The Double Edged Sword:

The Economic and Environmental Impact of China’s 2018 Imported Plastics Ban on U.S.-Asia Relations

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March 19, 2024

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ABSTRACT

The global waste trade has historically allowed wealthier nations to offload plastic waste to developing countries, exacerbating environmental degradation and economic dependency. Until 2018, China imported nearly half of the world's plastic waste, primarily from the United States. However, the Operation National Sword policy banned 24 plastic imports into China, triggering a dramatic restructuring of global waste trade flows, with U.S. plastic exports shifting to being processed domestically, but with a rise in Southeast and South Asia exports, particularly Malaysia, India, Vietnam, and Indonesia. This thesis quantitatively analyzes international trade data from 2013 to 2024, revealing that while China and Hong Kong once accounted for 87% of U.S. plastic waste exports in 2010, this figure plummeted to 0% in 2020, forcing waste redirection to alternative destinations, such as Malaysia, Indonesia, Vietnam, and India– although this spike in imports to developing nations was not long-term. This study also cross-analyzes waste import data with air quality trends at key recycling centers in China and Malaysia. Findings indicate that China's air pollution (PM2.5 levels) declined by 34% from 2014 to 2024, correlating with its sharp reduction in plastic imports; conversely, Malaysia's PM2.5 pollution increased by 31% during the same period, with a notable spike in 2019 following its peak plastic waste imports. This correlation, while not statistically significant, still suggests that while China's ban improved its own air quality, the environmental burden of plastic processing was simply transferred elsewhere, a continuation of the neocolonial power dynamics from before.

CHAPTER I

Introduction

> *"It's dirty, tiring, and doesn't make much money… [But I do it] to make a living. I have no choice. For my kids, for my parents… If I don't do this, how else can I make money?... Damn these plastics, they are breaking my body."*
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> - *"Plastic China", a 2016 CNEX Studio documentary*

There are many stakeholders within the realm of the global waste trade- those who produce it, those who consume it, and last– but most certainly not least– those who dispose of it. But the brunt of this industry falls upon the shoulders of this last category, those who handle the waste in the aftermath of its use. This is a brutal, dangerous industry, and those it impacts the most are also those who have the least say in it.

Since 1992, China has imported over 106 million metric tons of plastic waste into its borders (Brooks, 2018). This is nearly half of the entire world's plastic waste imports. If all of this waste was piled into garbage trucks lined up end to end, it would circle the Earth's equator nearly twice over. But, this was just the expected trajectory of China's waste importation as for the previous decade, as China, a developing country throughout the 20th century, had been taking increasingly higher amounts of waste from more developed countries– countries like the U.S., the U.K. Germany, and the Netherlands (Brooks, 2018). As global consumption evolved to include more disposables, more hazards, and just more of itself, often poorer, still developing nations were hired to absorb the brunt of this waste, both legally and illegally. China has historically been the largest and most significant absorber of the modern world's waste production (Nzayiramya & Beghin, 2021).

But, since 2013, China has been undergoing an evolution of their own. Operation Green Fence was an experimental and radical policy, designed to strictly limit importations of plastic, both illegal and legal, into China. Later, it would crystallize into Operation National Sword in 2018, an outright ban on 24 types of plastic into China (WTO, 2017). Imported plastics dropped by 99%- nearly nothing to what they were before, creating a massive ripple effect in the global waste economy (Nzayiramya & Beghin, 2021).

The implementation and impact of such a drastic and all-encompassing policy was unprecedented. Nations panicked- where would all the displaced waste go? Who would be forced to process the waste instead, and what implications did it have for the environment and the people most impacted? What does this mean for the future of the global waste trade?

This thesis aims to answer the fundamental question of how China's operation National Sword impacted the global waste trade in displacing hazardous waste disposal, especially concerning the environmental and economic repercussions experienced by those working and living in the industry.

The global waste trade is the nexus of several different categories of study- from environmental science, to neo-colonial economics, to international law. In order to truly understand this new development in global waste history, two background analyses must be made- the first, a historical analysis that discusses pivotal global waste disposal trends and regulations, the second, a sinological analysis that covers China's role in the global waste industry, her eventual ban on the industry, and the aftermath of that ban. Understanding both of these frameworks, international and domestic, would reveal the contentious, changing nature of the global waste trade and its future.

Historical Analysis of the Global Waste Trade

In December, 1987, in a tiny, struggling port town in Haiti, the *Khian Sea* docked onto a nearby beach and began unloading its 14,000 tons of topsoil fertilizer. In reality, this "topsoil fertilizer" was toxic incinerator ash generated in Pennsylvania, and upon this realization, Haiti promptly exiled the ship from its ports, rendering the ship desperate as it attempted to find any other country that would take its toxic cargo (Leonard, 2010). After almost 2 years and no country willing to take the hazardous waste, the remaining 10,000 tons of ash would "mysteriously disappear" at sea (Jaffe, 2023).

Throughout the 1980s and 1990s, this happened many times over, in many different ways. The ship *Karin B* tricked Nigerian farmers into allowing them to dump barrels containing a dense variety of carcinogenic toxins, acids, and radioactive material from Italy (Agency for International Development, 1998); trucks driven by *maquiladoras* smuggled waste from the

United States into unregulated and illegal dumping grounds in Mexico (Clapp, 2003), ships holding “brick building materials” docking on Kassa Island, Guinea dumped held poisonous fly-ash (Sirleaf, 2018).

The increasing number of incidents involving the exportation of hazardous waste from industrialized to developing countries in the 1980s caused an increase in public outcry and condemnation (Clapp, 2003).

The senders were almost always much wealthier, industrialized states and the receivers were almost always their poorer, less developed, and far more vulnerable counterparts. This also aligned with OECD (The Organization for Economic Cooperation and Development) membership (Clapp, 2003). The scholastic literature published at this time about the global waste trade reflected this parallel, and they often used OECD membership as a delineator between industrialized and developing countries. Crucially, during the 1980s-2000s, China fell into the latter category, and began to be a key importer of both plastic and paper waste. This raw material helped build their manufacturing sector, which contributed to China’s incredible economic boom in the latter half of the 20th century (Wang et al, 2019).

This unbalanced power dynamic that shaped the global waste trade is often dubbed “toxic colonialism”, and was coined by Jim Puckett to describe the “dumping of the industrial wastes of the West on territories of the Third World” (Pratt, 2011). Any term carrying “colonialism” is a loaded designation; it describes a dynamic between two countries where one, typically a wealthy, Western nation, exploits the other, typically a significantly poorer, non-Western nation, by extracting natural resources at the greater benefit of the exploiter. Neocolonialism, the modern day cousin of colonialism, describes this continued exploitative and extractive relationship between more industrialized states in the Global North and previously colonized states in the Global South (Afisi, 2024). In toxic colonialism, however, a natural resource isn't being extracted in the traditional sense– rather it is being used at the detriment of the exploited nation. The use of resources like air, water, and land that are negatively impacted by plastic waste are "outsourced" from the richer nation, seeking to not pollute their own resources, to the poorer nation, who lacks the economic means to say no. In this way, air, water, and land are natural resources that are almost "extracted" from the poorer, less developed nation to the richer, more industrialized one.

China, throughout its development in the late 18th to 19th century, was directly colonized by Britain, France, Russia, Japan, and Germany. After the removal of the Treaty of Tientsin in 1860, China became increasingly vulnerable to foreign imperialism. From Britain's Opium Wars, to the collapse of the Qing dynasty, to the Sino-Japanese War, these battles for control between these colonial powers divided China into "spheres of influence", creating an unstable and unpredictable political environment (Llewellyn & Kucha, 2023). China would undergo its own radical development into the 20th century, but the shadows of this colonial relationship would not quite vanish, as seen in China's relationship to the Global North in the global waste trade. And because this waste is often hazardous and "toxic", this neocolonial relationship framework created this new dynamic of toxic colonialism.

This toxic colonialism is enabled by two push and pull factors: the robustness of industrialized nations against waste disposal and the vulnerability of developing nations in the global waste trade.

Robustness: Industrialized nations have the advantage in resources, technology, and power over developing nations, and this upper hand ensures that they have the first and final say in the global waste trade. In 2000, 400 million metric tons of hazardous waste was produced, three-quarters of which was created by industrialized nations (Pratt, 2011). "Developed nations inevitably produce more hazardous substances, due in large part to the development process itself, which involves heavy industrialization in order to achieve capitalistic economic progress." (Pratt, 2011) With the waste being generated by industrialized nations, they have greater power in determining what ultimately happens to this waste. Because industrialized nations tend to have greater environmental demands and awareness, industrial countries can often pass domestic policies seeking to protect themselves from waste (Clapp, 2003). One such example is the United States' Resource Conservation and Recovery Act (RCRA) introduced in 1976, increasing more stringent protocols in handling and disposing of municipal and industrial waste (United States Code, 2024). This was enacted to protect U.S. neighborhoods and ecosystems– but did have the adverse effect of increasing U.S. waste exports abroad. Waste disposal costs increased, on average, from $250 to $350 per metric ton (McCrory, 1991). Waste producing firms reacted by exporting waste overseas to developing countries rather than contending with the more expensive disposal processes outlined by the RCRA. This is also a symptom of the "Not In My Backyard" (NIMBY) mentality– after all, if the adverse effects of waste don't impact you directly, they are far easier to ignore. Waste producers often send waste to "waste dealers", often shady, illegitimate firms, who exported the waste on the producers' behalf (Clapp, 2003). Thus, the burden of the global waste trade naturally shifted to be placed upon the shoulders of developing states.

Vulnerability: There are two vital reasons for why developing countries are attractive targets for waste disposal and recycling: 1) they have a comparative advantage in processing waste due to lax regulation and mass labor, and 2) they are often in vulnerable financial positions due to liberal global economic policies.

Nearly all current literature on the global waste trade agrees on this point: Developing countries have incredible comparative advantage when it comes to waste disposal. This is due to several factors, including the often nonexistent regulation (which in turn, cheapens disposal costs) and the access to massive amounts of low-paying, low-skilled labor (which even further cheapens disposal costs) (Clapp, 2003). Because the disposal cost per metric ton of hazardous waste is cheaper in developing countries, they are far more likely to be shipped there. In the 1990s, disposal costs averaged $40 per metric ton in African nations, far cheaper and more appetizing for waste-producing firms than their developed nation counterparts (McCrory, 1991). However, this lax regulation and mass labor comes at a steep price. Proper disposal procedures are less likely to be followed, and workers are more likely to be subject to inhumane or toxic conditions. And, if disaster occurs, cleanup costs are more than certain to be unaffordable for developing states (Clapp, 2003). China is no stranger to crises like this. In 2013, a lead poisoning incident occurred in Dongyang, Zhejiang Province, where the local battery recycling industry was found to be releasing toxic fumes and improperly disposing of lead waste, which contaminated the air and soil. This led to severe health issues for residents, especially children, who were exposed to high levels of lead (MAC, 2011). These factors, when combined, create an environment where developing countries become the most attractive option for waste-producing firms to export their cargo.

In addition, the financial positions of developing countries left them vulnerable to industrial nations' trade offers, and if those were to fail, they were vulnerable to bribery and corruption. Many formerly colonized nations were in desperate debt, and thus in need of physical currency to pay off loans often given by the International Monetary Fund and the World Bank (Clapp, 2003). These loans were often given from rich donor countries to poorer recipient countries in returns to promising reforms– including democratic transitions and liberal economic policies. These policies were often deliberately and forcibly friendly to donor countries. These liberal policies opened doors to industrialized nations to exploit and profit even more from these developing states (Clapp, 2003). In addition, the governments of these nations are susceptible to corruption, with little to protect or punish criminal behavior. Somalia, despite fighting a civil war, was approached by Italian and Swiss multinational corporations who offered $80 million dollars for the right to dump toxic waste for 20 years within Somalia. Despite this negotiation holding no legitimacy, as Somalia had no real legitimate government, Italy and Switzerland still proceeded to dump waste that contained radioactive and toxic materials into Somalia (Sirleaf, 2018). This remains just one example of a state that was financially vulnerable and susceptible to corruption, leading to its exploitation as a global waste dump.

Key International Regulations

These trends throughout the 1980s were incredibly concerning in international discourse, and sparked a series of treaties and conventions discussing future international regulation on the global waste trade. The most prominent and relevant of these was the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

Four key stakeholders emerged to play crucial roles in the shaping of international pollution regulation (Clapp, 2003). On one side, there were developing countries and environmental NGOs advocating for the ban of the exportation of waste disposal to developing countries. On the other hand, there were industrialized states and waste-producing transnational corporations (TNCs) who advocated for regulation of waste rather than an outright ban.

The 77 developing states present, dubbed the "G-77", which included China, wanted to protect their right to refuse imports and to protect their economic and judicial development (Clapp, 2003). They were aided immensely by powerful and passionate NGOs, most notably Greenpeace International. These environmental NGOs played a crucial role in spreading awareness of the environmental and human rights injustices of this trade, and created mounting pressure on industrialized countries to reduce their hazardous exports (Secretariat of the Basel Convention, 1992). They argued that industrialized nations paying for exportation gives no incentive for clean production methods to be adopted, and the current global waste trade exploited developing states along neocolonial lines (Puckett, 1992).

Waste-producing TNC interests were represented by organizations like the International Chamber of Commerce and the International Metals Institute, and later, the Bureau of International Recycling. They argued that not all states can dispose of their wastes safely, and that a ban would restrict both the industrialized and developing states' rights to choose how they'd handle waste. The global free trade system would be put at risk, which would endanger jobs and investment in developing states (Clapp, 2003).

Eventually, the Basel Convention came to a conclusion, successfully brokering an agreement to both sides. It instituted stricter definitions and regulations on hazardous waste and its exportation, with one of its defining features being the right to prior consent (Krueger, 1998). This right requires exporting countries to obtain the written consent of the importing country before shipping hazardous wastes or other wastes. Despite the monumental nature of the Basel Convention, it did contain key weaknesses that would permeate throughout international waste legislation afterwards. Apart from definitions, inspection procedure, and technicalities, the most pertinent weakness were the loopholes in the global trade industry. Loopholes that would be exploited to transform the global waste industry from then onwards.

In the aftermath of the Basel Convention, industrialized states sought to find cheaper alternatives to exporting waste around the prior consent and stringent waste management regulations. This manifested in various different pipelines, all of which make it harder to track waste data. One was the illicit waste trade, where waste is often smuggled into developing countries without proper documentation or consent from the receiving country (Clapp, 2003). This waste is more often than not improperly disposed of, a threat to the local environment and health. Another is the Waste to Energy Pipeline in developing countries involves converting municipal solid waste into energy through various technologies such as incineration, pyrolysis, gasification, and anaerobic digestion (Clapp, 2003). But the most revolutionary has been the Waste to Recycling Pipeline.

After the Basel Convention, as much as 90% of the hazardous waste previously destined for exportation and disposal was misleadingly relabelled as “recyclable” (Jiang, Yijing, et al, 2023). In this way, export firms could still get rid of their waste without contending with the new Basel Convention laws. Compared to the waste disposal industry, the recycling industry was far less regulated and less scrutinized. However, this is an extremely dangerous precedent. Recycled materials sent abroad are often contaminated, mislabelled, improperly sorted, or just hazardous, and the danger of an unregulated recycling industry came under fire from environmental NGOs.

Over the years, the Basel Convention has been updated to include plastics, recyclables, and other wastes. But, no matter the iteration, no matter the amendments, the toxic colonialism and the push and pull factors of the global economy remain crucially important themes to understand China’s role in the global waste trade.

China’s Role in the Global Waste Trade

The waste industry generated in industrialized nations and exported to China has been polluting the Chinese landscape for over 3 decades, of which over 106 Tg of was plastic waste intended for recycling (World Bank Group, 2019). One of China’s largest exporters of waste was the United States itself, who in 2010, sent the majority of its plastic waste to China directly, or indirectly, via Hong Kong, but whose destination would remain the same (Nzayiramya & Beghin, 2021). Often contaminated, unprocessable, or downright hazardous, the mountains of waste imported from industrialized states remains a blight on the CCP's vision for a more sustainable industry. In its height, over 12 million Chinese civilians were involved in the recycling industry, operating dangerous machinery, inhaling toxic fumes, and earning pennies on the dollar (World Bank Group, 2019).

In 2013, China made an unexpected formal announcement of its Operation Green Fence, cracking down on imported plastic waste as a preliminary step to address the growing environmental and health crises caused by the global waste trade. Operation Green Fence implemented higher rates of inspections as well as stricter regulations on imported recyclables, rejecting shipments that did not meet high enough purity standards, and a zero tolerance policy for banned materials (e-waste, human/animal waste, food waste, etc) (Resource Recycling News, 2022). This was part of China's fight against all forms of imported waste, including glass, paper, and plastic, as these more stringent regulations resulted in waste imports dropping from 2014 onwards. This was felt across the globe. U.S. plastic waste exporters found themselves shipping more waste domestically instead of to China, which allowed domestic mills to drop their prices and pressured exporters to adhere to higher standards of waste processing prior to shipping. Every sector in recycling, glass, paper, and plastic experienced noticeable drops in imports into China following Operation Green Fence (Powell, 2020) In plastics, from 2014-2017, plastic waste imports dropped by 40%, an exigent amount whose impacts rippled worldwide (Staub, 2020). The shape of the global waste network was beginning to change.

In 2017, the Chinese government escalated its efforts with the announcement of Operation National Sword, a more aggressive and comprehensive policy aimed at permanently banning the import of 24 types of solid waste, including various plastics, unsorted paper, and textiles. By fully closing its borders to contaminated waste, China aimed to reduce domestic pollution, improve its waste management infrastructure, and create a circular economy where resources were reused more efficiently (WTO, 2017).

The effect was immediate. China's plastic imports dropped by 99% that very next year (Wang et al, 2019). The implementation of Operation National Sword had ripple effects across the globe. Developed nations, which had long relied on China to process their waste, suddenly faced mounting piles of recyclables with nowhere to go. This exposed significant flaws in their recycling systems, including a lack of domestic infrastructure to manage their own waste. The policy also led to an increase in illegal waste exports to other developing countries, exacerbating environmental issues in nations ill-equipped to handle the influx (Brooks et al, 2018). For China, however, the transition marked a step toward environmental reform, pushing industries to innovate and adopt cleaner practices while reducing the health risks to millions of workers who had long borne the brunt of the waste trade. No longer was China the exploited country in a neocolonial framework– it had managed to escape. This new power dynamic effectively disrupted global recycling systems even further than the Green Fence Policy had by forcing exporting countries to confront their excessive production and sheer volume of plastic waste– what would they send it now?

These long-term questions in the aftermath of Operation National Sword still remain largely unanswered. It has been 6 years since the establishment of this policy, and its true impacts have not been fully explored. What remains apparent, however, is that it is significant both geopolitically, by changing China's role in the global stage of toxic colonialism, and environmentally, by changing the journey plastic waste takes after it has been discarded.

Conclusion

As Varsha Madapoosi, the author of The Intersectional Environmentalist, aptly puts it: "Despite its name, the global waste trade is not a trade. It is an extractive process with imperial roots… Developed nations have used… [their] imperial legacies to subjugate other nations to be their garbage dump."

And with China deliberately escaping this "garbage dump" designation with its newest ban, it has created a tidal wave of change in the global waste industry. It's clear that China's actions have flipped the toxic colonialist dynamic that has dominated its disposal industry on its head, and has created a unique and radical change in the global waste trade that has never been seen before.

CHAPTER II

Literature Review

Given the multidimensional, interdisciplinary field that is the global waste trade, there exists a substantial amount of literature about the historical, geopolitical, and environmental implications of it. China's 2018 Operation National Sword is unique in its recency and relevancy in disrupting this field of study from its previously deeply-eroded path. Internationally, the operation is another thread of international legislation shaping the complex weave that are international global waste trends; domestically, a revolutionary policy pushing to improve China's economic standing and environmental impact. But, from these three aspects– the long and consequential history of developed and undeveloped nations interacting through the global waste trade, the geopolitical changes shaping international power dynamics and trade dependencies, and the environmental consequences of shifting waste flows– we can create a more complete picture of this operation's true, long-term impact. But, while the current literature has sought to create this complete picture, it currently does not do enough to cover the immense nuance and complexity of this ever-growing, dynamic field.

My paper will step beyond the limited parameters of previous studies through three main advantages: first, a greater timeframe– by including recent 2024 data, my paper will have a longer time frame post 2018 that will reveal longer-term ripple effects of the 2018 ban; second, a greater geopolitical area- by not only looking at how the 2018 ban impacted China, but her Asian sister countries, an area under-researched and under-examined; third, a greater datascope– by analyzing the immediate air quality surrounding key recycling plants which provides more concrete evidence than CO2 speculation or broad geographical generalizations.

Current Literature Time-frame

Prior to 2018, there did not exist much, if any, literature centered around China's relationship with the global waste trade. However, once the unprecedented 2018 ban was announced, this quickly shifted as an onslaught of papers were published within 1-3 years of the announcement, hoping to contribute to the understanding of the ban's immediate aftermath. Some of the limitations of this, of course, is timeliness– because of how recent the ban had been, most publications only had one or two years of post-ban data to analyze. This shortened timeline has limited the scope of these academic articles, although later ones, like those published in 2023, have been able to conduct a slightly longer-term analysis. But, the limitation remains– only short-term trends were able to be captured and few papers focused on long-term effects were published, meaning there is a gap in the literature regarding the most recent impacts of this policy.

Wang, Zhao, Lim, Chen and Sutherland is one such study, where in early 2019, they mapped out global waste trade networks and analyzed overall trade changes to these networks post-ban. These networks are mapped via the bilateral trade flows between countries and effectively communicates the most important pre-ban trends– major importer and exporter hubs, inter and intra continental trade trends, and the evolution of these networks over time. Asia has become an increasingly attractive hot spot for importing waste, especially from 1998 onwards, and their portion of the global waste imports has ballooned in ratio to other regions. China, especially, has taken a central role in this transformation, until the 2018 ban. Crucially, although thorough in their analysis, they lack any data post-2018. The true long-term impact of the ban on global trade networks remained unmapped and unknown.

Chukwukelu, 2020 and Nzayiramya & Beghin, 2021, expanded on this previous literature to explore just exactly how these trends have been disrupted. The most direct, observable impact was the plastic imports going into China– Nzayiramya & Beghin found that, “In 2010, both China and Hong Kong combined represented 87% of total plastic waste exports from the U.S. These dropped down to 18% of total exports in 2018. The total combined imports from the U.S. to China was 1.93 MMT in 2010, whereas it was only 0.15 MMT in 2018…” These significant drops in Chinese imports are also reflected in Chukwukelu’s findings, where Chinese and Hong Kong imports of waste (whereas significant portions of waste are processed first by Hong Kong and then shipped to mainland China) drop from accounting for 60% of the global waste trade to under 10% within 12 months of Operation National Sword’s implementation. This was even reflected on the exporting side– the G7 countries, US, Japan, Italy, Germany, Canada, France, and the UK– all experienced plastic waste exports fall as an immediate consequence. But the key words “immediate” remains– whether or not this drop was sustained through today is still relatively murky.

In addition, that does not mean all waste is accounted for– if China refuses to take the many millions of tons of waste, where does it ultimately end up? Brooks, Wang & Jambeck track this displacement of waste across borders, and have found that immediately following the ban, South-East Asia, particularly Malaysia, Vietnam, and India, bore the burden of absorbing the displaced waste now rejected by China. But, this was only within a 12 month period of study– there exists little to no literature that have documented these trends for the years following. The long-term displacement of this waste is not a well-researched area in this field due to the sheer concentration of studies focusing on the immediate, 12 month aftermath of the ban.

But, as the United States and other developed nations continue to generate more and more plastic waste every year, it is crucial that an expanded time frame is used to better understand this crucial question: Where does this plastic waste go?

Current Literature Geopolitics

There currently exists an information vacuum and imbalance in the literature surrounding China's 2018 plastic waste ban– while there exists a great concentration of studies and reports investigating the largest, most notorious countries' involved in the global waste trade- namely the U.S. and China– there exist few studies concerning the impact this ban has had on the Malaysian, Vietnamese, Thai, etc populations who were supposedly the countries forced to bear the brunt of this policy's impact. There could be multiple reasons that could explain this information imbalance, including the fact that the majority of studies about the Chinese 2018 ban come from either the United States or Chinese institutions and political scientists, and that because these countries are largely developing economically and less politically stable than their developed peers, less information, smaller in quantity and lower in quality, has been available for data analysis. This means that the true gravity and scope of the ban's impact is not known, as it has only been assessed ignoring the impact on smaller, developing Asian countries, a critical blind spot.

For example, there exists more than ample data on the United States' exportation data, right down to the very state and the very type of plastic exported out. In Bourtsalas et al., the USA Trade Online Database contains data in immense detail about U.S. state-by-state exports of Ethylene Polymers, Styrene Polymers, Vinyl Chloride Polymers and Nesoi plastics, and can map out the minute adjustments of plastic exports. California, Illinois, and Texas led with the highest rates of plastic exportation abroad. However, despite the data's detailed analysis and scope, it still suffers from a limited timeframe, with its most recent data only dating back to 2021, and lack of data on the finality of these exports; after becoming exported, the study does not track the processing of this waste into the new host countries. This remains true for other Western, developed nations, with studies focusing on Germany, Australia, and the Netherlands all being published scrutinizing their imports and exports of plastic waste, but rarely ever is it tracked past these numbers and analyzed once it enters developing countries.

Even within Asia, there exists an information vacuum between China and other Asian nations in regards to the global plastic waste trade. While dozens of studies exist studying the economic and environmental impacts post-2018, almost all of them exclusively focus on China, with almost no studies focusing on these impacts on Malaysia, Indonesia, or other Asian countries that were supposedly the victims of the displaced plastic waste.

In addition, what most of these scholarly articles have in common is the source of their data. Most of these studies accumulate data gathered from the UN Commission on Human Rights' Special Rapporteur and other UN sources. The United Nations Commodity Trade Database, aka the UN Comtrade, is an internationally recognized source of trade information from around the world, and can be extremely useful on a country-by-country and industry basis. Because of this, the conclusions drawn by many of these articles are similar in both scope and results. However, there are limitations of gaining information from this avenue, as it does not account for clandestine, illegal trade and dumping. Additional main sources for the data come from the OECD, the Organization for Economic Co-operation and Development's databases and the articles analyzing the Basel Convention and her sister legislations within the *Journal of Environment and Development.* Most of these databases likewise have incredible amounts of detailed information on the U.S. and China, but not other relevant Asian countries. My study will focus and highlight the actual impacts on countries other than just China and the U.S. because our second question is all the more important: Who does this plastic waste affect?

Current Literature Datascope

The environmental analysis of the 2018 ban mostly only exists on two realms- speculative, as in projected or widely estimated environmental consequences- or correlatory, using generalized data for a whole region instead of honing in on direct impacts.

Cotton, Cook, & Vellis published an incredibly deep look into the plastic waste trade globally, mapping out in minute detail plastic production on a municipal level in countries all over the world. However, the strength and limitation of their paper is ultimately their Plastic Emissions Outlook, where they produce visuals and data on estimated Plastic Emissions across the world. However, in large part, these emissions are merely speculative– although based on real data on pollution levels and plastic consumption, ultimately it is not based on the real, tangible data of pollutants in the air. My study will improve upon Cotton, Cook & Vellis's study by actually providing these concrete data points, possibly supporting their estimations, or even possibly contradicting them.

Generalized data is often used for analyzing the environmental impact of this policy. Oftentimes, the logical link between the 2018 plastic ban and the data on air quality or pollution is shaky at best, using overall, regional data to propose conclusions without information about where plastic pollution actually occurs.

For example, Xinsheng Shi and Ming-ang Zhang explore the air quality of key regions of China before and after the policy change, concluding that due to direct result of China's Green Fence and National Sword policies, air quality of previously plastic processing prefectures has improved. Data was gathered using over a thousand air pollution tracking stations throughout China through the National Urban Air Quality Real-Time Releasing Platform. In addition, they used NASA's Visible Infrared Imaging Radiometer Suite (VIIRS) to find that the number of garbage-based fires has drastically been reduced after the 2018 ban, from which they conclude must improve air quality in these regions. Their results support the "pollution haven hypothesis", in which, "countries with lax environmental regulations have comparative advantages regarding pollution-intensive industries and therefore are more likely to export products produced by these industries, which are expected to negatively affect the environment." (Shi and Zhang, 2023). However, their logic tying random fires spotted by satellite and plastic waste processing does not consider alternative causes of fire nor does their data utilize existing plastic pollution firm locations.

Ren, Shi, Bardow, Geyer, and Suh likewise explore the life-cycle of environmental implications of the 2018 ban, analyzing how the policy may inadvertently cause greater demand for virgin coal to create PET fiber without the previous stock of recyclable plastic, thus worsening the air quality and environmental impacts. They draw this conclusion from 3 "what-if" scenarios, generating data drawn from hypothetical, speculative situations, an unreliable methodology. In addition, this is the opposite conclusion of the Shi & Zhang study, which exemplifies the need for more literature to clarify the true impact of the policy. There exists little to no other literature on its environmental impact, however, which leaves room for further research into other environmental impacts- which includes, but is not limited, to microplastics, water quality, and, especially, human rights related impacts. Thus, that brings us to our last question: What are the true harms of this plastic waste ban?

Ultimately, the research landscape surrounding plastic waste trade and environmental policy remains incomplete. My study improves upon previous literature to better answer these three key questions: Where does this plastic waste go? Who does this plastic waste affect? What are the true harms of this plastic waste ban? First, by incorporating more recent data beyond the limited 1-2 year time frame analyzed in prior studies, I will examine long-term trade shifts and environmental consequences post-2018. Second, my study expands beyond China and the U.S., capturing the effects of plastic waste redistribution on Malaysia, Indonesia, Vietnam, India, and Thailand, nations that have largely been overlooked in existing research. Lastly, I will improve upon speculative and correlational environmental assessments by utilizing direct air quality measurements at key recycling sites—providing concrete, quantifiable evidence of the environmental consequences of shifting waste trade policies.

Methodology

Two key research questions will be answered in this paper:

1. Plastic Waste Importation: Where does U.S. generated plastic waste end up in the years following 2018, and how does this differ from prior to 2018?
2. Air Quality vs. Plastic Waste: What were the environmental implications of the 2018 National Sword policy in terms of air quality?

The methodology conducted in this paper is twofold: the first, a quantitative analysis of the U.S.-China and U.S.-Central/South Asian Countries plastic import trends from 2013-2024; and the second, a quantitative and correlatory assessment of the environmental impact of the changes seen in the first analysis.

1. Plastic Waste Importation Methodology

The primary data source for this analysis is UN Comtrade, specifically under Harmonized System (HS) Code 3915, which categorizes waste, parings, and scrap of plastics. This dataset includes breakdowns for specific polymer types, such as ethylene polymers (391510), styrene polymers (391520), vinyl chloride polymers (391530), and other miscellaneous plastics (391590) (United Nations, 2025). UN Comtrade is a widely recognized and authoritative global trade database, frequently cited in existing literature on international waste flows. However, it does have blind spots, as not all countries consistently report their waste trade data, and illegal plastic waste exports remain unaccounted for, limiting the full visibility of the global plastic waste economy. Despite these limitations, UN Comtrade provides the most comprehensive and standardized dataset available for tracking reported plastic waste trade flows.

The methodology for this section involved graphing and analyzing trade flows to capture macro trends in U.S. plastic waste exports and Asian plastic waste imports. First, I examined the total plastic waste exports from the U.S., identifying the top 10 recipient countries from 2013 to 2024. Parallel to this, an analysis of China's plastic waste imports was conducted, reflecting its dominance as the primary importer prior to 2018, and the subsequent shift in waste flows after the implementation of the National Sword policy. Additionally, I mapped importation trends for Malaysia, India, Indonesia, and Vietnam, the leading alternative destinations for U.S. plastic waste in the post-China-ban era. To provide a more contextualized environmental impact assessment, I also examined how imported plastic waste is managed in each country—whether through recycling, landfilling, or incineration—to evaluate the potential environmental and human health consequences associated with these waste streams. This is captured in Chapter III.

2. Air Quality vs. Plastic Waste Imports Methodology

While the imports and exports of plastic waste is readily documented and easily tracked, their environmental impacts are much more difficult to quantify. The biggest impacts of plastic pollution are on air and water quality. In a perfect world, this air and water data could be cross-referenced with plastic processing centers (landfill, recycling, incineration, etc) over time to view the environmental effects of the decreasing/increasing plastic imports. In this study, air quality was chosen as the dependent variable, recycling centers were chosen as the geographic locations, and China and Malaysia were chosen as case studies– the independent variables.

Air Quality: Water quality is difficult to link back to plastic waste processing, as there exists almost no databases that geographically map water quality to a precise location. In addition, data around water quality does not specify plastic particulates, only particulates of a certain size. This lack of geographical specificity combined with the lack of plastic-specific data makes water quality difficult to measure in respect to plastic pollution. Meanwhile, there exists enormous amounts of data on air quality globally, with hundreds of thousands of stations worldwide with data spanning almost a decade. These stations can be mapped to precise geographic locations, and the data even includes the particulate and molecular makeup of the air. Because of this, air quality was chosen over water quality as a dependent variable of measurement.

Recycling Centers: There were four main paths plastic waste often took upon entry into a country– landfilled, incinerated, recycled, or untracked. Tracking all four would be a difficult endeavor that would require more time and data than this project could reasonably cover. For the first path, plastics that end up landfilled are difficult to track because of the sheer quantity of both plastic and landfills throughout each nation. While landfills do leach toxic chemicals into the environment, which could be measured through water quality analysis, water quality analysis is outside the scope of this project's research. Many landfills are not registered, nor they do not track the origin of the plastic they bury, and their impact on air quality is not as measurable or tangible as other methods of plastic processing. Likewise, when plastic is incinerated, it can be either done in a professional facility or in the open, often undocumented and without permission.

This can happen with landfill or recycling sites where employees, tasked with sorting the plastic, lack the proper resources, labor, or time to do so and instead burn the plastic. This is also difficult to track, and there exists no databases on formal incineration plants on a global scale. However, perhaps because recycling is a greener industry that is more positively viewed, there exists much more data on recycling centers than any of the other disposal methods. Numerous databases about recycling center locations, business history, size, and disposal methods are included for countries around the globe. Additionally, recycling has a direct link to air quality. Recycling can either be done through chemical or mechanical recycling. Chemical recycling includes pyrolysis, gasification, solvolysis, etc (Sharp, 2025) that requires immense energy to break down plastic polymers to more useful monomers, producing toxic waste and fumes during the process (Singh & Walker, 2024). Mechanical recycling physically breaks the plastic down into smaller pellets or shreds where it can then be washed and extruded, which produces microplastics and additional fumes. Both methods produce major pollutants, such as CO, CO_2, and NO_2; toxins, such as benzene, mercury, arsenic, and formaldehyde; and polycyclic aromatic hydrocarbons, which are carcinogenic and can cause severe health issues (Shennum, 2023). All of these combined reduce air quality and increase the public's risk of airborne diseases and cancer. It produces three tons of CO_2 for every one ton of plastic (NCEL, 2025) and workers who work in the plastic industry in developing countries have higher exposure rates to toxic chemicals and higher chances of developing cancer (Brosché et al, 2024). Thus, the high amounts of data on recycling combined with a more direct link to air quality makes recycling centers the most optimal candidate to measure air quality in this study.

Countries: For this, China and Malaysia were the two countries chosen to represent a developed Asian country who benefitted from the 2018 import ban, and a developing Asian country who was disadvantaged by the 2018 import ban. Both countries had an abundance of air quality and recycling center data to pull from, meaning there would be plenty of data to analyze. We can further quantify the true impact of the plastic waste and recycling industry by cross-analyzing the locations of these waste/recycling plants and their nearby air quality stations. This, over time, can reveal a much more closer look at the tangible, not speculative nor generalized, impact of the 2018 import ban.

Plastic waste/recycling sites were chosen from the ENFPlastic database, which remains the biggest database of recycling companies in the world, researched by hand by recycling industry experts and constantly updated with key information like company founding date, plant address, and size of plant (ENF Recycling, 2025). Although not guaranteed to be comprehensive, it is still the most comprehensive database of recycling companies across multiple countries, including the U.S., China, and Malaysia. Of these, 10 waste/recycling sites were chosen at random as data points. Once a waste/recycling site was chosen and located, the nearest air quality station was manually found.

Air quality stations were chosen from the World Air Quality Index project (AQICN) database, a free, comprehensive, worldwide, live, and constantly updated database of air quality information from around the world started in 2007 (AQICN). If the nearest air quality station was over 5 kilometers away, the recycling station was ruled out, and another chosen. Likewise, if the nearest air quality station lacked sufficient data, such as only having air quality data that does not date back past 2018, then the recycling station was ruled out, and another chosen. Each air quality station contains data of different types of pollution, but the one chosen for this study was particulate matter of under 2.5 micrometers. This was chosen because PM2.5 is typically used for pollution analysis from industry, as emissions from gas, oil, plastic, and fuel primarily produce PM2.5 (California Air Resources Board, 2025). Thus, the overall trend of PM2.5 pollution over time can be graphed for each recycling station.

From this air quality data and the previous section's import/export data, I calculated the Pearson's Correlation Coefficient and its corresponding p-values for China and Malaysia respectively, with a p-value lower than .05 indicating statistical significance. Thus, a correlatory relationship between Chinese and Malaysian plastic imports and their air quality changes over time can be either established or refuted. This is covered in Chapter IV.

CHAPTER III

This chapter will answer the first of my two research questions: Where does U.S. generated plastic waste end up in the years following 2018, and how does this differ from prior to 2018?

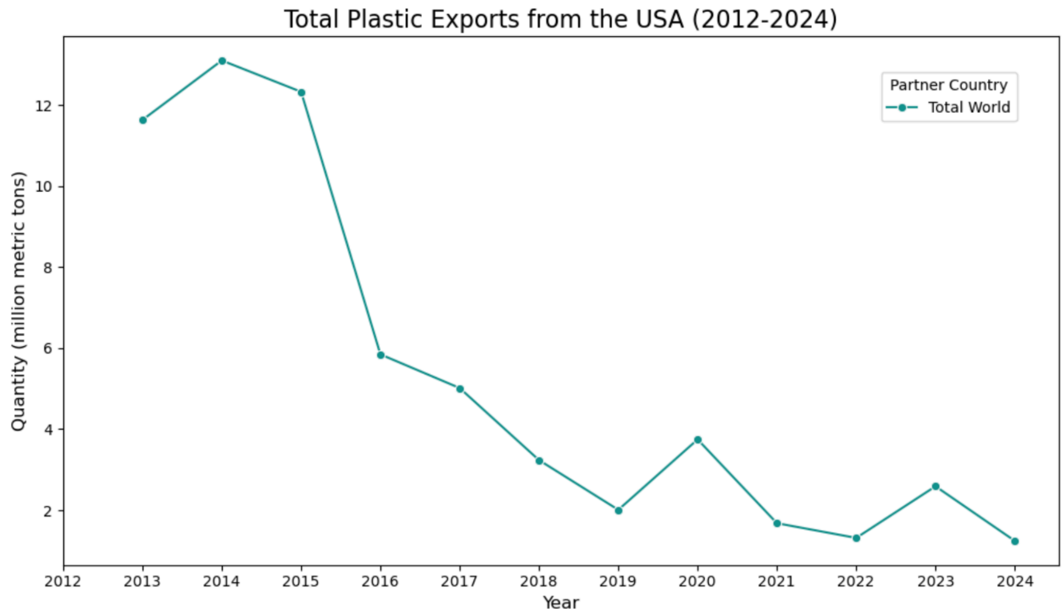
The answer to this question has two dimensions:

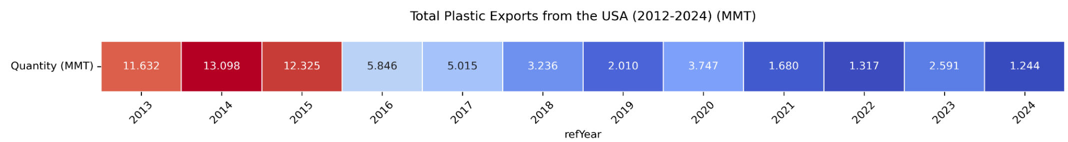
I. Dimension I: Location. What fraction of U.S. plastic waste is handled domestically or exported internationally? Of the plastic exported internationally, to what countries does it ultimately end up?

II. Dimension II: Management. Of the plastic handled domestically, through what methods is it handled? Of the plastic exported internationally, through what methods is it handled?

The U.S., true to its international notoriety, has only gotten bigger, larger and greater in terms of its plastic waste generation over time. However, although recent concrete data on the exact number has been absent, the notable growth in plastic waste generation over time is irrefutable (Geyer et al, 2017), and was last measured in 2019 to be an approximate 72.8 million metric tons (OECD Data Explorer, 2019). Of this, and other plastics both created domestically and imported from abroad in 2019, an estimated 44 million metric tons were handled domestically. (Milbrandt et al, 2022). It is of this remaining 28.8 approximate million metric tons (last calculated in 2019, with only a growing upward trajectory over time (United States Environmental Protection Agency, 2024) that we need to find the final destinations for.

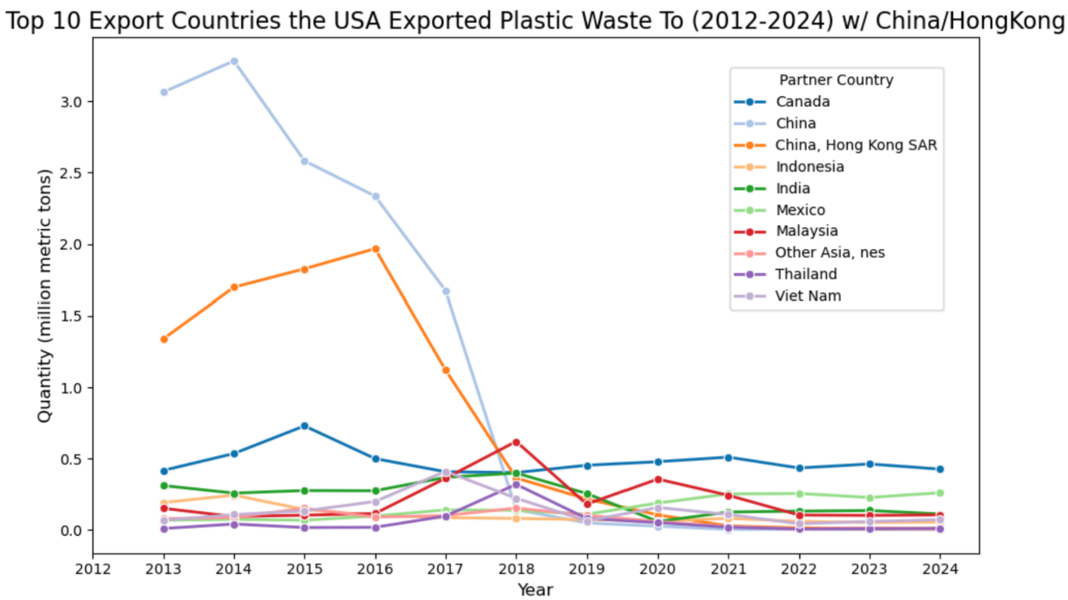
U.S. Plastic Waste Final Exportation Locations

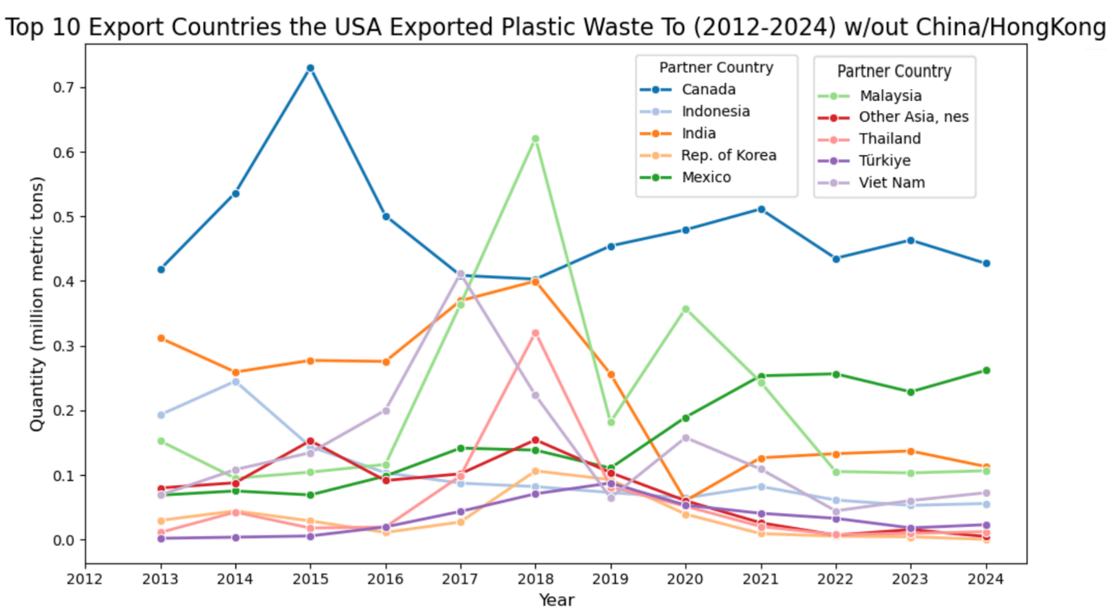




From the immense quantities of data on how much plastic the United States ships outward, one can extrapolate and infer that any plastic that the United States does not report to be exported was either 1) handled domestically or 2) exported illegally. The United States has, in large part, drastically reduced its total amount of exported plastic waste since 2014. In 2013, the United States exported a total amount of 11.632 million metric tons of plastic waste, followed by an even higher year in 2014 where they exported 13.098 million metric tons of plastic waste. However, starting in 2016, the United States began a steep decline in plastic waste exports, with the exceptions of small increases in 2020 and 2023.

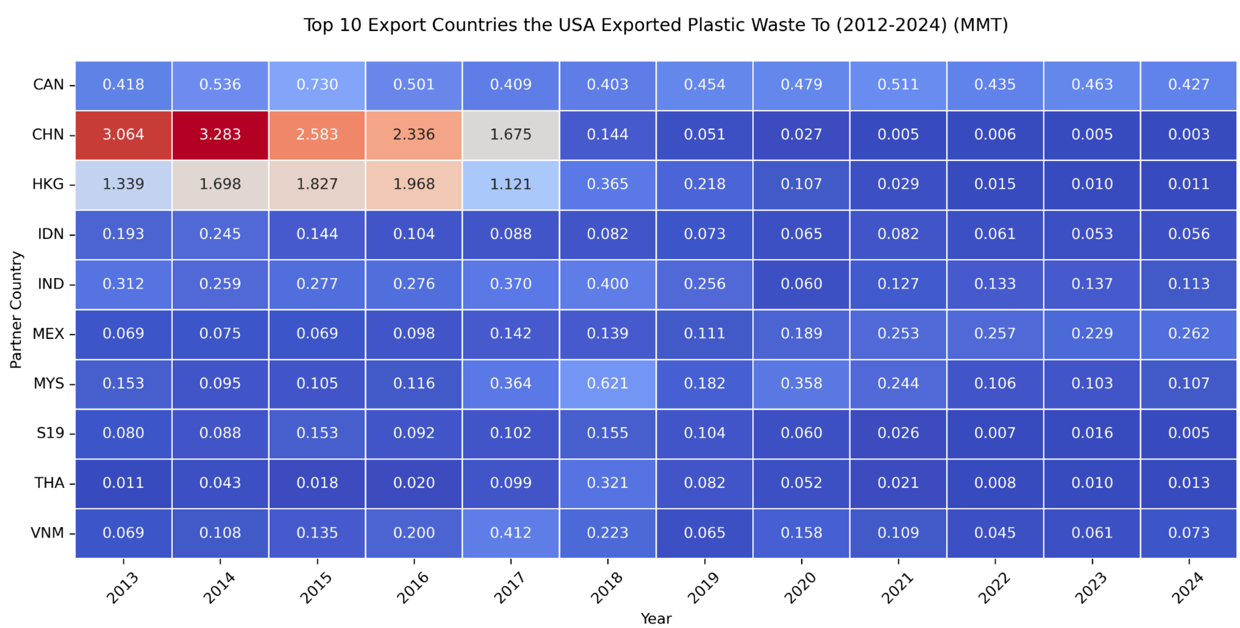
Of the total exports, unsurprisingly, China and Hong Kong made up the highest proportion of U.S. plastic exports prior to 2018. However, the remaining top export states and their quantities remained relatively constant in comparison to drastic drop- these including Canada and Mexico, the U.S.'s geographical neighbors, and India, Indonesia, Malaysia, and other developing Central and South Asian countries.

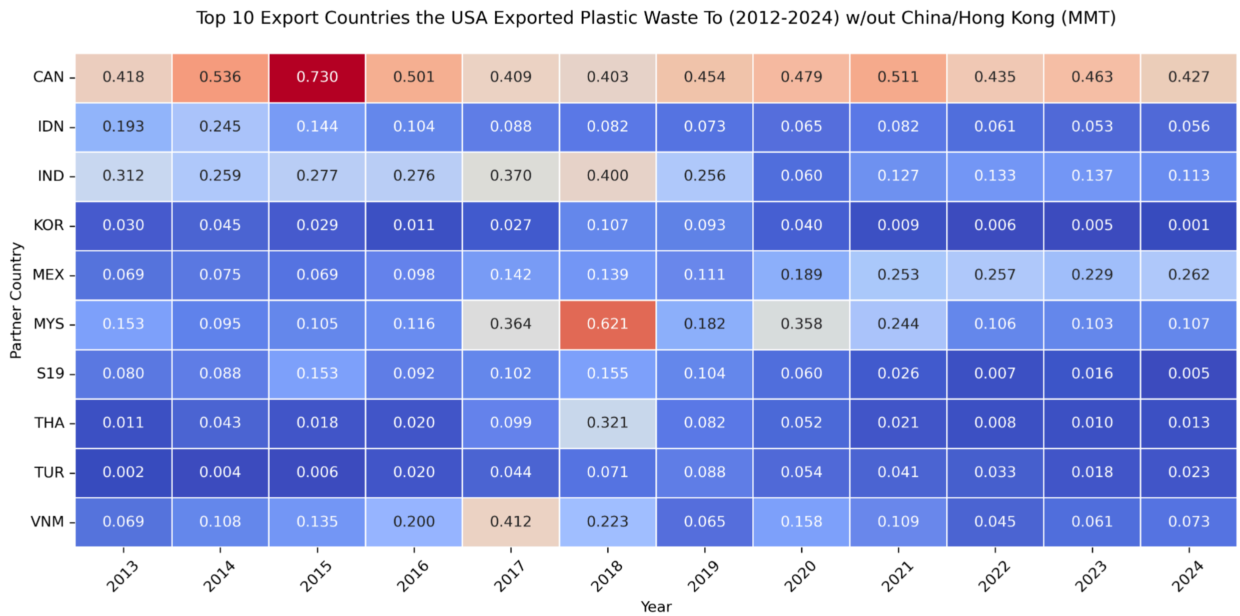




Graphs with and without China/Hong Kong are provided to allow differences that are too small compared to Chinese/Hong Kong exports to be seen.

Notably, there is a significant decline in Chinese exports beginning in 2014, and this decline continues throughout 2014-2018, peaking above 3 MMT to dropping to near zero. Likewise, Hong Kong exports began declining in 2016, dropping from almost 2 MMT in 2016 to under .5 MMT in 2018, to nothing by 2020. This most likely can be explained by China's burgeoning Green Fence policy beginning in 2013 where China began severely restricting imports of plastic waste into the country as part of a larger initiative for greener policies. It's likely that the policy's full effects were not felt until a year or more after implementation, leading to a slight one year delay in decline for Chinese exports and a longer three year delay for Hong Kong exports, most of which were then shipped to China.





Tables with and without China/Hong Kong are provided to allow differences that are too small compared to Chinese/Hong Kong exports to be seen.

Canada and Mexico remained the top export countries after 2018, most likely due to regional and geographical ties to the United States. Canada, in part, also exports an almost equivalent amount of plastic waste to the United States. There is a consistent drop in exports in 2019 across the whole board with the exception of Malaysia, which spikes to a surprising .62 MMT, and Indonesia, which also spikes to an unprecedented .4 MMT. Likewise, numerous other export streams to Asian countries grew slightly in 2018, most likely to accommodate for the immediate and all-encompassing Chinese ban.

Possible Explanations:

There exists multiple possible explanations for these trends. The first and most obvious, as well as the subject of this paper, was China's 2018 National Sword Policy, with the drop in U.S.

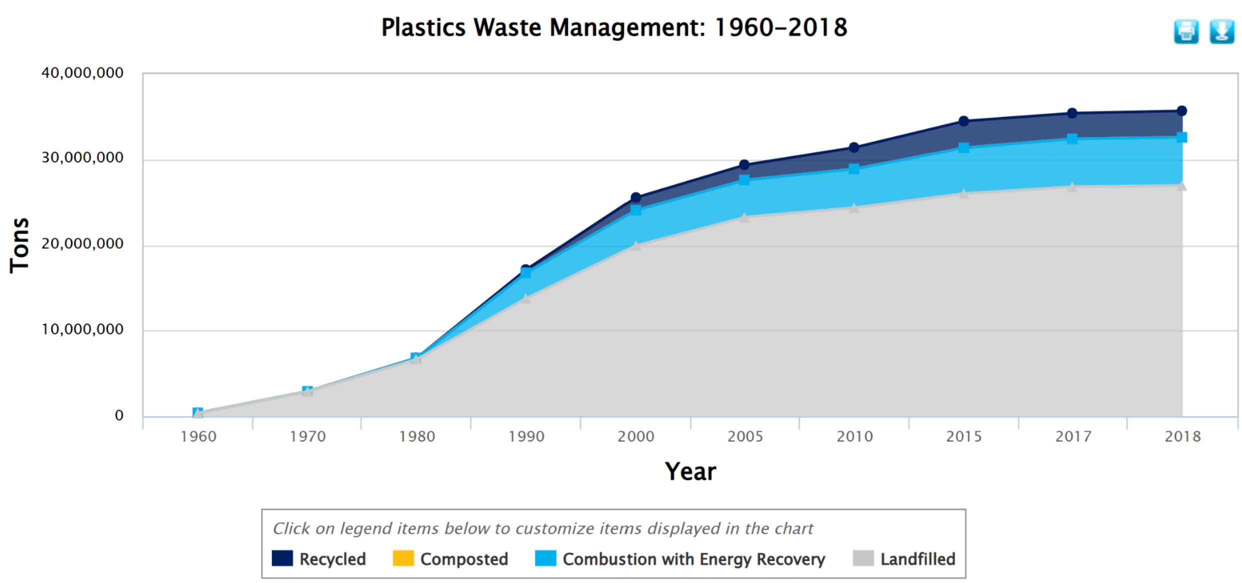
exports corresponding almost exactly with the passage of this ban. This seems to have led to temporary spikes in exports to countries like Malaysia and Indonesia in 2019; however, these increases seem to be short-lived, as many Southeast Asian nations implemented their own restrictions to avoid becoming the next global dumping ground for plastic waste. This means that the spike observed by much of the previous literature has been inaccurately predicted to be a long-term trend. By 2021, Malaysia, Thailand, Vietnam, and India had all enacted stricter import regulations, further limiting the U.S.'s ability to export plastic waste to Asia. These cascading policy changes demonstrate how one nation's waste regulation can have global ripple effects, forcing structural changes in how plastic waste is managed across multiple countries. However, while the increase in Central and South Asian exports seem minute in comparison to the United States overall exportation trends, in reality, these changes are large and significant to the export country in question; the perspective in which these exports are viewed will change the magnitude of significance these changes have been.

In addition to national policies, global agreements and economic factors played a role in reshaping export patterns. The Basel Convention Waste Amendments, which took effect in 2021, introduced stricter controls on the international trade of contaminated and mixed plastic waste, further restricting the ability of the U.S. to send waste to developing nations. Similarly, the U.S.-Canada Waste Agreement—which allows for continued trade of plastic waste between the two nations under certain conditions—likely contributed to the relatively stable export flow between these two countries. Additionally, the COVID-19 pandemic disrupted global supply chains and waste management systems, potentially causing temporary declines in exports as international trade slowed. However, as economies reopened, exports rebounded slightly, particularly in 2023.

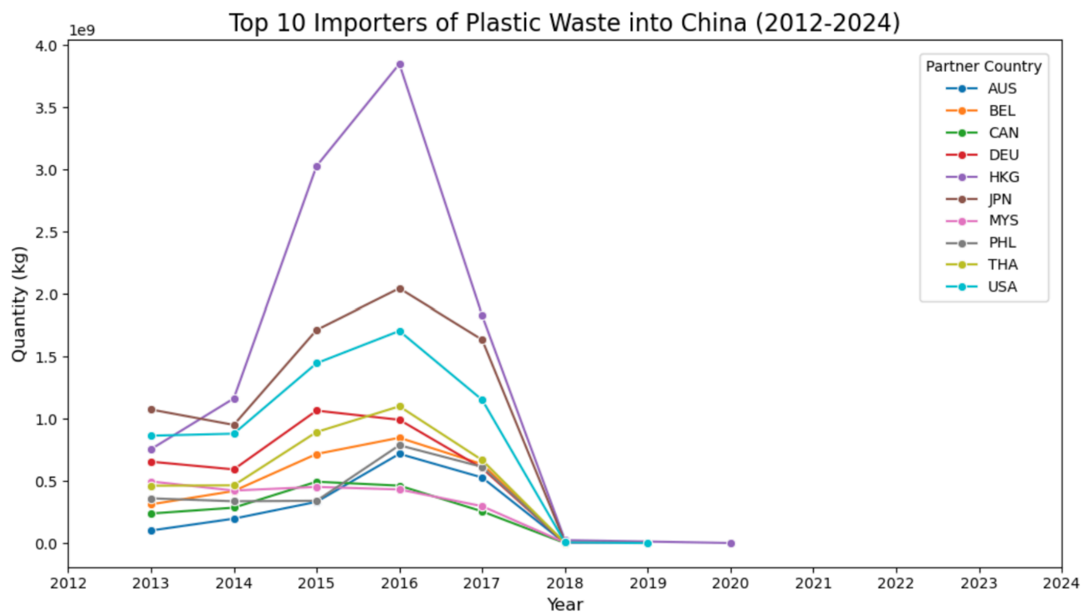
Collectively, these factors suggest that while the immediate reaction to China's ban was a redirection of waste exports to new regions, long-term trends indicate a broader shift toward keeping more plastic waste within North America—either through increased domestic processing or illegal dumping and misreporting, a concern that remains difficult to quantify.

Waste Management in U.S. and Central/South Asia

United States: Although there is no recent data on the U.S.'s domestic handling of plastic waste post-2019, the ratio of landfilled/recycled/combusted remains relatively consistent with trends in waste management in the last decade. "Of the estimated 44 Mt of plastic waste managed in 2019 domestically, approximately 86% was landfilled, 9% was combusted, and 5% was recycled." (Milbrandt et al, 2022) This remains largely consistent with previous data- in 2018, 75.59% was landfilled, 15.75% was combusted, and 8.66% was recycled; in 2017, 75.74% was landfilled, 15.79% was combusted, and 8.47% was recycled. Although we do not know how plastic was handled domestically from 2020-2024, we can assume from this data that the majority of plastic waste was landfilled, with a small fraction being combusted and recycled.

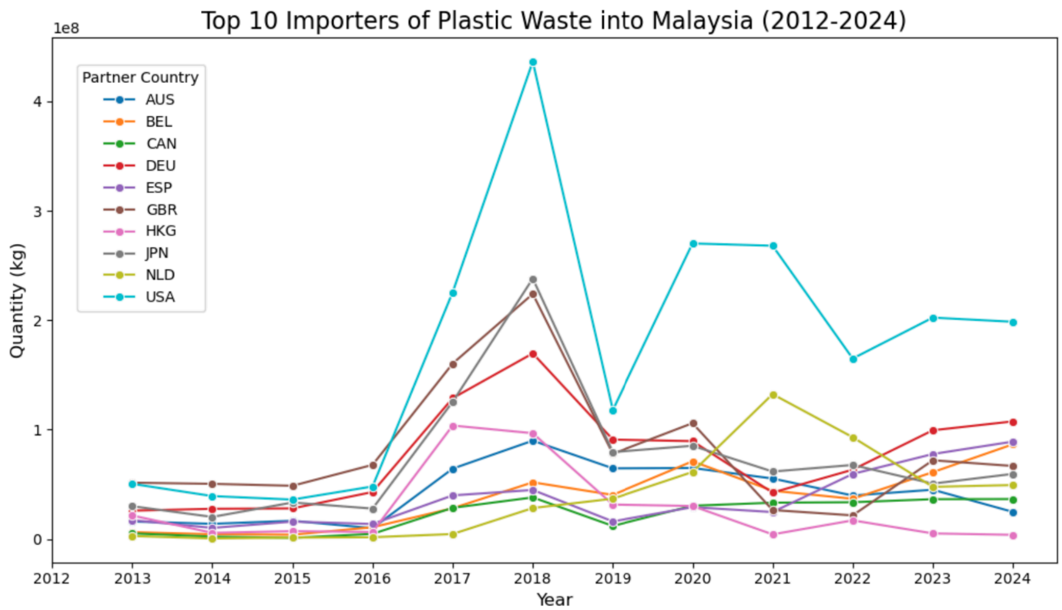


China: Ranking higher than the United States in plastic waste generation and domestic management, China contains a large amount of the world's plastic, whether it be domestically produced or imported from abroad. However, as predicted, China's 2018 ban had an immediate and drastic impact on its plastic imports from abroad, dropping to 0 after 2020.



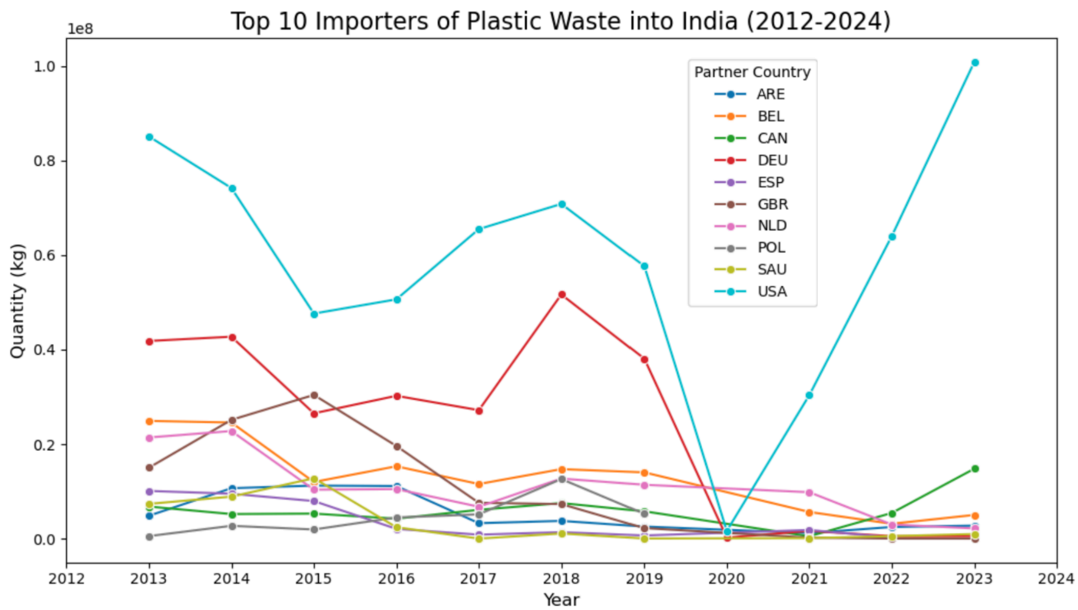
Over the course of 2000-2019, of the plastic waste handled within China, 27% was recycled, 34% landfilled, and 32% incinerated (Jian et al, 2022).. Some of the figures are questionable due to how China's recycling centers sometimes work, sending plastic to be melted down into pellets to individual families. This plastic often ends up unaccounted for or lost as the labor cannot keep up with the demand– but it is very difficult to determine to what degree this occurs and there exists little to no formal documentation of the practice.

Malaysia: Surprisingly, the spike in plastic waste imports into Malaysia was, in many ways, temporary. From the U.S.A, imports spiked to .62 MMT immediately following the ban, but this drastically fell in 2019 and never returned to its previous levels, although overall higher than previously. As a whole, plastic waste imports almost tripled overall, starting from .6 MMT in 2013 to approximately 1.6 MMT in 2024.



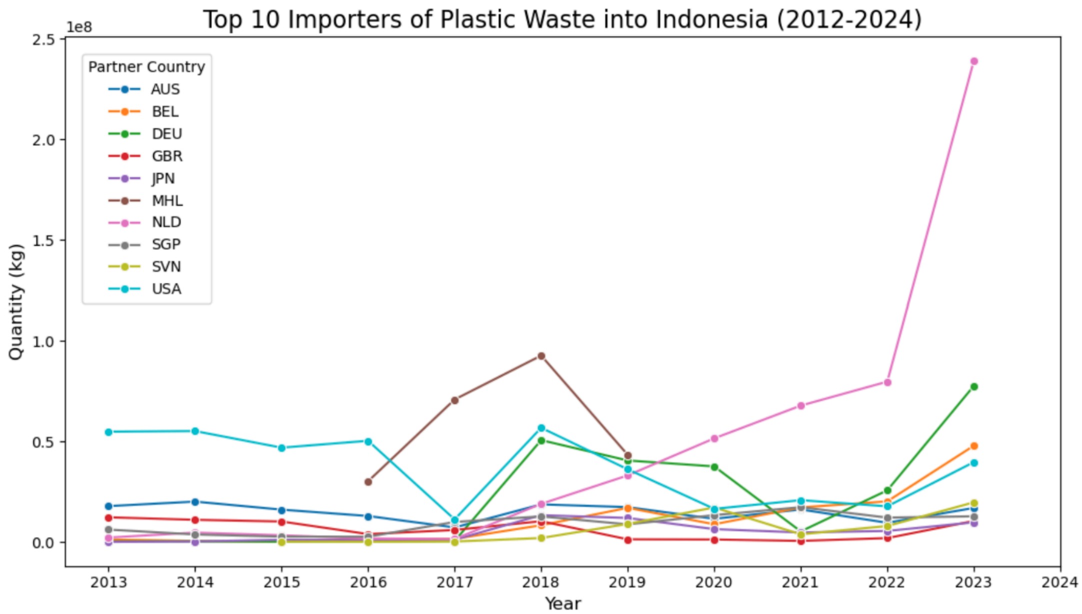
In 2015, prior to the ban, Malaysia recycled 9% of its plastic waste, incinerated 12%, and landfilled 79%. Data post-2018 is not available. However, a significant part is still mismanaged, either left to burn or dumped into nearby water systems, an impact tangible in villages like Klang and Jenjarom. Dozens of illegal dumpsites have been found and shut down over time, but it is safe to assume that these practices did not stop as a result of the increased plastic waste imports into Malaysia post-2018 (Greenpeace, The Recycling Myth, 2018).

India: India total imports of plastic waste has decreased overall from 2013 to 2023; however, the ratio of what country's imported waste has shifted drastically. Plastic waste from any country other than the U.S. has dropped to almost nothing compared to what it has been before, with a collective and drastic drop in all plastic waste imports in 2020, which could be attributed to COVID-19 or plastic disposal policy decisions within India (Cottom, Cook, & Vellis, 2024)



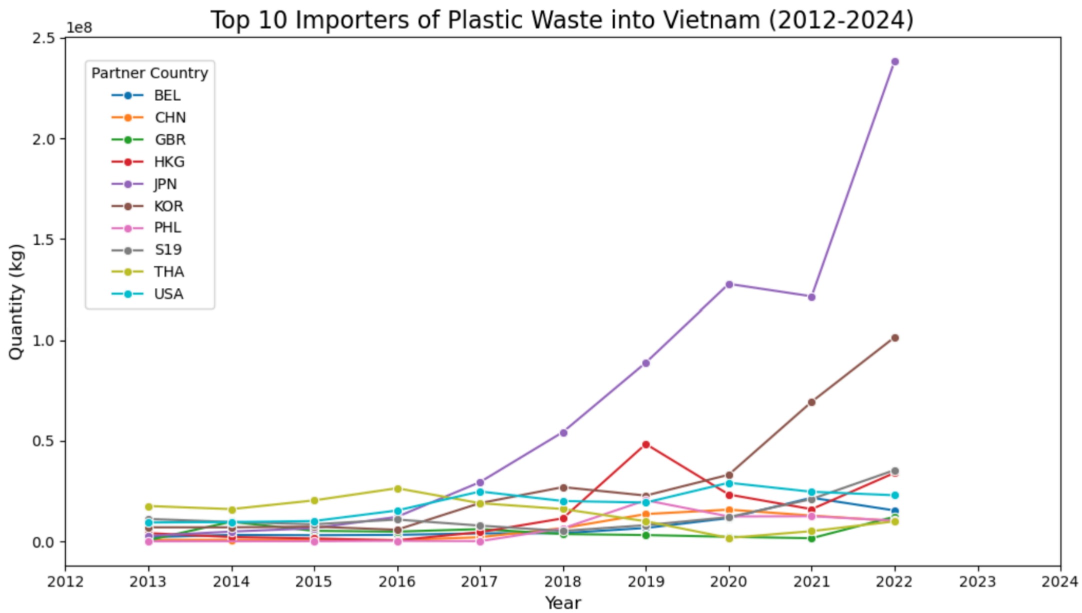
While India reports a recycling rate of 60-70%, in reality, investigation shows that about only 8% actually ends up recycled, while out of the remaining, 28% becomes landfilled, 3% is incinerated, and 66% is either mismanaged or considered "stock" (CSIRO, 2023). This reflects an unfortunate reality in developing Asian countries– there just does not exist enough infrastructure, labor, or incentive to properly process plastic waste.

Indonesia: The continuation of the Netherland's colonial influence in Indonesia is extended in Indonesia's plastic waste industry, with their exports gaining incredible momentum from 2022-24, after a slow, general rise in imports from 2016-22. Surprisingly, the U.S. does not constitute a large portion of Indonesia's plastic waste imports.



About 2% of waste in Indonesia is recycled in the formal recycling sector, with about 15% handled in the informal recycling sector. 60-70% is landfilled, and the remaining 15-30% estimated to be improperly disposed of into the ocean or other bodies of water (Wang & Karasik, 2022). However, because so much of it is handled informally, it is difficult to determine the true final destination of much of this plastic other than the high pollution rates surrounding the country's waterways (UNEP, 2025). Once more, this reflects the power imbalance between developed and less developed nations– Indonesia, like India, lacks the proper resources to handle their plastic waste.

Vietnam: Vietnam is a unique case of Plastic Waste trends, with Japan topping the charts for plastic waste imports. Like Indonesia, the U.S. does not constitute a significantly large portion of their plastic waste imports, but rather, a separate, developed Asian nation (Japan) does. This does introduce a new element into plastic waste analysis- developed vs. developing Asian nations. Future studies could further investigate this growing power dynamic between these two types of Asian nations.

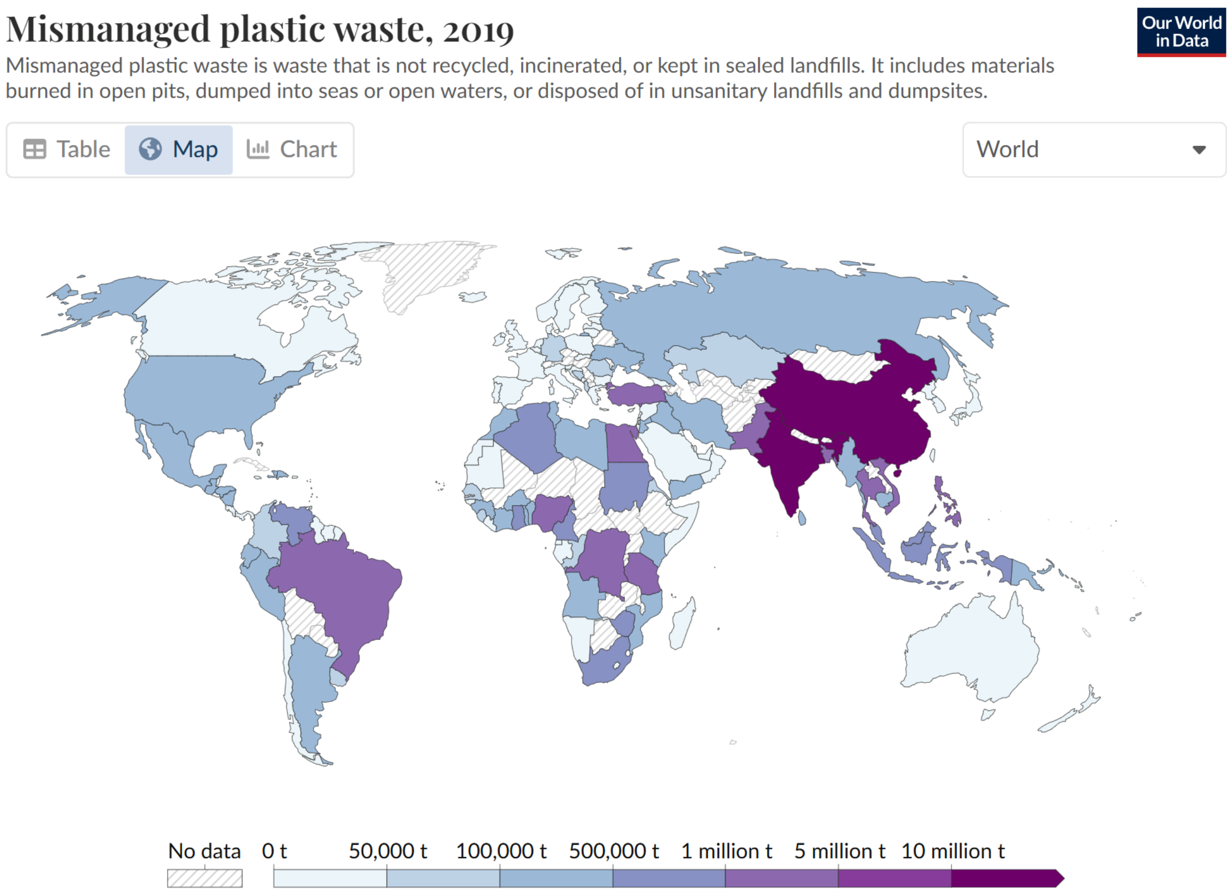


In Vietnam, approximately 75% of all plastic waste is considered mismanaged- their final destination indeterminate, but most likely in the ocean. Out of the remaining 25%, 46% is estimated to be landfilled and under 30% recycled (UN,. Ripples of Change, 2025). Again, the level of mismanagement in plastic waste reflects the power dynamic of developing Asian nations struggling with the sheer volume of plastic waste within their borders.

U.S.-Asia Plastic Waste Trade Analysis

The post-2018 shifts in U.S. plastic waste exports reflect not only changes in waste management practices but also broader geopolitical and economic realignments in the global waste trade. The data clearly shows that the 2018 National Sword policy was the most immediate and impactful driver of these shifts, forcing the U.S. to restructure its export strategies and find alternative destinations for plastic waste. However, while this ban led to temporary increases in exports to Southeast Asian nations—most notably Malaysia and Indonesia—many of these countries quickly followed suit with their own import restrictions and bans. “In the middle of [2018] Thailand and Vietnam announced restrictions on imports. Vietnam announced it would stop issuing import licences for plastic imports, as well as paper and metals, and Thailand plans to stop all imports by 2021. Malaysia has revoked some import permits and Indonesia has begun inspecting 100% of scrap import shipments.” (Retamol, 2019) The broader trend indicates that the global market for plastic waste is shrinking, with fewer countries willing or able to absorb it, and that the United States is facing increasing pressure to manage more of its waste domestically.

At the same time, the way waste is processed within recipient countries highlights stark differences in economic and infrastructural capacity. While China has made significant strides in reducing waste imports and improving its domestic waste management, other nations like India, Indonesia, and Vietnam lack the infrastructure to properly process the massive influx of plastic waste. This imbalance reflects a clear divide between developed and developing nations, where the latter continue to bear the burden of waste generated by the former. The rise in informal recycling, illegal dumping, and ocean pollution in these countries demonstrates how plastic waste does not simply disappear—it is merely redistributed to regions with fewer environmental protections and weaker regulatory enforcement: a pollution haven.



Ritchie & Roser, 2025. Mismanaged Plastic Waste, 2019

Moreover, the increasing involvement of developed Asian nations, such as Japan, in plastic waste exports to developing Asian nations like Vietnam, introduces a new dimension to this analysis—highlighting how power dynamics within Asia itself may be shaping the global plastic waste economy. More than anything, the data show that the historical model of waste exportation is no longer truly sustainable, and as developing nations tighten restrictions or suffer the consequences of imported waste, the U.S. will need to rethink its approach to plastic waste management.

CHAPTER IV

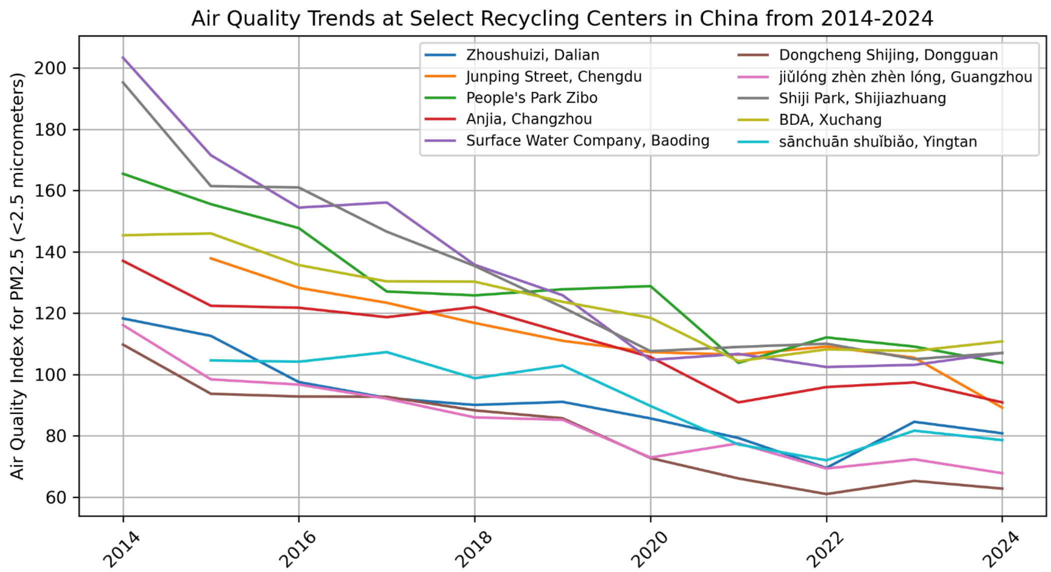
This chapter will answer the second of my two research questions: What were the environmental implications of the 2018 National Sword policy in terms of air quality?

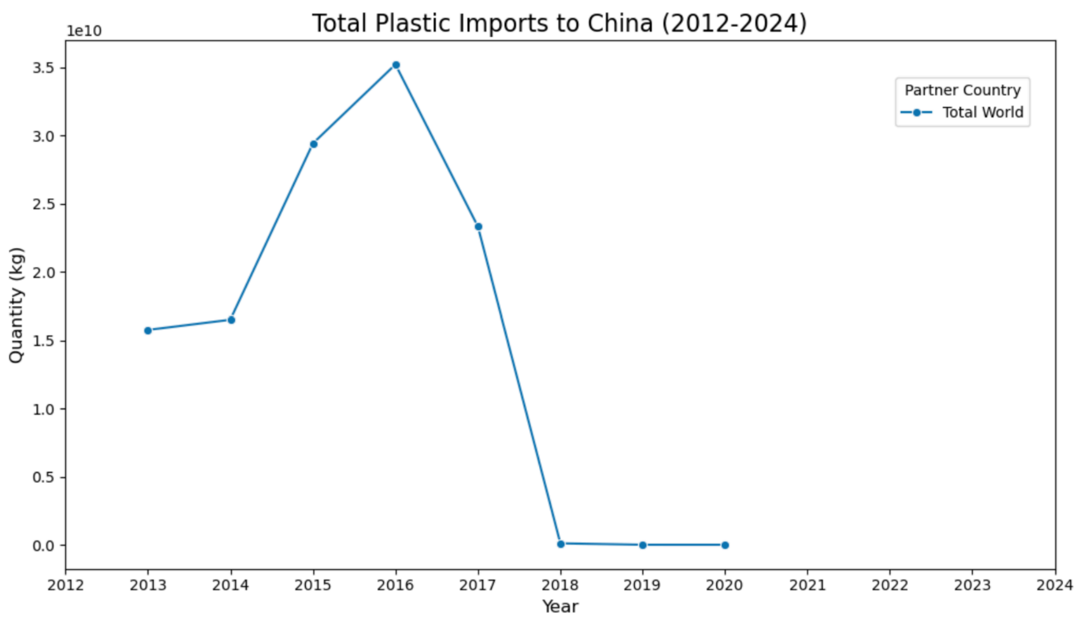
The answer to this question has two dimensions:

I. Dimension I: Air Quality Trends over Time. Over the course of the past decade, how has air quality at these recycling centers changed? What external elements could have shaped these trends, what alternative explanations are there to consider?

II. Dimension II: Importation vs. Air Quality Correlation. Is there any correlation between the air quality trends in China and Malaysia and their importation of plastic waste? What factors are there to consider (pollution delay, external polluters, industrialization) when looking at this correlation? Is this correlation statistically significant ($p < .05$)?

Air Quality in China

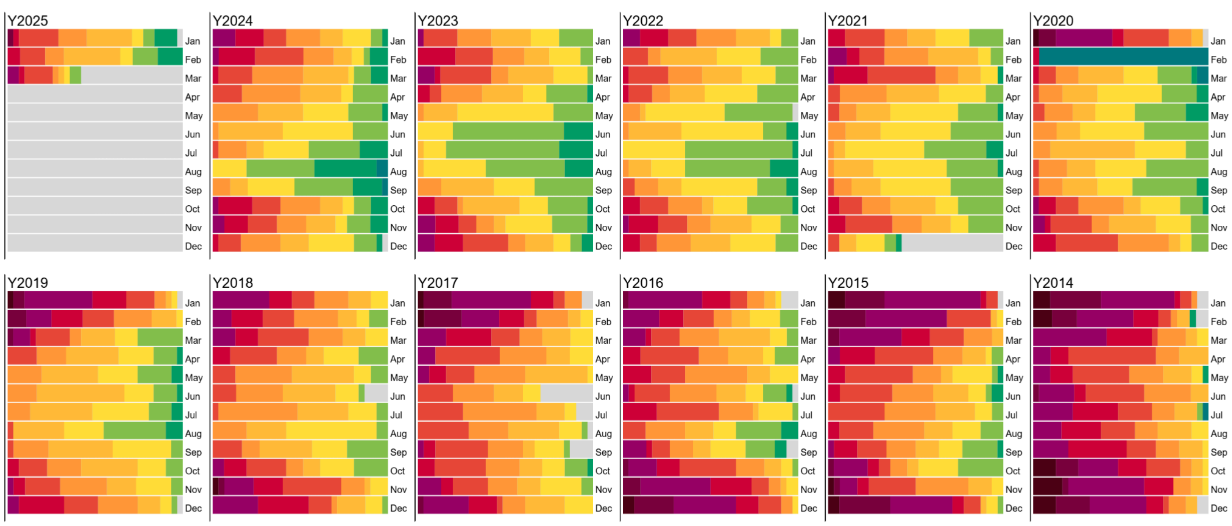




Pearson Correlation (China) = 0.5813, p-value = 0.1711

Dimension I:

Over the past decade, air quality at recycling centers across China has exhibited an overall improving trend. In 2014, the average AQI across locations in China was approximately 137, but by 2024, it had dropped to around 90, reflecting a significant 34% decrease in pollution levels. This suggests that China's aggressive environmental policies, such as Operation Green Fence (2013-2017) and the National Sword Policy (2018)—which restricted the import of contaminated recyclables—actually may have played a role in reducing domestic air pollution related to waste processing. While localized spikes in pollution are still observed, they are more likely tied to industrial production cycles, seasonal pollution patterns (e.g., winter smog), and government interventions.



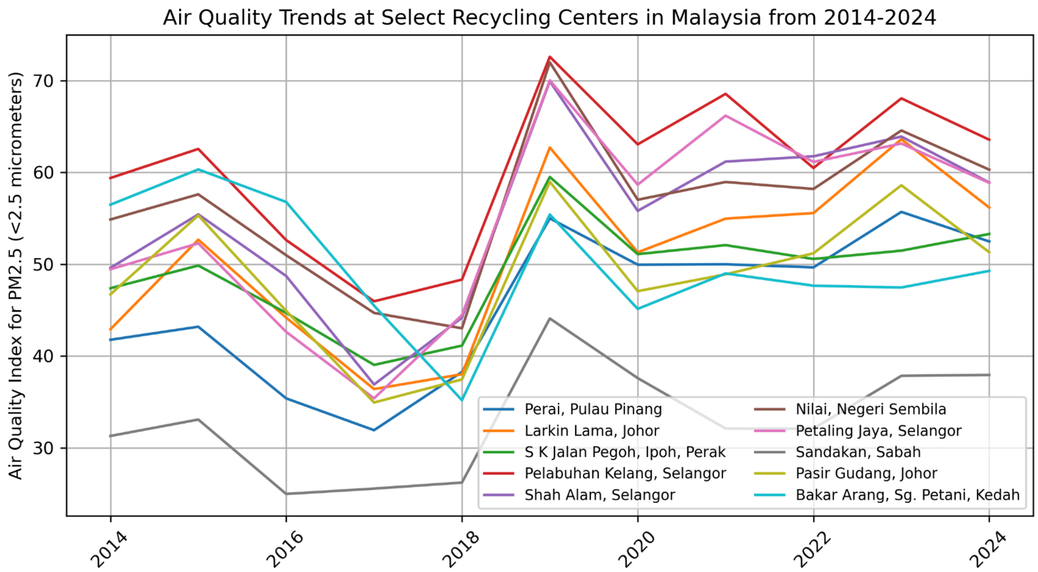
AQI at the Surface water company, Baoding location. While winters remain high points for pollution every year, the extent has lessened over time.

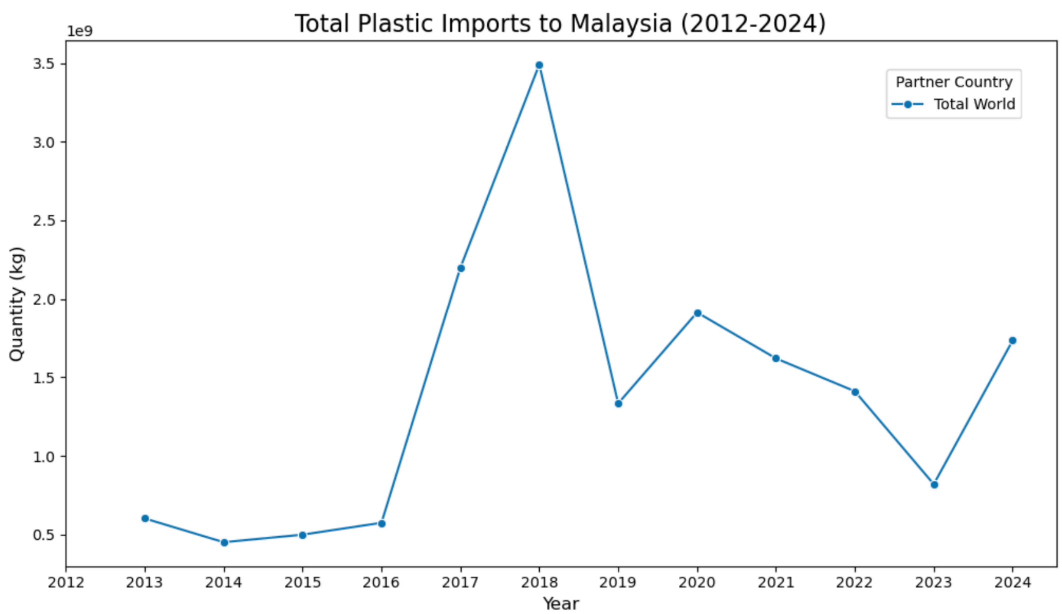
Additionally, while China ceased large-scale plastic waste imports, it has continued to increase its domestic plastic production, meaning any ongoing pollution from waste processing is more likely tied to domestic consumption than foreign imports. There are also concerns regarding the accuracy of reported AQI values in some urban centers, such as Beijing, where reports suggest air quality monitoring devices may have been artificially manipulated, as there is incentive for big cities to manipulate data (such as spraying water on front of AQI monitors) in order to be looked upon favorably by the CCP. However, given that the dataset encompasses multiple geographically distinct locations, this is unlikely that this occurred at every single location, and thus unlikely to significantly skew the overall trends observed in the data.

Dimension II:

The relationship between plastic importation and air quality trends in China presents a more complex picture. There is some evidence that higher imports in earlier years, prior to the 2018 ban, correlated with worse air quality. However, after China banned most plastic imports in 2018, air quality continued to improve, suggesting that the reduction in imported waste processing contributed to this positive trend. The Pearson correlation coefficient for China ($r = 0.5813$, $p = 0.1711$) suggests a moderate relationship between total plastic imports and AQI, but the p-value exceeds 0.05, meaning that the correlation is not statistically significant. This decrease in pollution may not have been caused by the 2018 ban, as it remains consistently improving over time, but the possibility that lowered plastic imports may have also contributed to this trend cannot be ruled out. If anything, China's economic stability and newfound hegemony on the global stage gave it the resources and time that developing nations lack to address its pollution problems.

Air Quality in Malaysia





Pearson Correlation (Malaysia) = -0.4420, p-value = 0.1734

Dimension I:

Over the past decade, air quality at the selected locations in Malaysia has shown a fluctuating but generally worsening trend, with some notable short-term spikes. Between 2014 and 2024, the average AQI across all locations varied significantly, reflecting both local and regional environmental factors. For example, in 2014, the average AQI was approximately 48, whereas by 2019, it had risen to around 63, indicating a 31% increase in air pollution levels. This trend suggests a gradual decline in air quality over time, though recent years have shown some stabilization, with 2024's AQI averaging 58.9, slightly lower than previous peaks. A key external factor to consider affecting Malaysian air quality is the Indonesian wildfires, which have historically led to significant AQI spikes. The data reveals sharp increases in air pollution in September 2015 (69.9 AQI), October 2019 (72.6 AQI), and October 2023 (68.1 AQI), aligning with known wildfire events that produce cross-border haze. In addition, many of these sites are located within Kuala Lumpur, an increasingly industrialized city, which may also contribute to increasing AQI. But, overall, the overarching trend of decreasing air quality cannot be dismissed.

AQI at the Larkin Lama, Johor location. You can see spikes of higher AQI that correlate with nearby Indonesian wildfire dates.

Dimension II:

The spike in importation in 2018 may be correlated with the spike in AQI in 2019, which does make sense. It does take time to go from receiving plastic imports to processing them, and this change in AQI may not have been reflected in 2018, but rather in 2019. This suggests a possible delayed effect, where a rise in imports correlates with worsening air quality in subsequent years. While the correlation coefficient ($r = -0.4420$) suggests a moderate relationship, the p-value (0.1862) is too high to actually confirm a statistically significant link, meaning one cannot definitively attribute air quality changes to plastic imports alone. This could be because of many factors- including increased landfilling of recycled plastic over combustible or melted reuse of recycled plastic, which would increase the quality of air around these sites, but lower the quality of water and land. Thus, while we cannot conclusively attribute this overarching rise in AQI to increased plastic imports, the data does suggest that there could still possibly exist some contributory relationship. However, it does promote the overall story of developing Asian nations industrializing, with air quality falling as manufacturing and industrialization rising.

CHAPTER V

Discussion

The findings presented in this study underscore the significant impact of China's 2018 National Sword policy on global plastic waste flows and air quality trends. The policy not only reshaped international waste trade patterns but also highlighted broader economic and geopolitical shifts in waste management responsibilities. As the United States and other developed nations were forced to find alternative destinations for their plastic waste, countries in Southeast and South Asia experienced temporary surges in plastic imports, followed by a rapid tightening of import regulations in response to rising environmental and public health concerns. This series of cascading policy changes demonstrates a larger global trend—as developing nations increasingly push back against waste imports, developed nations are left to reassess their domestic waste management systems.

The air quality analysis further reinforces the environmental consequences of these shifting waste flows. China's improving air quality trends suggest that limiting plastic waste imports may have had positive environmental effects, though this cannot be definitively confirmed due to the lack of statistical significance in the correlation analysis. Conversely, Malaysia's declining air quality—alongside the influx of plastic waste—suggests that increased plastic processing activity could be a contributing factor, though again, the statistical relationship remains inconclusive. The broader picture reflects an ongoing tension between industrial growth and environmental sustainability, particularly in developing nations tasked with managing the world's plastic waste.

Current Limitations and Future Research

Given the resources and time available to this research paper, there were limits to what this thesis could cover. This tighter scope had two main limitations: the choice of dependent and independent variables and the size of the data that was able to be sampled.

The choice of recycling centers in China and Malaysia and air quality stations as my independent and dependent variables were driven by restrictions of both data available and the time I had. Due to the lack of data available, I could not track plastic as they were landfilled or incinerated, and the lack of this data forced me to choose recycling centers as my measurement of whether or not the increase or decrease of plastic imports impacted air quality. This contains two weak links– the link between the change of plastic import levels and recycling centers, and the link between recycling centers and air quality. The first weak link makes the assumption that changes in plastic level imports will directly change the level of plastic processed in recycling centers. Some of these recycling centers could be processing domestic plastic only, and remain unaffected by levels of plastic imports. Some of these recycling centers could have varying sources of plastic, and thus would be impacted to a lesser or greater degree by plastic imports. Without tedious manual review, there is almost no way to truly know. The second weak link makes the assumption that these air quality stations could accurately measure the air pollution emitted from the selected recycling station. In addition to the air pollution from recycling centers, these stations are susceptible to air pollution from other nearby sources, such as cars and factories, which are likely to be abundant in the same areas as recycling centers. This was somewhat mitigated by having the air quality stations situated as close as possible to the recycling centers, optimally on the same street or less than a few kilometers away. But, the true impact of outside pollutants cannot accurately be measured.

In addition, the size of the data sampled- 10 Chinese recycling centers and 10 Malaysian recycling centers- was limited because of how time-intensive the sampling process was. Each plant had to be vetted for public information like size, years of operation, and address, and then cross-referenced with its closest air quality stations, which also had to be vetted for location and length of time of operation. There were more Chinese and Malaysian recycling plants to use the air quality data of, but of which there was not enough time to sample more due to how long and intensive the manual selection process was. Not only could the number of recycling plants be increased, but the scope of the country could also be widened to accommodate more research on plastic waste trends outside of China and Malaysia. Additional countries, such as Vietnam, India, and Indonesia, could have also been analyzed to see those respective countries' air quality impacts.

These limitations could be addressed in future research to give us a more robust understanding of the true impact of China's National Sword. Future research that incorporates a broader and more representative dataset, alongside more precise tracking of plastic waste flows and pollution sources, would significantly deepen our understanding of how international plastic trade policies like China's National Sword impact the environment. Integrating satellite-based air quality measurements, landfill and incineration data, and industrial emissions registries could help isolate the specific contributions of plastic processing facilities to local air pollution. Additionally, machine learning tools could aid in automating the pairing of recycling centers and air quality stations, reducing the labor-intensive nature of the current methodology. By expanding the temporal and geographic scope of the dataset and refining the measurement tools, future studies can build on this work to more accurately quantify the environmental externalities of global plastic waste trade and inform more sustainable international waste policies.

Conclusion

The modern world is drowning in plastic, and for decades, wealthier nations have treated developing countries as the dumping grounds for their waste, outsourcing the environmental consequences to those with the least capacity to handle them. The 2018 National Sword policy was a wake-up call, a moment of reckoning that forced global powers to confront their reliance on a broken system. But instead of fostering meaningful reform, the immediate response was a frantic redirection—plastic waste that once flowed to China was simply rerouted to other nations, continuing the cycle of exploitation and environmental harm. The burden was merely shifted, not alleviated, and the consequences are now being felt in the air, water and lives of millions across the globe. However, this study shows signs that this crisis has catalyzed a shift in global waste management. While China's air quality improved in the wake of the import ban, Malaysia's worsening air pollution and the rise of illegal dumpsites in regions illustrate the unintended environmental consequences of rerouting waste to less-prepared nations. The fight for sustainable waste management is far from over. The solution will not be found in another policy loophole or another shift in trade patterns—it lies in fundamentally rethinking plastic production, improving recycling infrastructure, and holding corporations and governments accountable. The choices we make now will determine whether we continue this destructive cycle or finally begin to take responsibility for the plastic we create.

> *"There is no such thing as 'away'. When we throw anything away, it must go somewhere."*
>
> *–Annie Leonard, executive director of Greenpeace USA*

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APPENDIX

Chinese Recycling Plants Air Quality Data

Company Name	Area	Materials Accepted	Recycled Products	Closest Air Quality Station	Air Quality Data over Time
Baoding Kairui Plastic Products Manufacturing Co., Ltd.	Hebei	ABS, PP, PS	Granules/Pellets	Surface Water Company, Baoding	2014-2018: 164.2427973 2019-2024: 108.3338952
BioPack Co., Limited	Guangdong	PLA	Granules/Pellets	新会银湖	N/A: Not enough data
Changge Jurong Plastic Industry	Henan	ABS, HIPS, PP	Granules/Pellets	N/A: No nearby stations	N/A
Changzhou Jinyong Technology Materials Co., Ltd.	Jiangsu	HDPE, LDPE, LLDPE, MDPE, PP	Granules/Pellets	Ānjiā, Changzhou	2014-2018: 124.4005736 2019-2024: 99.09790751
Chongqing Shunmao Renewable Resources Co., Ltd	Chongqing	ABS, PE, PP, PS	Granules/Pellets, Flakes	N/A: No nearby stations	N/A
Dalian Babobee Recycling Resources Reusage Co., Ltd.	Liaoning	HDPE, LDPE, PA, PE	Granules/Pellets	Zhoushuizi, Dalian	2014-2018: 102.1709741 2019-2024: 81.8322317
Dongguan Effort New Material Technology Co., Ltd.	Guangdong	PVC	Granules/Pellets	东莞松山	N/A: Not enough data
Dongguan Guoheng Plastic Technology Co., Ltd.	Guangdong	ABS, HIPS, PC, PP	Granules/Pellets	Dongcheng Shijing, Dongguan	2014-2018: 95.47307143 2019-2024: 68.94870984
Dongguan Huazuan Plastic Material Co., Ltd	Guangdong	ABS, HDPE, HIPS, LDPE, PP	Granules/Pellets	N/A: No nearby stations	N/A

GRM Green Recycled and Modified Polymer Co. Ltd.	Shanghai	ABS, GPPS, HIPS, PE, PET, PP, PS	Granules/Pellets	N/A: No nearby stations	N/A
Guangdong Intop Industrial Holding Ltd.	Guangdong	HDPE, PET	Granules/Pellets, Flakes	生态园	N/A: Not enough data
Guangzhou Donoyo Chemical Co., Ltd	Guangdong	ABS, PC, PC/ABS, PE, PP	Granules/Pellets	天河奥体	N/A: Not enough data
Guangzhou Tonghe Plastic Products Co., Ltd.	Guangdong	HDPE, PET	Granules/Pellets, Flakes	jiǔlóng zhèn zhèn lóng, Guangzhou	2014-2018: 97.88504596 2019-2024: 74.20152896
Hebei Changsheng Plastic Industry Co., Ltd.	Hebei	EVA, HDPE, LDPE, LLDPE, PET, PP, PS, PVC	Granules/Pellets	Shiji Park, Shijiazhuang	2014-2018: 159.9449816 2019-2024: 110.1141832
Henan Pingyuan New Material Technology Co., Ltd.	Henan	ABS	Granules/Pellets	BDA, Xuchang	2014-2018: 137.5631221 2019-2024: 112.2105009
Incom Resources Recovery (Tian Jin) Co., Ltd.	Tianjin	PET	Granules/Pellets, Flakes	Jianshe Road, Tianjin	N/A: Not enough data
Jiangxi Royal One Renewable Resources Co., Ltd.	Jiangxi	PET	Flakes	sānchuān shuǐbiǎo, Yingtan	2014-2018: 103.7174664 2019-2024: 83.6940964
Jieshou Dongwei Plastic Industry Co., Ltd.	Anhui	HDPE, LDPE, PP	Granules/Pellets		

Julier (Xiamen) Technology Co. Ltd.	Fujian	ABS, EVA, PA, PBT, PC, PC/ABS, PEEK, PEI, PLA, POM, PP, PPO, PPS, PVC, TPE, TPU, TPV	Granules/Pellets		
Kunshan Yuanda Scrap Metal Processing Co., Ltd.	Jiangsu	Waste Plastic	Granules/Pellets		
MCB Technology Co., Ltd.	Guangdong	HDPE	Granules/Pellets		
Nanchang Yuxiang Zaisheng Ziyuan Co., Ltd.	Jiangxi	ABS, PA, PC, PE, PP, PS, PVC	Granules/Pellets		
Nantong Guorui Renewable Materials Co., Ltd.	Jiangsu	ABS, PA, PC	Granules/Pellets		
Ningbo Tailite Chemical & Plastic Co., Ltd.	Zhejiang	HDPE, LDPE, PP	Granules/Pellets		
Shandong Power Plastic Co.,Ltd	Shandong	PP, PE, HDPE, LDPE, LLDPE	Granules/Pellets		
Shandong Yingke Environmental Renewable Resources Co., Ltd.	Shandong	PET, PS	Granules/Pellets	People's Park, Zibo	2014-2018: 144.3419637 2019-2024: 114.2373953
Shanghai Jianqiao Plastic Co., Ltd.	Shanghai	PA, PBT, PC/ABS, PC/PBT, POM, PP	Granules/Pellets		
Shanghai Lucheng Environmental Protection Technology Co., Ltd.	Shanghai	Waste Plastic	Granules/Pellets		

Shanghai Tianqiang Environmental Protection Technology Co., Ltd.	Shanghai	HDPE, PA, PP	Granules/Pellets		
Shaoxing Taiyo Plastic Co., Ltd.	Zhejiang	PET	Granules/Pellets		
Shenzhen Senlantuo Technology Co., Ltd.	Guangdong	PP	Granules/Pellets		
Shenzhen xinchanglong New Material Research Institute Co., Ltd	Guangdong	HDPE	Granules/Pellets		
Shenzhen Zhongheng Xinjian Plastic Pigment Co., Ltd.	Guangdong	ABS, PP	Granules/Pellets		
Sichuan Tiancheng Recycled Plastic Particles Co., Ltd.	Sichuan	ABS, PP	Granules/Pellets	Junping Street, Chengdu	2015-2018: 126.5926285 2019-2024: 104.762227
Suzhou Huashida Engineering Plastic Co., Ltd.	Jiangsu	ABS, ASA, PA, PBT, PC, PC/ABS, PC/PBT, PP, PPS	Granules/Pellets		
Suzhou Jiulong Recy-Tech Co., Ltd.	Jiangsu	HDPE, PET, PP	Granules/Pellets, Flakes		
Wankai New Material Co., Ltd.	Zhejiang	PET	Flakes		
Xiamen Keyuan Plastic Co., Ltd.	Fujian	ABS, PA, PBT, PC, PC/ABS, PEEK, PEI, PETG, PLA, PMMA, PP, PPS, TPE	Granules/Pellets		

Xiamen LFT composite plastic Co.,Ltd	Fujian	ABS, HDPE, PA, PBT, PEEK, PP, PPS, TPU	Granules/Pellets		
Yancheng Beidi Plastic Industry Co., Ltd.	Jiangsu	LDPE, PE	Granules/Pellets		
Yizheng Zhongxing Environmental Protection Technology Co., Ltd.	Henan	PET	Flakes		
Zaige Group	Hebei	Waste Plastic	Granules/Pellets		
Zhejiang Haili Environmental Technology Co., Ltd.	Zhejiang	PET	Granules/Pellets, Flakes		
Zibo Chenze Machinery Co., Ltd	Shandong	EPDM, HDPE, MDPE, PC/PBT, PETG, PLA, POM, PP, PVDF, TPU, Waste Plastic	Granules/Pellets		
Zibo Chiding Petrochemical Co., Ltd.	Shandong	PE, PET, PP, PS, PVC	Granules/Pellets		

Malaysia Recycling Plants Air Quality Data

Company Name	Materials Accepted	Recycled Products	Closest Air Quality Station	Air Quality Data over Time
Asasrama Sdn. Bhd.	HDPE, LDPE, PET, PP	Granules/Pellets, Flakes	Shah Alam, Selangor	2014-2018: 46.97116172 2019-2024: 61.92387601
Aspen Recycle Sdn. Bhd.	Waste Plastic	Granules/Pellets	Pelabuhan Kelang, Selangor	2014-2018: 53.78149695 2019-2024: 66.06562515
Aun Lian Plastic Resources Sdn Bhd	ABS, HDPE, HIPS, PP	Granules/Pellets, Flakes	Perai, Pulau Pinang	2014-2018: 38.11118 2019-2024: 52.13817
Chi Yang Global Recycle	ABS, HDPE, LDPE, PE, PP	Granules/Pellets	Pelabuhan Kelang, Selangor	2014-2018: 53.78149695 2019-2024: 66.06562515
CITC Compound Sdn. Bhd.	ABS, HIPS, PC, PC/ABS, PPS	Granules/Pellets	Putrajaya, W.p. Putrajaya	N/A: Not enough data
CKY Recycle Plastic Sdn Bhd	HDPE, PP	Granules/Pellets	Nilai, Negeri Sembilan	2014-2018: 42.84105712 2019-2024: 57.39856422
CY Intertrade Sdn. Bhd.	HDPE, LDPE, LLDPE, PP	Granules/Pellets	Shah Alam, Selangor	2014-2018: 46.97116172 2019-2024: 61.92387601
CY Plastic Recycling Sdn Bhd	LDPE, LLDPE	Granules/Pellets	Petaling Jaya, Selangor	2014-2018: 44.84975707 2019-2024: 63.01532945

Dacing Trading Sdn Bhd	Waste Plastic	Granules/Pellets	Shah Alam, Selangor	2014-2018: 46.97116172 2019-2024: 61.92387601
Danex Plast Sdn Bhd.	LDPE	Granules/Pellets	N/A: No nearby stations	
Dialog Diyou PCR Sdn. Bhd.	PET	Granules/Pellets	Nilai, Negeri Sembilan	2014-2018: 42.84105712 2019-2024: 57.39856422
Diyou Fibre (M) Sdn Bhd	ABS, HDPE, HIPS, LDPE, PE, PET, PP	Granules/Pellets, Flakes	Nilai, Negeri Sembilan	2014-2018: 42.84105712 2019-2024: 57.39856422
Dragon Alliance Sdn. Bhd	Waste Plastic	Granules/Pellets	N/A: No nearby stations	
EPD Plastic Industries Sdn Bhd.	HDPE, LDPE, LLDPE, PE, PP	Granules/Pellets	Petaling Jaya, Selangor	2014-2018: 44.84975707 2019-2024: 63.01532945
Fizlestari Plastic Sdn Bhd	HDPE	Granules/Pellets, Flakes	Nilai, Negeri Sembilan	2014-2018: 50.24500923 2019-2024: 61.85053176
Galaxy Polymers Sdn Bhd	HDPE, LDPE, LLDPE, PP, PVC	Granules/Pellets	Shah Alam, Selangor	2014-2018: 46.97116172 2019-2024: 61.92387601
GC Plastic Industry Sdn Bhd	ABS, HIPS, PP	Granules/Pellets	Kulim Hi-Tech, Kedah	N/A: Not enough data
Global Xess Int	ABS, EPS, EVA, GPPS, HDPE, LDPE, PC, PET, PMMA, PP,	Granules/Pellets, Flakes	Sandakan, Sabah	2014-2018: 28.22693993 2019-2024: 36.948608

	PVC, SAN, TPE			
Glowmore Express Sdn. Bhd	PET	Granules/Pellets, Flakes	Pelabuhan Kelang, Selangor	2014-2018: 53.78149695 2019-2024: 66.06562515
Gold Mine Polymer (M) Sdn. Bhd.	Waste Plastic	Granules/Pellets	Pasir Gudang, Johor	2014-2018: 43.87448067 2019-2024: 52.68080218
HC Plastic Sdn. Bhd.	PE	Granules/Pellets	Nilai, Negeri Sembilan	2014-2018: 42.84105712 2019-2024: 57.39856422
Heng Hiap Industries Sdn Bhd	PE, PET, PP	Granules/Pellets	Pasir Gudang, Johor	2014-2018: 43.87448067 2019-2024: 52.68080218
Hiroyuki Industries (M) Sdn Bhd	PET	Granules/Pellets, Flakes	Larkin Lama, Johor	2014-2018: 42.84106 2019-2024: 57.39856
HKS Century Sdn Bhd	ABS, LDPE, LLDPE, PA, PBT, PC, POM, PS	Granules/Pellets	Pelabuhan Kelang, Selangor	2014-2018: 53.78149695 2019-2024: 66.06562515
Hong Loang Plastic Sdn Bhd	HDPE, LDPE, LLDPE, PP	Granules/Pellets	Bakar Arang, Sg. Petani, Kedah	2014-2018: 50.86178549 2019-2024: 48.99845895
Ipoh S.Y. Recycle Plastic Sdn. Bhd.	HDPE, HIPS, LDPE, PA, PC, PP, PS, PVC	Granules/Pellets, Flakes		
JPT Plastic Sdn. Bhd.	HDPE, PP	Granules/Pellets		

JS Poly Industry Sdn Bhd	HDPE, LDPE, LLDPE	Granules/Pellets		
Kanma Plastic Material Sdn. Bhd.	HDPE, LDPE, PP	Granules/Pellets		
Karich Sdn Bhd	ABS, HIPS, PC, PE, PP	Granules/Pellets, Flakes		
Kraiburg TPE Technology (M) Sdn Bhd	TPE	Granules/Pellets		
Lim Seng Plastic Sdn Bhd.	ABS, HIPS, PA, PE, PET, POM, PP, PS, PVC, SAN	Granules/Pellets	S K Jalan Pegoh, Ipoh, Perak	2014-2018: 44.42735419 2019-2024: 53.01238042
LSM Industrial (M) Sdn. Bhd.	ABS, HDPE, PP, PS	Granules/Pellets		
Megatrax Plastic Industries Sdn. Bhd.	HDPE, LDPE, PE, PET, PP	Granules/Pellets, Flakes		
MEP Enviro Technology Sdn Bhd	Waste Plastic	Granules/Pellets		
MIS Plastic Sdn. Bhd.	HDPE, LDPE, LLDPE	Granules/Pellets		
Moldex Plastic Recycling Sdn Bhd.	Waste Plastic	Granules/Pellets		
MRT Industries Sdn. Bhd.	HDPE, HIPS, PP	Granules/Pellets		
NS Plastic & Metal Trading Sdn. Bhd.	LDPE	Granules/Pellets		
OCK Recycle Sdn Bhd	Waste Plastic	Granules/Pellets		
Perusahaan Chew Hur Sdn. Bhd.	HDPE, LDPE, PP, PPCP	Granules/Pellets		

Plascycle Resources Sdn. Bhd.	ABS, PES, PP, PPO, PS	Granules/Pellets, Flakes		
Plasticycle Industries Sdn Bhd	HDPE, LDPE	Granules/Pellets		
Plastik V Sdn. Bhd.	LDPE	Granules/Pellets		
PW Jit Seng Plastic Material Sdn Bhd	ABS, HIPS, LCP, PA, POM, PP, PPO	Granules/Pellets		
RS Poly Industry Sdn Bhd	HDPE, LDPE, LLDPE, PET, PP	Granules/Pellets	Pelabuhan Kelang, Selangor	2014-2018: 53.78149695 2019-2024: 66.06562515
Seri Aman Manufacturing Sdn Bhd	ABS, HIPS, LDPE, LLDPE, PP	Granules/Pellets		
SG Green Resources Sdn. Bhd.	ABS, HDPE, LDPE, PE, PP	Granules/Pellets		
Sheng Foong Plastic Industries Sdn. Bhd.	ABS, HDPE, HIPS, LDPE, PA, PP	Granules/Pellets		
Shye Guan Plastic Industries Sdn. Bhd.	ABS, ASA, PA, PC, PE, PET, PMMA, PPO, PVC	Granules/Pellets, Flakes		
Spot Trend Sdn. Bhd.	ABS, HDPE, LDPE, PE, PP	Granules/Pellets		
Sunnyjaya Plastic Industries Sdn. Bhd.	ABS, HDPE, HIPS, LDPE, LLDPE, PMMA, PP	Granules/Pellets		
Tai Hong Plastic Industries Sdn. Bhd.	ABS, HIPS, PC, PC/ABS, PP	Granules/Pellets, Flakes		

Tian Li Eco Group Holdings Sdn. Bhd.	HDPE, PET	Granules/Pellets, Flakes		
Topflight Plastics Sdn Bhd	HDPE, LDPE, PET, PP, PVC	Granules/Pellets, Flakes		
Tritex Polymer Sdn Bhd	ABS, HDPE, HIPS, LDPE, LLDPE, PC, PET, PP, PVC	Granules/Pellets, Flakes		
UDA Materials Sdn. Bhd.	ABS, HDPE, HIPS, PA, PC, PET, PMMA, PP, TPU	Granules/Pellets		
Wespack Waste Management Sdn Bhd	ABS, HDPE, HIPS, LDPE, LLDPE, PC, PET, PP	Granules/Pellets, Flakes		
Wit Polymer Sdn. Bhd.	ABS, HDPE, LDPE, PC, PP, PVC	Granules/Pellets		
Zinco Colours Compounding Sdn. Bhd.	ABS, GPPS, HDPE, HIPS, LDPE, PA, PBT, PC, PMMA, PP, SAN	Granules/Pellets		