Factors Shaping Policy Adoption on Single-Use Plastic Bag Regulation in Philippine Cities and Municipalities

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Abstract. In the absence of national legislation regulating plastic bag use in the Philippines, cities and municipalities are implementing local ordinances to regulate single-use plastics. This study tested factors shaping policy adoption on single-use plastic bags in cities and municipalities, and those that would explain the variation in the type of policy adopted. Five variables were tested to generate a logistic regression model for policy adoption and a multinomial logistic regression model for policy-type variation study. These variables are waste generation, consistency in implementing solid waste management, flooding hazard, income class, and number of plastic industries. Among these factors, flooding hazard and waste generation significantly explain why LGUs are likely to adopt plastic regulation policy. While none of the factors tested could explain the choice of policy between total and partial ban, and between total ban and tax, flooding hazard significantly explained the choice of partial ban over tax.

***Keywords*:** logistic regression, environmental policy, policy adoption, local government policies, plastic policy

Plastic is the workhorse material of the modern economy (Ocean Conservancy & McKinsey Center for Business and Environment, 2015). Nowadays, several products are made of plastic. In 2017, global polymer production, excluding fibers, is estimated to be over 348 million tons (PlasticsEurope, 2018), and it is expected to further increase at 8.4% annually (Geyer et al., 2017; Mills, 2011; PlasticsEurope, 2006; PlasticsEurope, 2016). Out of this annual production, only 50% will be disposed after a single use (Mathalon & Hill, 2014) and only 9% of the 9 billion tons of plastic produced is recycled (Enviroment Programme [UNEP], 2018).

Consequently, accumulation of plastic is evident in landfills or the natural terrestrial and marine environment, making it a growing concern (Barnes et al., 2009; Global Alliance for Incinerator Alternatives [GAIA], 2019). Severity to the extent that plastic waste is abundant has been suggested as a geological indicator for the proposed Anthropocene era[1] (Zalasiewicz et al., 2016). According to Knoblauch et al. (2018), concerns on plastic shopping bags as environmental hazards threatening human and animal welfare is continuously increasing. Annual plastic bag consumption worldwide ranges from 0.5-5 trillion pieces per year (Clapp & Swanston, 2009; Halweil, 2004; Spokas, 2007). In the US, less than 5% of plastic bags are recycled, while others are collected in landfills or leak into the environment (US Environmental Protection

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Agency [US EPA], 2006). Clapp and Swanston (2009) reported that issues on plastic bag pollution are aggravated by the plastic bag's light weight and parachute-shaped design, which makes its transport easy through air and waterways.

In the Philippines, plastic waste generation is increased by the so-called "sachet economy" (Tacio, 2018). Usually, products that average Filipinos buy are packed in small portions just to make these products affordable. Single-use sachets include that of instant coffee, toothpaste, cooking oil, shampoo, food seasoning and other instant food packaging.

According to the waste assessment and brand audit of GAIA (2019), the average Filipino uses 163 transparent plastic or "*labo*" bags, 174 plastic shopping "*sando*" bags, and 591 pieces of sachets annually. About 17.5 billion pieces of plastic bags are annually used, or 48 million plastic bags daily. Meanwhile, around 16.5 billion pieces of transparent plastic bags are used or equivalent to 45.2 million pieces daily (GAIA, 2019).

In the absence of national legislation, Philippine local government units (LGUs) in cities and municipalities have adopted their own plastic bag use regulations. The first municipality to adopt regulation or ban on plastic bags is Los Baños, Laguna, which passed Municipal Ordinance 2008-752 in 2008. It prohibited the use of plastic bags on dry goods, regulated its consumption on wet goods, and prohibited the use of styrofoam (Delos Reyes & Garcia, 2011).

Other plastic regulation policies introduced "plastic holidays," a partial ban on plastic bags during specified days, offering other alternatives, such as paper bags (Adriano, 2023). In San Fernando City, La Union, an ordinance was adopted in 2014 for the gradual transition into a plastic-free city.

Other LGUs, in lieu of a total or partial ban on plastic bag use, imposed tax on plastic bags, which go to a common fund available for environmental programs. One example is the "green fund" of the Quezon City Local Government under Ordinance No. SP 2140, s. 2012 (Braganza, 2017).

This study listed about 121 cities and municipalities in the Philippines that implement single-use plastic policies as of 2018. Only the local government of Quezon City and San Fernando City, La Union (before the full transition into total ban) adopted plastic bag pricing to discourage the use of plastic bags. Meanwhile, only 11 out of 121 LGUs adopted partial ban, usually in the form of plastic holidays.

Majority (i.e., 108 cities and municipalities) with single-use plastic policies have adopted total ban, particularly on dry goods. Exceptions are sometimes provided for wet goods in the absence of alternative containers or eco-friendly bags, like those implemented in Laoag City, Ilocos Norte.

Statement of the Problem

Few studies exploring the plastic policies in the level of local government units are available. But what remained even less explored is if the factors found in the literature also drive policy adoption of these LGUs. Questions that this research addresses are the following:

1. What are the factors that influence policy adoption against single-use plastic by LGUs in the level of cities and municipalities?
2. Of those LGUs that adopted policies against single-use plastic, what would explain the choice of approach or method being implemented?

Significance of the Study

According to Ocean Conservancy and McKinsey Center for Business and Environment (2015), about 8 million metric tons of plastic per year goes into the ocean, around 55-60% of which are from China, Indonesia, the Philippines, Thailand, and Vietnam. The Philippines alone is estimated to generate 2.7 million tons of plastic waste yearly, with 0.5 million tons of plastic going into the sea and other bodies of water, making it the third largest plastic polluter in marine environment (Ocean Conservancy & McKinsey Center for Business and Environment, 2015). Despite this, the Philippines does not yet have a national legislation specifically regulating plastic use. It only implements Republic Act (RA) 9003, or the Ecological Solid Waste Management Act of 2001. Under this law, plastics are considered recyclable material, and recycling is currently the only national policy in place for disposing plastics in the Philippines (DENR, 2001).

In the lens of public administration, it is important to determine the factors that shape policy adoption on single-use plastic regulation in local governments of Philippine cities and municipalities in the absence of a national legislation. These factors would help explain why some LGUs adopted different types of plastic regulation, while others do not have a policy yet. Understanding the policy adoption mechanisms and dynamics happening in local governments adopting plastic regulation policies is important in formulating broader laws that address plastic bag use.

Review of Related Literature

Several countries adopted various single-use plastic regulations. Studies on the policy types implemented in other countries are discussed. Literature covering solid waste management and plastic policies in the Philippines is also elaborated. What remains missing in the literature are in-depth studies on various types and implementation of plastic regulation policies by LGUs in the absence of national legislation. Policy adoption theories and factors that prompted the adoption of plastic regulation policies in different countries are then used to generate theoretical basis for the hypotheses of this research, and to determine if it will help explain policy adoption in the context of LGUs.

Studies on Plastic Bag Regulation Policies

Amid the rising issue on plastic pollution, countries are adopting policies to regulate use, production, or disposal of plastics, particularly single-use plastics. The United Nations Environment Programme (UNEP) reported that, as of July 2018, 127 out of 192 countries have laws to regulate plastic bags. Of these countries, 91 adopted some type of plastic use ban. The two main policies adopted by national governments are bans on supply and distribution, and market-based instruments, such as taxes or levies (UNEP, 2018).

Some countries adopted a type of plastic regulation called the extended producer responsibility (EPR). It is a policy approach wherein the plastic producer's responsibility is extended to the post-consumer stage of the product's life cycle, such as clean-up or recycling, or other means of waste management (UNEP, 2018). Plastic pollution is typically blamed on consumers, but through EPR, the weight of responsibility is shifted or shared with producers. Through this policy, companies

are incentivized to replace products using plastics into alternative materials that are easily recyclable and reusable (Cowan et al., 2021).

In 2018, the European Commission (EC) adopted a policy that promoted a circular economy, mandating that all plastic packaging in Europe must be reusable and recyclable by 2030, and that restrictions of other single-use plastics should be put in place (Cowan et al., 2021).

The timeline of plastic bag and microbead reduction policies being implemented regionally and nationally in European countries was studied by Xanthos and Walker (2017). Germany and Denmark were the first countries to introduce plastic bag taxes in 1991 and 1994, respectively. Meanwhile, Ireland introduced tax on plastic shopping bags known as "plastax" in 2002 due to strong public demand and growing concerns on plastic pollution in Ireland's coastal areas (Convery & Ferreira, 2007).

According to the study, industrialized countries mostly adopted tax policies, mainly driven by global public pressure. Meanwhile, developing countries usually implemented plastic bag bans, due to limited waste collection and recycling rates in developing countries (Knoblauch et al., 2018).

Developing countries adopting plastic bag regulations are noted by several studies. In India, policies against the use of plastic bag were being adopted in several states and cities by late 1990s and early 2000s, since plastic bags were perceived as the key risk factor leading to floods and landslide, and they also posed health risks to free-roaming sacred cows that could ingest plastic wastes (Behuria, 2019; Clapp & Swanston, 2009). Clapp and Swanston (2009) noted that Bangladesh initially adopted plastic bag ban in its capital city Dhaka alone, but it later legislated the policy nationally in 1998 after plastic bags were pointed as the probable cause of persistent flooding. Meanwhile, Adam et al. (2020) studied the adoption of policies regulating single-use plastics by 16 West African countries. They found that policy adoption is driven by the desire for environmental protection, sanitation, protection of livestock, and protection of the tourism industry (Adam et al., 2020).

Clapp and Swanston (2009) observed that policy diffusion against plastic bag consumption goes against the trends shown in norm dynamics literature, wherein policies are first introduced in developed countries, then, through norm entrepreneurs from organized social groups or international institutions, these policies are diffused to developing states. Plastic bag policies were first adopted by developing countries through bottom-up initiatives at different jurisdictional levels, such as villages and cities, to states and to entire countries. Developed countries adopted similar policies more recently (Clapp & Swanston, 2009).

Other studies tackled plastic bag adoption in countries and subnational jurisdictions. These included the study of Nielsen et al. (2019), which states that, while plastic regulation policies are seen to usually start at the local level, these policies tend to go up to the global level. Plastic waste is now considered a global environmental concern that needs intergovernmental solutions (Nielsen et al., 2019). Meanwhile, Willis et al. (2018) studied waste abatement campaigns and government policies in reducing plastic waste in Australia, and Zhu (2011) analyzed China's plastic bag ban.

Policies in reducing single-use plastic shopping bags adopted by local governments in the US in the absence of national legislation were explored by Wagner (2017). The study revealed that US local governments, such as counties, cities, towns,

villages, and tribes, are taking the lead in adopting plastic bag regulation because they have the primary responsibility for municipal solid waste (MSW) management, while the role of the US federal government in MSW management is minimal. On the other hand, state governments are responsible for planning and creating the regulatory framework for MSW management. Thus, as of September 2017, a total of 271 US local governments representing 9.7% of the US population, have adopted plastic bag ordinances. The local governments adopted five policy types, such as bans, fees and taxes, minimum product design of bags, consumer education, and retailer take-back programs (Wagner, 2017). Although plastic bag regulation policies are being adopted worldwide and across different levels, state laws passed in some states, such as Arizona, Florida, Idaho, Indiana, Iowa, Michigan, Minnesota, and Missouri, prohibit implementation of plastic-related policies (Schnurr et al., 2018).

Wagner (2017) states that, among these policies, ban is the most effective approach and the most common ordinance to reduce consumption of plastic bags. Meanwhile, imposing taxes and fees for consumer bags is expected to decrease demand. Incorporating costs on consumers is based on the "polluter pays" principle. Fees and taxes on plastic bags aim to modify the consumer behavior by internalizing some cost, unlike bans, which regulate the behavior (Wagner, 2017).

Studies on Plastic Regulation Policies in the Philippines

Kunesch and Morimoto (2019) evaluated waste management policies in the Philippines using the "wicked problem" lens. Complexities of waste management make the problem difficult to address, given the ambiguity surrounding the problem and the conflicting values of stakeholders and policymakers (Kunesch & Morimoto, 2019). The study also discussed the difficulties in passing national legislation strengthening RA 9003. In particular, residual waste management, a primary responsibility of the LGUs, is poorly implemented at the local level. One of the issues explored is the ongoing debate between command-and-control style policies and reduced policy intervention as the more effective solution to plastic waste. Plastic ban is a type of command-and-control policy, which induces behavioral change and strengthens environmental policies, vis-à-vis reduced policy interventions, like market-based solutions and technological innovation, to reduce waste (Kunesch & Morimoto, 2019).

Paul et al. (2015) cite the lack of financial means as a major barrier to enhance solid waste management. Other factors included lack of knowledge, low environmental awareness, lack of regulations, low private sector involvement, and lack of mechanisms for cost recovery on solid waste management services by users (Paul et al., 2015). However, the study established that, through new local policies, such as economic instruments to collect fees for waste collection, solid waste management programs become sustainable (Paul et al., 2015).

Meanwhile, Galarpe et al. (2021) pointed out that plastic regulation policies in the Philippines are solely reliant on national solid waste management policies that focus on waste disposal and regulation on land. The only national policy banning plastic is a resolution issued by the National Solid Waste Management Commission (NSWMC) Resolution no. 1363, s. 2020, which bans single-use plastic in national and local government offices. So far, no national policy particularly addresses plastic pollution. No national policy has likewise mandated measures to mitigate the potential impact of plastic pollution on marine environment. Instead,

local governments enforced policies that ban or regulate single-use plastic products. Galarpe et al. (2021) concluded that plastic regulation policies in the Philippines are not shaped by the emergence of macroplastic and microplastic research in Philippine marine coastal environments but are influenced by studies outside the country.

Amurao's study (2019) lists plastic bag regulations in Philippine local governments and the proposed bills at the national government level. However, the goal of the study is only to compare the regulatory policies being implemented by some LGUs. One of the findings is that plastic ban is the preferred policy of LGUs, like that in other countries.

Valenzuela is among the only five cities in the Metro Manila that did not regulate or ban plastic bags (Braganza, 2017). In 2012, Valenzuela has around 224 plastic and rubber manufacturing companies employing thousands of workers (Braganza, 2017). Hence, given the magnitude of the industry on which rests people's livelihood, only regulation on use and not total ban of plastic is feasible (Arcangel, 2013).

Crowley (2020) studied the plastic bag consumption habits in three municipalities in Ilocos Norte region that do not have plastic bag regulation. The research concludes that age, municipality, and type of waste disposal and management are predictors of plastic bag consumption (Crowley, 2020).

These studies only explored the complexities of solid waste management and plastic policies implemented in local government levels. What remains less explored is the analysis of factors that drive the local government units to adopt plastic regulation policies. Are the factors in the international level that governed the diffusion of policies in countries also valid in the Philippine context in the subnational level?

Variable Selection and Justification

The factors that contributed to the adoption of plastic policies in countries from the literature are used to determine if they help to understand policy adoption in Philippine cities and municipalities.

Economic Status of Government

Knoblauch et al. (2018) revealed that developing countries are taking the lead in adopting plastic bag policies. They found that industrialized countries only adopted plastic bag taxes, whereas developing countries have more stringent plastic bag policies such as total ban. Developing countries were also faster in adopting policies against plastic due to limited waste collection or lower recycling rates. Meanwhile, industrialized countries adopted plastic regulation policies due to global pressure of international organizations and commitments (Knoblauch et al., 2018). These findings coincide with that in a similar study by Clapp and Swanston (2009).

In the economic model by Feiock and West (1993), local governments with greater fiscal capacity are more likely to adopt new policies than income-deficient governments. Resources are needed to fund and administer adoption of new policies. However, if new policies will involve fewer resources, then the income-deficient government is more likely to adopt these policies. This is the case with plastic bag regulation. Adopting plastic regulation policies is expected to reduce plastic waste handling costs, an incentive to income-deficient governments.

Consistency in Implementation of Solid Waste Management

Although there is no legislation yet in the Philippines that nationalizes plastic regulation, the Ecological Solid Waste Management Act of 2001 (RA 9003) regulates solid waste management in general. Under Section 10 of RA 9003 (2001), the primary role of LGUs in implementing solid waste management was emphasized. Likewise, segregation of biodegradable, compostable, and reusable wastes is mandated at the *barangay* level. Meanwhile, the responsibility of collecting non-recyclable materials and special waste is given to cities and municipalities. The law mandates the creation of city and municipal solid waste management boards (RA 9003, Section 12). Moreover, the Local Government Code of 1991 (RA 7160) mandates cities and municipalities to provide efficient and effective systems of solid waste and garbage collection and disposal (RA 7160). Hence, local governments of cities and municipalities are expected to adopt policies that will help them discharge their duty in maintaining efficient and effective solid waste management.

Alpizar et al. (2020) provides a framework for designing policies to reduce marine pollution in developing countries. Several policy entry points are suggested to reduce plastic waste, such as price-based, rights-based regulation, and behavioral instruments in different levels targeting the plastic industry as the source; consumption of plastic by households and firms; and disposal of plastics. The study emphasizes the need for comprehensive and complementing policies, and effective implementation of existing solid waste management policies.

The need or responsive policymaking model by Feiock and West (1993) suggests the adoption of new policies to strengthen the current policies on solid waste management in LGUs. Local governments tend to adopt policies to fulfill their objectives and responsibilities, and in response to the need articulated by its citizens.

Presence of Plastic Industry

Clapp and Swanston (2009) studied the rise of subnational and national plastic regulation policies in countries despite the absence of international level treaty or institution to encourage the adoption of these policies. The study argues that the policy adoption varied depending on the role and power of industry actors in the interpretation of plastic regulation policies. In countries where plastic industry has a strong economic interest against plastic ban, the legislation process is influenced through structural, instrumental, or discursive means. For instance, in the US, the plastic industry's strong structural power prevented national legislation of plastic regulation (Clapp & Swanston, 2009). Meanwhile, industries promote an alternative policy option, which is recycling and reuse, and they also have the instrumental power to use multiple lawsuits to threaten municipalities against adopting plastic regulation (Clapp & Swanston, 2009). In sum, industry actors, such as plastic manufacturers or producers, have a pivotal role in determining the tendency of a country to adopt plastic regulation policies and how extensive these policies are (Clapp & Swanston, 2009).

Behuria (2019) studied the cause of variation in the implementation of plastic regulation policies in East African countries, such as Rwanda, Kenya, and Uganda. The paper argues that the plastic industry's structural power on economy and job security, and instrumental power on policy lobbying, help in explaining the variation in implementing environmental policies in the region (Behuria, 2019).

As reported by Harvey (2016), a state-wide ban on plastic regulation was passed in Michigan due to the view that the American petrochemical industry can be severely affected. In 2008, China adopted a plastic ban. As soon as the policy was enforced, Suiping Huaqiang Plastic, which employed 20,000 workers, went out of business (Xanthos & Walker, 2017). Plastic ban opposition from stakeholders, including restaurants and supermarket associations, stated that plastic ban policies increase costs and confuse customers (Harvey, 2016).

The interest group influence model, as cited in Feiock and West's (1993) study, suggests that policy adoption and barriers to adoption depends on the interest groups and their participation in the policy process. Since plastic regulation directly affects plastic-related industries, their presence in the jurisdiction of local governments can affect adoption of the policy.

Higher Risk of Flooding

Several studies suggested that deterioration of urban drainage systems contributed to flooding occurrence and intensity. Fobil and Hogarh (2006) found that flooding in major cities of Ghana is caused by the blockage of urban draining systems by plastic wastes. Meanwhile, a qualitative study of recent floods in cities and towns of Nigeria by Aderogba (2012) attributed plastic pollution to the poor plastic waste disposal habits of residents living near canals, drainage, and waterways.

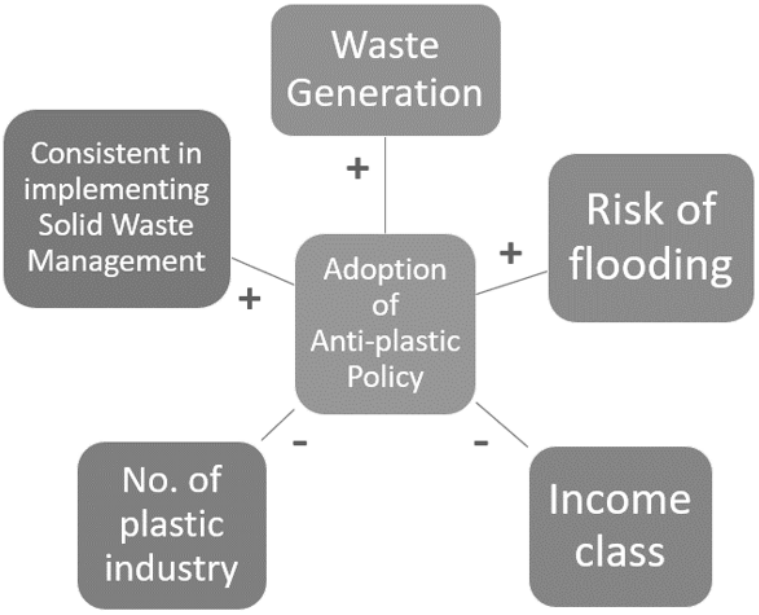
In the case of the Philippines, a common justification in ordinances adopting plastic regulation policies is to avoid and address flooding that is aggravated by clogged drainage system and pumping stations. Gleaning from Feiock and West's (1993) need/responsive policymaking perspective, flooding can serve as trigger for LGUs to adopt plastic regulation.

Higher Waste Generation

According to Ocean Conservancy and McKinsey Center for Business and Environment (2015), waste generation has direct relationship to the cost of waste collection. The current study attempts to explore if high levels of waste generation resulting in high budgetary cost for waste collection can explain single-use plastic policy adoption. Higher waste generation in cities and municipalities is expected to prompt LGUs to intensify programs and policies that facilitate effective and efficient waste collection. As such, LGUs with high waste generation may likely tend to adopt policies in support of effective and efficient plastic waste management.

This research explores five factors that might explain plastic regulation policy adoption of Philippine LGUs in cities and municipalities. Factors are based on literature explaining adoption of similar policies in other countries. Factors having positive relationship with adoption of plastic regulation policy, as shown in Figure 1, means that having more of these factors makes LGUs more likely to adopt plastic regulation policy. Factors with positive relationship to the adoption of this policy, included waste generation, consistency in implementing solid waste management, and risk of flooding. Conversely, factors with negative relationship means that having less of these factors makes LGUs more likely to adopt the policies. Factors that have negative relationship are the presence of plastic industry and the income class of city or municipality.

Figure 1
Theoretical Framework



Hypotheses

The relationship of each factor to plastic regulation policy adoption is defined as follows:

Hypothesis 1: LGUs with lower income are more likely to adopt policies on plastic regulation.
Hypothesis 2: LGUs that are consistent in implementing environmental management are more likely to adopt policies on plastic regulation.
Hypothesis 3: LGUs with no plastic manufacturers and related industries in their area are more likely to adopt policies on plastic regulation.
Hypothesis 4: LGUs with higher risk of flooding are more likely to adopt policies on plastic regulation.
Hypothesis 5: LGUs with higher waste generation are more likely to adopt policies on plastic regulation.

Methodology

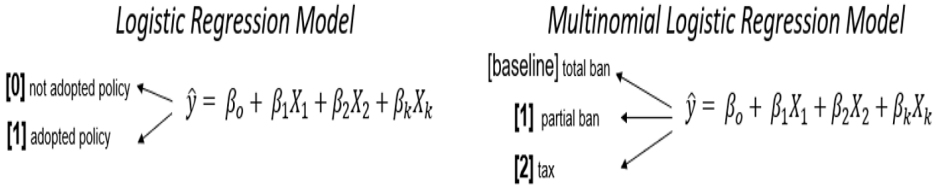
Sampling

The unit of analysis in this quantitative research is the city or municipal LGU in the Philippines. Stratified sampling was used to generate a representative sample, since the stratum of interest (i.e., LGUs with policy) is only a small percentage of the population. All Philippine cities and municipalities (N=1,634), are divided into two strata: those with plastic regulation ordinances (121 LGUs) and without ordinances

(1,513 LGUs). The sample included all LGUs with plastic policy (121 LGUs) and randomly selected 226 LGUs from 1,513 LGUs without single-use plastic regulation policy. Each LGU without the policy is assigned a specific number, and then a random number is generated in choosing the LGUs in this stratum. Random sampling was used to adequately represent the stratum in the sample. Overall, the sample size is 347 to obtain a 5% margin of error at 95% confidence interval. Sampling weights were then added to correct oversampling and undersampling of both strata (with and without policy). The generated sample is composed of LGUs from 287 cities and 60 municipalities. From this sample, 212 LGUs are from Luzon, 66 are from Visayas, and 69 are from Mindanao.

Figure 2

Regression Models



Legend: $\hat{y}$ – *dependent variable;* β_k – *coefficients;* X_k – *independent variables*

Two models were used. The first model was a logistic regression model using five factors as independent variables, while the dependent variable assigned was 0 to LGUs without plastic regulation policy and 1 to LGUs that adopted. The first model tried to address which factors explained plastic regulation policy adoption of LGUs. The second model was a multinomial logistic regression model using the same set of independent variables, but the dependent variable had three values representing the type of policy adopted, such as total ban, partial ban, and tax. The multinomial logistic regression model was run twice, using total ban as baseline in the first run and partial ban as baseline in the second run, to generate all relationships between three types of plastic bag regulation. This model attempted to explain the variation in the types of plastic regulation policy adopted by LGUs.

No single reference summarizes all Philippine cities and municipalities that have plastic regulation. Data on plastic regulation policies of Philippine cities and municipalities were culled from news articles and the plastic ban map in Google Maps, validated through LGU websites. Then, each policy was categorized as total ban on using plastic bag, imposition of tax on using plastic bag, or partial ban through declaration of plastic holidays, or having a specific day in a week wherein plastic bag is banned from retail distribution. Whenever all types of policy are altogether being adopted in a particular LGU, such LGU was categorized as having the strictest policy type, i.e., a total ban.

Independent variables, as shown in Table 1, included local government resources, measured through income class designated by the Bureau of Local Government Finance. Although income class is considered a categorical variable, differences in income brackets served as the second-best indicator of local government resources.

Meanwhile, consistency in implementing solid waste management is represented by the Seal of Good Local Governance (SGLG) environmental management scores from 2014-2016, based on the following criteria: (a) presence of a ten-year solid waste management plan, (b) solid waste management system, (c) presence of material recovery facility, and (d) access to sanitary landfill or alternative technology (Department of Interior and Local Government [DILG], n.d.). The maximum number of points that a city or municipality could attain for this variable in the given period is 12 points. Cities and municipalities with poor solid waste management in four components between 2014-2016 could obtain the lowest score of 0.

Table 1
Summary of Variables and its Sources

Variable		Indicator	Category	Secondary Data Sources
Dependent variable	Single-use plastic regulation policy adoption and type	Ordinances relating to single-use plastic ban	Logistic regression: 0 – without policy 1 – with policy	LGU legislative units; news articles, plastic ban maps in Google Maps
			Multiple logistic model: Part 1: 0 – total ban (baseline) 1 – partial ban 2 – tax Part 2: 0 – partial ban 1 – total ban 2 – tax	
Independent variable	Government resources	Income class	Category: 1 – 1st class city 2 – 2th class city 3 – 3rd class city 4 – 4th class city 5 – 5th class city 6 – 6th class city 7 –1st class mun. 8 – 2nd class mun. 9 – 3rd class mun. 10 – 4th class mun. 11 – 5th class mun. 12 – 6th class mun.	DILG
	Consistency in solid waste management	SGLG Criteria for Environmental Management (2014-2016)	Continuous variable	DILG

Presence of plastic industry	Number of plastic manufacturer or related industry in the city/ municipality	Continuous variable	Philippine Plastics Industry Association, Inc. (PPIA); plastic manufacturers plotted in Google maps
Flooding hazard	Intensity (level) and scope (area covered) in 25 years span	Continuous variable	Nationwide Operational Assessment of Hazards (NOAH)
Waste generation	Waste generation	Continuous variable	National Solid Waste Management Commission (NSWMC), Philippine Statistics Authority (PSA)

The presence of plastic industry is represented by the number of plastic manufacturers and related industries within the city and municipality based on data from the Philippine Plastics Industry Association (PPIA) and plastic industries plotted in Google Maps.

Three types of flood hazard, such as high (1.5m and above), medium (0.5m-1.5m) and low (<0.5m), were derived from Project NOAH data (Nationwide Operational Assessment of Hazards [NOAH], n.d.). The scope of flood hazards was estimated in percentage based on Google Maps data. A numerical value of 1 was assigned to low hazard, 2 to medium hazard, and 3 to high hazard. The flooding hazard data set was then transformed by multiplying flood hazard by the scope of area covered.

Waste generation in cities and municipalities was derived from 2015 regional data on waste generation by the National Solid Waste Management Commission (NSWMC), as included in the 2014 Compendium of Philippine Environment Statistics (Philippine Statistics Authority [PSA], 2015), and the 2015 population census in cities and municipalities (PSA, n.d.).

Results and Discussion

Summary Statistics

Table 2 shows the summary statistics for the different variables after applying sampling weights.

Table 2
Summary Statistics of Variables (n=347)

Variable	Mean	Standard Deviation	Minimum	Maximum
Dependent variable				
Single-use plastic regulation policy adoption and type	0.35	0.48	0	1
Independent variables				
Government resources	7.60	2.93	1	12
Consistency in solid waste management	8.60	3.06	0	12
Presence of plastic industry	0.21	1.02	0	10
Flooding hazard	0.24	0.42	0	2.38
Waste generation	49.85	158.13	0.45	2065.77

Logistic Regression

Logistic regression and multinomial logistic regression models were run using R version 3.5.2 and a survey package to consider sampling weights. Variance inflation factor or VIR function under car package was calculated to test for multicollinearity of independent variables. All factors passed the VIR test with a value of less than 5, which means that multicollinearity is not present among factors. Outliers were checked using outlierTest function. Based on the Bonferroni p result, there is no outlier in the logistic regression model generated. Logistic regression model results were shown in Table 3.

As shown in the regression results in Table 3, two variables are statistically significant, such as flooding hazard (p-value <0.01), and waste generation (p-value <0.01). Cities and municipalities are 2% more likely to adopt plastic bag regulation with higher waste generation as shown by the odds ratio of 1.02. Meanwhile, higher flooding hazard makes LGUs 2.8 times more likely to adopt plastic policies having 2.78 odds ratio.

Working likelihood ratio test (Rao-Scott) is used to compare goodness of fit under reduced model using only the statistically significant factors, such as waste generation and flooding hazard, rather than the full model of five factors. The RegTermtest function in R was used. Results, such as statistic = 27.645 and p value = 0.0000304, suggested that the full model is a better fit to the data than the reduced model.

Hypothesis 4, which states that the higher the risk of flooding in the city or municipality, the more likely that the LGU will adopt plastic regulation policy, is proven to be true. Flooding as the precursor for adopting plastic bag regulation is not unique in the Philippines. Several studies cited by Clapp and Swanston (2009) suggested that flooding served as the main reason why Bangladesh and India adopted plastic regulation. This predictor helps explain plastic policy diffusion among cities and municipalities and offers an answer on why some LGUs are quick to adopt plastic regulation policies. Without national legislation, LGUs do their part in addressing plastic pollution by adopting single-use plastic regulation policy. \

Table 3
Logistic Regression Results (n=347)

Variable	Log Odds	Odds Ratios	Standard Error	p Value
Intercept	-4.379	0.01	0.894	0.0000015***
Government resources	0.026	1.03	0.069	0.71072
Waste management	0.096	1.10	0.050	0.05862*
Plastic industry	0.374	1.45	0.278	0.17991
Flooding hazard	1.021	2.78	0.332	0.00225***
Waste generation	0.015	1.02	0.005	0.00371***

Note. * p<0.1; ** p<0.05; *** p<0.01; McFadden's pseudo R2: 0.164

Applying the lens of need/responsive policy making model by Feiock and West (1993), flooding hazard prompts the LGUs to respond by adopting policies reducing its impact. However, this result also means that LGUs with low risk of flooding are not incentivized to adopt plastic regulation policies, given that the benefit the policy provides in terms of decreasing flooding tendency is not applicable or is of low priority to these LGUs. It is also possible that the cost of these policies, such as additional cost of packaging to consumers using alternative materials, and the possible loss in income, among other concerns, on the part of plastic industries, outweigh the applicable benefit it would generate. Thus, LGUs are not keen to adopt.

Hypothesis 5 predicted that the higher the waste generation of the LGUs, the more likely they are to adopt single-use plastic regulation policy. This hypothesis is proven true by the regression result. Waste generation as a strong predictor of single-use plastic regulation policy can be explained through the economic model and need/responsive policy making model by Feiock and West (1993). Cities and municipalities with high waste generation spend a lot to collect and handle waste. Thus, it is possible that these LGUs adopt policies that will lessen generation of waste at the source to help them reduce waste collection expenses.

Similarly, since plastics are non-biodegradable, higher waste generation means a higher absolute amount of plastic waste that these LGUs need to handle, either through recycling, reuse, or disposal. Leakage into terrestrial and marine environment is so high that the effective way to reduce it is by the source.

Meanwhile, local government resources, consistency in implementing waste management, and the presence of plastic industry in LGUs are not statistically significant. Thus, hypotheses 1, 2, and 3 are rejected. This means that policy adoption of LGUs is not driven by the aforementioned factors.

Local government resources, using income class as an indicator, may not influence the likelihood of a Philippine city and municipality in adopting plastic bag policy. A possible explanation is that some other factors or resources aside from income/revenue may affect the likelihood of the LGUs to adopt plastic bag policy.

Consistency in waste management of LGUs, as indicated by DILG's Seal of Local Good Governance Criteria for Environmental Management from 2014 to 2016, does not likewise significantly affect adoption of plastic bag regulation by LGUs. This result can possibly be explained by two behaviors of LGUs: on one hand, LGUs with low environmental management score may adopt plastic regulation policy to increase

their score and comply with RA 9003. On the other hand, LGUs with high score on environmental management component of SGLG may adopt plastic regulation policy to maintain or further improve their track record.

Plastic industry presence, measured by the number of plastic bag companies, is not a significant factor, but it could possibly have a significant influence on policy adoption if other indicators are used, such as output value of plastic bag industries in a city/municipality. The presence of five plastic bag companies in one city/municipality is possibly equivalent in terms of output value to one plastic bag company in another city/municipality. Hence, there is a bias on the indicator used.

Multiple Logistic Regression

Since there are three types of plastic regulation policy—such as total ban, partial ban, and tax—two multinomial logistic regression models were used. Table 4 shows the result using total ban as the baseline, i.e., comparing total ban to partial ban and total ban to tax. Meanwhile, Table 5 shows the result using partial ban as the baseline, i.e., comparing partial ban to total ban and partial ban to tax.

Table 4

Multinomial Logistic Regression Results (Baseline – Total Ban (n=347))

Variable	Partial Ban		Tax	
	Log Odds	Standard Error	Log Odds	Standard Error
Intercept	-4.379	3.006	-3.263	7.251
Government Res.	0.270	0.169	-0.233	0.396
Waste Management	0.344	0.214	0.013	0.618
Plastic Industry	-1.689	1.301	-0.497	1.019
Flooding Hazard	-0.754	0.760	-7.542*	4.003*
Waste Generation	0.008	0.006	0.005	0.006

Note. * p<0.1; ** p<0.05; *** p<0.01

Using total ban as the baseline in multinomial logistic regression model, only flooding hazard is statistically significant between tax to total ban type of policy, but since the p value is less than 0.1, the level of significance is not high. Thus, none of the factors tested can significantly explain variation between tax and total ban.

Meanwhile, using partial ban as the baseline, results of the multinomial logistic regression model showed that flooding hazard has highly significant influence on policy adoption, with a p-value less than 0.01. This means that the higher the flooding hazard of a municipality or city, the more likely a partial ban will be adopted than a tax policy. This is consistent with the need/responsive policy making model of Feiock and West (1993).

Table 5
Multinomial Logistic Regression Results (Baseline – Partial Ban (n=347))

Variable	Total Ban		Tax	
	Log Odds	Standard Error	Log Odds	Standard Error
Intercept	7.626***	2.823***	4.293***	0.317***
Government resources	-0.269*	0.163*	-0.500	0.329
Waste management	-0.343*	0.204*	-0.325*	0.185*
Plastic industry	1.689	1.296	1.194	1.685
Flooding hazard	0.757	0.760	-6.724***	0.083***
Waste generation	-0.008	0.006	-0.003	0.008

Note. * p<0.1; ** p<0.05; *** p<0.01

In the case of LGUs that adopted plastic regulation policies, none of the factors tested can help explain the variation of the type of policy adopted between total ban and partial ban, and between total ban and tax. This could possibly be because LGUs that adopt partial ban or tax type of policy usually transition to total ban policy after some time. Meanwhile, flooding hazard significantly explains the choice of LGUs between partial ban and tax. The higher the flooding hazard, the more stringent form of initial policy will be adopted, which is partial ban.

Conclusion

This study investigates factors that affect plastic regulation policy adoption of LGUs, and the type of policy they adopt. Five variables are tested to generate logistic regression model for policy adoption and multinomial logistic regression model for policy-type variation. These are local government resources, consistency in implementing solid waste management, number of plastic industries, waste generation, and flooding hazard.

Two variables, flooding hazard and waste generation, significantly affected the decision of LGUs to adopt plastic regulation policies. Flooding hazard prompts LGUs to respond by adopting plastic regulation. Likewise, LGUs are more likely to adopt policies that will lessen waste generation at the source to help them manage waste collection expenses.

Meanwhile, none of the factors tested were able to explain why LGUs varied in their choice of total ban over partial ban and tax. It is possible that LGUs that adopt partial ban or tax usually transition to total ban. Between partial ban and tax, cities/municipalities with higher flooding hazard are keen to adopt partial ban, which is a more stringent policy than tax.

This study only considered LGUs in the level of cities and municipalities that passed and are already implementing ordinances pertaining to plastic regulation on or before the year 2018. It does not include voluntary single-use plastic reduction of commercial establishments or private groups. Lastly, this study did not cover the effectiveness and impact of these policies or ordinances.

For future research, the level of public support for plastic regulation in cities and municipalities is worth exploring, since, according to the literature, it could also influence the level of plastic regulation policy adoption. No data on public support for these policies at the LGU level is currently available.

The flooding hazard significantly explained both the choice to adopt policy and the policy type adopted. It is worth exploring other locally available sources of flooding hazard data aside from Project NOAH since flooding hazard for LGUs are still being updated. Lastly, using other indicators measuring the presence of plastic industry, such as value or net worth of the plastic bag company, is also worth exploring, given that the number of plastic bag companies may not fully represent the variable.

Recommendations

This study finds that cities and municipalities with higher flooding hazard and higher waste generation are inclined to adopt plastic regulations. Engaging with LGUs that have lower flooding hazard or lower waste generation and are thus not likely to adopt plastic regulation policies, may encourage them to adopt plastic regulation policies. Meanwhile, LGUs with existing plastic regulation policies may benefit from technical assistance to make their policies efficient and effective in curbing plastic waste.

Lastly, variety in the level of flooding hazards, waste generation, and policy choices among LGUs make harmonizing plastic regulation policies difficult. Nonetheless, problems in implementing plastic regulation policies in one city/municipality may also affect neighboring cities/municipalities. Thus, there is a need for a national law to harmonize LGU-level policies regulating plastic use.

Endnote

[1] Anthropocene era refers to the "informal geologic chronological term wherein human activities have had significant global impact on Earth's ecosystems" (Bockheim, 2020).

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