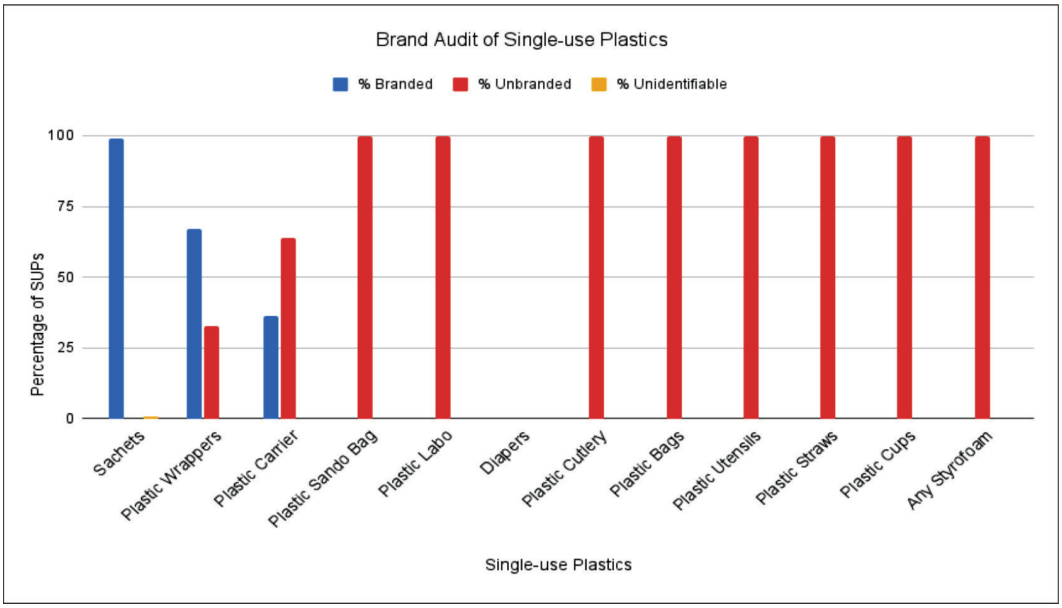

Figure 4: Brand audit of each single-use plastic classification across six barangays

city's solid waste management, as there is no clear accountability, and they may end up in the environment without a responsible entity managing their impact. However, with the implementation of effective waste management strategies and coordinated efforts between local governments, businesses, and residents, handling unlabelled SUPs can be improved.

These findings can support Local Government Units (LGUs) in assessing the impact of SUPs on Iligan City's waste generation. This, in turn, may prompt "zero plastic waste city" initiatives and influence LGUs to on the implementation of the Extended Producer Responsibility Act. Under this policy, producers are held accountable for the full life

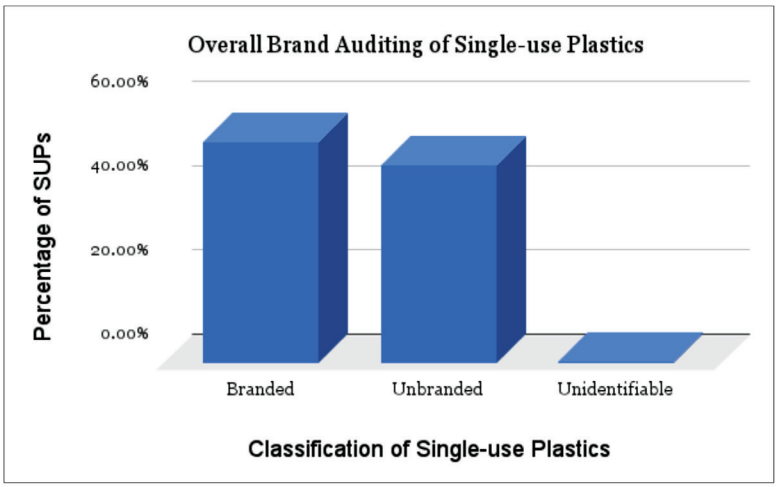

Figure 5: Overall brand audit of single-use plastics

cycle of the plastics they introduce into the economy, compelling them to adopt sustainable practices for design to disposal. Ultimately, these measures could help LGUs establish a more efficient waste management system while promoting responsible waste disposal practices within the community.

Conclusions and Recommendations

The majority of residents in Iligan City prefer branded SUPs, particularly those sold in sachets. However, unbranded SUPs such as plastic *labo* are also commonly used and readily available. Unbranded tossups pose challenges to the city's solid waste management system, as no specific companies can be held accountable for their distribution. Nestlé is the primary distributor of SUPs in the city, with Nescafé being the most prevalent brand. Therefore, the company should be held responsible for its extensive distribution of plastic packaging. However, compliance with the Ecological Solid Waste Management Act of 2000 (Republic Act 9003) remains essential for all stakeholders. Given the substantial volume of sachet waste generated by residents, efforts should also focus on identifying and holding accountable the main producers of these single-use plastics. While branded SUPs are the most abundant overall, distribution varies across barangays. In three barangays, branded SUPs are the most prevalent, whereas in the other three, unbranded plastics are more common. Across all six barangays, the most frequently identified brands include Nescafé, Lucky Me, Birch Tree, Bear Brand, Milo, and Kopiko.

Conducting studies to classify SUPs as branded, unbranded, or unidentifiable is important for identifying the companies responsible for managing plastic waste. Furthermore, brand audits serve as strong evidence supporting the need for wider implementation of the Republic Act 11898, or the Extended Producer Responsibility Act, not only in Iligan City but nationwide. This legislation encourages companies to design products with reduced environmental impact and adopt sustainable packaging materials. Lastly, these findings can assist the local government in improving plastic recycling methods, promoting proper waste segregation, and the most effective, waste management strategies.

Future researchers could expand the scope of investigation to include more barangays, puroks, and households within the city. Follow-up studies may also be conducted to further validate the findings.

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Conflict of Interest Statement

The authors declare no conflict of interest.

References

Abreo, N. A. S., Blatchley, D., & Superio M. D. (2019). Stranded whale shark (*Rhincodon typus*) reveals vulnerability of filter-feeding elasmobranchs to marine litter in the Philippines. *Marine Pollutant Bulletin*, *141*, 79-83. https://doi.org/10.1016/j.marpolbul.2019.02.030

Abreo, N. A. S., Macusi, E. D., Blatchley, D. D., & Cuenca, G. C. (2016a). Ingestion of marine plastic debris by green turtle (*Chelonia mydas*) in Davao Gulf, Mindanao, Philippines. *Philippine Journal of Science, 145*(1), 17-23.

Abreo, N. A. S., Macusi, E. D., Blatchley, D. D., & Cuenca-Ocay, G. (2016b). First

evidence of plastic ingestion by the rare deraniyagala's beaked whale (*Mesoplodon hotaula*). *IAMURE International Journal of Ecology and Conservation*, *19*(1), 16-36. http://orcid.org/0000-0003-3562-0309

Acot, F. T., Sajorne, R. E., Omar, N. A. K., Suson, P. D., Rallos, L. E. E., & Bacosa, H. P. (2022). Unraveling macroplastic pollution in rural and urban beaches in Sarangani Bay Protected Seascape, Mindanao, Philippines. *Journal of Marine Science and Engineering*, *10*(10), 1532. https://doi.org/10.3390/jmse10101532

Adam, I., Walker, T. R., Bezerra, J. C., & Clayton, A. (2020). Policies to reduce single-use plastic marine pollution in West Africa. *Marine Policy*, *116*, 103928. https://doi.org/10.1016/j.marpol.2020.103928

Arcadio, C. G. L. A., Navarro, C. K. P., Similatan, K. M., Inocenter, S. A. T., Ancla, S. M. B., Banda, M. H. T., Capangpangan, R. Y., & Bacosa, H. P. B. (2022). Microplastics in surface water of Laguna de Bay: First documented evidence on the largest lake in the Philippines. *Environmental Science and Pollution Research*, *30*, 2982-29833. https://link.springer.com/article/10.1007/s11356-022-24261-5

Bartolotta, J. F., & Hardy, S. D. (2018). Barriers and benefits to desired behaviours for single use plastic items in northeast Ohio's Lake Erie basin. *Marine Pollution Bulletin*, *127*, 576-585. https://doi.org/10.1016/j.marpolbul.2017.12.037

Baxter, L., Lucas, Z., & Walker, T. R. (2022). Evaluating Canada's single-use plastic mitigation policies via brand audit and beach cleanup data to reduce plastic pollution. *Marine Pollution Bulletin*, *176*, 113460. https://doi.org/10.1016/j.marpolbul.2022.113460

Bernardo, E. (2008). Solid-waste management practices of households in Manila, Philippines. *Annals of the New York Academy of Sciences*, *1140*(1), 420-424. https://doi.org/10.1196/annals.1454.016

Bezerra, J. C., Walker, T. R., Clayton, C. A., & Adam, I. (2021). Single-use plastic bag policies in the Southern African development community. *Environmental Challenges*, *100029*. https://doi.org/10.1016/j.envc.2021.100029

BreakFreeFromPlastic (BFFP). (2017). Green groups reveal top plastic polluters following massive beach cleanup on Freedom Island. https://www.breakfreefromplastic.org/2017/12/17/green-groups-reveal-top-plastic-polluters-following-massive-beach cleanup-on-freedom-island/

Brighty, G., Jones, D., & Ruxton, J. (2017). *High-level science review for 'A Plastic Oceans' film*. Plastic Oceans Foundation.

Camedda, A., Matiddi, M., Vianello, A., Coppa, S., Bianchi, J., Silvestri, C., PalazZo, L., Massaro, G., Atzori, F., Ruiu, A., Piermarini, R., Cocumelli, C., Briguglio, P., Hochscheid, S., Brundu, R., & de Lucia, G. A. (2021). Polymer composition assessment suggests prevalence of single-use plastics among items ingested by loggerhead sea turtles in the western mediterranean sub-region. *Environmental Pollution*, *292*, 118274. https://doi.org/10.1016/j.envpol.2021.118274

Dey, A., Dhumal, C. V., Sengupta, P., Kumar, A., Pramanik, N. K., & Alam, T. (2020). Challenges and possible solutions to mitigate the problems of single-use plastics used for packaging food items: A review. *Journal of Food Science and Technology*, *58*(9), 3251-3269. https://doi.org/10.1007/s13197-020-04885-6

Escañan, A. S., & Bacosa, H. P. (2022). Assessment of riverine plastic flux in Pulot River and its tributary in Sofronio Española, Palawan, Philippines. *Journal of Marine and Island Cultures*, *11*(2). https://doi.org/10.21463/jmic.2022.11.2.02

Floyd, D. S. (2016). Plastic Oceans: A new way in solving our plastic pollution.

Gaboy, S. M., Guihawan, J. Q., Leopardas, V. M., & Bacosa, H. P. (2022). Unravelling

macroplastic pollution in seagrass beds of Iligan City, Mindanao, Philippines. *Marine Pollution Bulletin*, *185*, 114233. https://www.sciencedirect.com/science/article/abs/pii/S0025326X22009158

Global Alliance for Incinerator Alternatives. (2019). Plastics exposed: How waste assessments and brand audits are helping Philippine cities fight plastic pollution.

Holcim Philippines. (2019). Holcim to help Iligan City in waste management. *Holcim Philippines*. https://www.holcim.ph/holcim-help-iligan-city-waste-management

Huang, B., Sun, L., Liu, M., Huang, H., He, H., Han, F., Wang, X., Xu, Z., Li, B., & Pan, X. (2021). Abundance and distribution characteristics of microplastic in plateau cultivated land of Yunnan Province, China. *Environmental Science and Pollution Research*, *28*(2), 1675-1688. https://doi.org/10.1007/s11356-020-10527-3

Hutley, T. J., & Ouederni, M. (2016). Polyolefins-the history and economic impact. In *Polyolefin compounds and materials* (pp. 13-50). Cham: Springer. https://doi.org/10.1007/978-3-319-25982-6_15

Inocente, S. A. T., & Bacosa, H. P. (2022). Assessment of macroplastic pollution on selected tourism beaches of Barobo, Surigao Del Sur, Philippines. *Journal of Marine and Island Cultures*, *11*(1). https://doi.org/10.21463/jmic.2022.11.1.14

Jambeck, J., Geyer, R., Wilcox, C., Siegler, T., Perryman, M., Andrady, A., Narayan, R., & Law, K. L. (2015). Plastic waste inputs from land into the ocean. *Science*, *347*(6223), 768-771. https://doi.org/10.1126/science.1260352

Meijer, L. J., van Emmerik, T., van der Ent, R., Schmidt, C., & Lebreton, L. (2021). More than 1000 rivers account for 80% of global riverine plastic emissions into the ocean. *Science Advances*, *7*(18), eaaz5803. https://doi.org/10.1126/sciadv.aaz5803

Miezah, K., Obiri-Danso, K., Kádár, Z., Fei-Baffoe, B., & Mensah, M. Y. (2015). Municipal solid waste characterisation and quantification as a measure towards effective waste management in Ghana. *Waste Managment*, *46*, 15-27. https://doi.org/10.1016/j.wasman.2015.09.009

Morales, I. D. G., Macusi, E. D., Jondonero, M. A. P., Quihawan, J. Q., Bacosa, H. P., & Amparado, R. F. (2023). Facemask: Protection or threat? *Marine Pollution Bulletin*, *188*, 114681. https://www.sciencedirect.com/science/article/pii/S0025326X23001121

Navarro, C. K. P., Arcadio, C. L. A., Similatan, K. M., Inocente, S. A. T., Banda, M. H. T., Capangpangan, R. Y., Torres, A. G., & Bacosa, H. P. (2022). Unraveling microplastic pollution in mangrove sediments of Butuan Bay, Philippines. *Sustainability*, *14*(21), 14469. https://www.mdpi.com/2071-1050/14/21/14469

Nguyen, K. L. P., & Bui, T. K. L. (2023). Riverbank macro-litters monitoring in downstream of Saigon River, Ho Chi Minh City. *Case Studies in Chemical and Environmental Engineering*, *7*, 100306. https://doi.org/10.1016/j.cscee.2023.100306

Owens, K. A., Sarasamma, J. D., Conlon, K., Kiruba, S., Biju, A., Vijay, N., Subramaniam, M., Vijayamma, S. A., Jayadev, A., Hoon, V., Padgett, R., Khanolkar, P. J., Kakavipure, D. K., Mohan, P. M., Chattopadhyay, S., & Khanolkar, C. (2022). Empowering local practitioners to collect and report on anthropogenic riverine and marine debris using inexpensive methods in India. *Sustainability*, *14*(3), 1928. https://doi.org/10.3390/su14031928

Pacilan, C. J. M., & Bacosa, H. P. (2022). Assessment of macroplastic litters on the coastal seabeds of Sultan Naga Dimaporo, Lanao del Norte, Philippines. *Journal of Marine and Island Cultures*, *11*(2), 1-12. https://doi.org/10.21463/jmic.2022.11.2.02

Philippine Statistics Authority. (2017). Demographic and Socioeconomic Characteristics Iligan City. 2015 Census of Population. http://psa.gov.ph/sites/default/files/10_Iligan%20City.pdf

Plastics - the Facts. (2020). An Analysis of European Plastics Production, Demand and Waste Data" in Association of Plastics Manufacturers and EPRO (Brussels: European Association of Plastics Recycling & Recovery Organisations Association of Plastic Manufacturers and European Association of Plastics Recycling and Recovery Organisations 64.

Portugal, A. (2021). A Filipino company is turning plastic waste into building materials. World Economic Forum. https://www.weforum.org/agenda/2021/10/phillipines-company-turning-plastic-waste-into-building-materials/

Requiron, J. C. M., & Bacosa, H. P. (2022). Macroplastic transport and deposition in the environs of Pulauan River, Dapitan City, Philippines. *Philippine Journal of Science*, *151*(3), 1211-1220. https://philjournalsci.dost.gov.ph/accepted-articles/113-vol-151-no-3-june-2022/1638-macroplastic-transport-and-deposition-in-the-environs-of-pulauan-river-dapitan-city-philippines

Requiron, J. C. M., Gutierrez, C. S., Inocente, S. A. T., Pacilan, C. M., Gaboy, S. M. M., Sison, M. P. M., Amparado, R. F., & Bacosa, H. P. (2023). Aquaculture farmers' perception and level of awareness of plastic litter in San Pedro, Dapitan City, Mindanao, Philippines. *Journal of Sustainability Science and Management*, *18*(3), 77-91. https://jssm.umt.edu.my/wp-content/uploads/sites/51/2023/03/ARTICLE-6.pdf

Rola, A. C. (2019). Managing plastic waste and the role of local governments. *National Academy of Science and Technology Philippines* (2019).

Romarate, R. I. A., Ancla, S. M. B., Patilan, D. M. M., Inocente, S. A. T., Pacilan, C. J. M., Sinco, A. L., Guihawan, J. Q., Capangpangan, R. Y., Lubguban, A. A., & Bacosa, H. P. (2022). Breathing plastics in Metro Manila, Philippines: Presence of suspended atmospheric microplastics in ambient air. *Environmental Science and Pollution Research*, *30*(18), 53662-53673. https://link.springer.com/article/10.1007/s11356-023-26117-y

Sajorne, R. E., Cayabo, G. D. B., Madarcos, J. R. V., Madarcos, K. G., Omar Jr, D. M., Ardines, L. B., Sabtal, S. A., Mabuhay-Omar, J. A., Cheung, V., Creencia, L. A., & Bacosa, H. P. (2022a). Occurrence of COVID-19 personal protective equipment (PPE) litters along the eastern coast of Palawan Island, Philippines. *Marine Pollution Bulletin*, *182*, 113934. DOI: 10.1016/j.marpolbul.2022.113934

Sajorne, R. E., Cayabo, G. D. B., Gajardo, L. J., Mabuhay-Omar, J. A., Creencia, L. A., & Bacosa, H. P. (2022b). Disentangling microplastic pollution on beach sand of Puerto Princesa, Palawan Island, Philippines: Abundance and characteristics. *Sustainability*, *14*, 15303. https://www.mdpi.com/2071-1050/14/22/15303

Stanton, T., Chico, G., Carr, E., Cook, S., Gomes, R. L., Heard, E., Law, A., Wilson, H. L., & Johnson, M. (2022). Planet patrolling: A citizen science brand audit of anthropogenic litter in the context of National Legislation and International Policy. *Journal of Hazardous Materials*, *436*, 129118. https://doi.org/10.1016/j.jhazmat.2022.129118

Van Rensburg, M. L., S'phumelele, L. N., & Dube, T. (2020). The 'plastic waste era'; Social perceptions towards single-use plastic consumption and impacts on the marine environment in Durban, South Africa. *Applied Geography*, *114*, 102132. https://doi.org/10.1016/j.apgeog.2019.102132

Vanaerschot, F., & Plaisier, M. (2021). The unbearable cost of single-use plastics.

Viera, J., Marques, M., Nazareth, M., Jimenez, P., & Castro, I. (2020). On replacing single-use plastic with so-called biodegradable

ones: The case with straws. *Environmental Science & Policy*, *106*, 177-181. https://doi.org/10.1016/j.envsci.2020.02.007

Vimal, K. E. K., Mathiyazhagan, K., Agarwal, V., Luthra, S., & Sivakumar, K. (2020). Analysis of barriers that impede the elimination of single-use plastic in developing economy context. *Journal of Cleaner Production*, *272*, 122629. https://doi.org/10.1016/j.jclepro.2020.122629

Wang, J., Li, J., Liu, S., Li, H., Chen, X., Peng, C., Zhang, P., & Liu, X. (2021). Distinct microplastic distributions in soils of different land-use types: A case study of Chinese farmlands. *Environmental Pollution*, *269*, 116199. https://doi.org/10.1016/j.envpol.2020.116199