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Wealth from Waste? Chinese Investments and Technology Transfer in the Tanzanian Plastic Recycling Industry

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ABSTRACT

**SAIS-CARI WORKING PAPER
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“Wealth from Waste?
Chinese Investments and
Technology Transfer in the
Tanzanian Plastic Recycling
Industry”

by Ying Xia

IN THIS PAPER, I EXAMINE THE PLASTIC INDUSTRY’S current state of development in Tanzania and the linkages it has created with the local economy. Most Chinese plastic investments are concentrated in lower-end recycling and manufacturing activities, which is likely why they appear to have developed stronger local linkages than other plastic firms. Chinese investors in the plastic industry mainly rely on locally recycled waste plastics as raw materials, and therefore have stimulated local supply and growth of plastic recycling activities. By providing suppliers with technological and financial support, transmitting information about opportunities to participate in global value chains, Chinese investors also facilitate knowledge transfer with local suppliers. More recently, the Chinese government has introduced a ban on the import of unprocessed plastic materials, which has increased the uncertainty and risks for plastic recyclers that depend on Chinese manufacturers as their buyers. In response to the Chinese ban, Chinese plastic recyclers in Tanzania have resorted to different adaptation strategies. The effects of these changes are multi-dimensional. On the one hand, environmental policy change in China may stimulate more investments in the plastic recycling and manufacturing industries in Tanzania, which would contribute to fostering greater linkages between the local industry and the global plastic recycling value chain. On the other hand, there are concerns that such an investment, without effective environmental enforcement by host country governments, would generate environmental and health hazards for the local community.

INTRODUCTION

SINCE THE EARLY 1990s, CHINA HAS PLAYED A CENTRAL ROLE in the global plastic recycling industry. Every year, over seven million tons of plastic waste from developed and developing countries are shipped to China and reprocessed into filling and packaging materials such as polyester fiber and flexible plastic films, and housewares such as containers and furniture, which are again exported to different parts of the globe.¹ In 2016, China imported seven million tons of waste plastics and twenty-eight million tons of waste paper, ultimately receiving more than half of the world's exports of waste plastics and waste paper that year.² In mid-2017, China announced that it was going to ban the import of twenty-four types of solid waste, including unprocessed plastic waste, in order to protect the environment and human health in China. Although the ban did not go into effect until January 2018, China was said to have stopped issuing or renewing licenses for solid waste imports since the policy was announced in July 2017.³ Researchers estimate that the Chinese ban will displace 111 million tons of plastic waste around the world by 2030.⁴

The plastic industry in Tanzania can be traced back to the 1960s and 1970s, with a few stated-owned and private companies producing plastic footwear and packaging materials. However, plastic recycling did not really exist in the country until much later on. The recycling business was started by Indo-Tanzanian investors in the 1990s. An industry now dominated by Chinese investments, Tanzania has also surpassed all other African countries in waste or scrap plastic material exports to China.⁵ About sixty Chinese factories are engaging in plastic recycling, granulation, and the manufacturing of a variety of plastic products in Tanzania. In addition, a substantial part of the recyclables, *i.e.*, scrap plastic flakes from bottles made of polyethylene terephthalate (PET), are exported to China for further processing. Compared to large-scale, non-Chinese plastic manufacturers, Chinese plastic factories have created stronger backward linkages with the local recycling industry through supply, sub-contractor, and machinery cooperation networks. Quite a few local waste transfer stations have obtained technical and financial support to engage in preliminary processing activities and some of them have set up manufacturing plants of their own. The Chinese foreign waste ban has had a transformative impact on the plastic recycling industry in Tanzania. Despite the short-term disruption in the local market, it is likely that the Chinese ban will incentivize many plastic recyclers to upgrade and expand their manufacturing activities in Tanzania, which would create more opportunities for technology transfer and employment. On the other hand, however, the recycling industry's expansion could also lead to environmental degradation in the host country if environmental laws and regulations in Tanzania are not effectively implemented.

BACKGROUND

FOREIGN MANUFACTURING INVESTMENTS AND INDUSTRIALIZATION

LOOKING AT THE DEVELOPMENT TRAJECTORIES of the United Kingdom, the US, Japan, and more recently, China, many believed that industrialization was the recipe

for economic transformation in Africa, as it would provide solutions to multiple issues, such as unemployment, poverty, and the knowledge gap between Africa and the rest of the world.⁶ Industrialization, however, requires accumulation of financial investment and human capital, both of which are insufficient in African countries. Therefore, questions of whether and how foreign investments can drive the “big push” for industrialization in Africa have stimulated fierce debates among policy-makers and scholars. For example, Dambisa Moyo, a Zambian-born Harvard and Oxford-trained economist, has advocated for more foreign investment, which has the advantage of job creation and knowledge transfer, rather than giving aid to African countries.⁷ In the meantime, however, empirical evidence seems to suggest that foreign investment has not had a significant impact on the industrialization of many African countries, either because multinational investors were attracted to natural resources industries rather than manufacturing industries, or because African host governments have failed to introduce or implement policies and regulations that induce linkages between foreign investment and the local economy.⁸ Regardless, manufacturing investments in Africa have historically been very uneven, with almost seventy percent of Africa’s manufacturing activities concentrated in South Africa, Egypt, Nigeria, and Morocco as of 2016.⁹ Moreover, due to the financial crisis manufacturing investments in sub-Saharan Africa have stagnated or shrunk since the late 2000s, with only a few exceptions such as Ethiopia and Rwanda.¹⁰

While investment from traditional investors such as the US, UK, and Japan has been decreasing in the post-crisis era, investment from the South - as represented by China and India - in African countries, has kept growing. Combined, China and India account for 20 to 25 percent of manufacturing foreign direct investments (FDI) in Africa between 2003 and 2014.¹¹ There has been insufficient research into South-South FDI flows and their effectiveness creating local linkages and strengthening local learning in African markets, although there has been more scholarship in recent years. For example, Amighini and Sanfilippo argued that thanks to a smaller technology gap between the foreign investor and local industry, Southern FDI is more likely to trigger knowledge spillovers than Northern FDIs in low-tech and less diversified manufacturing sectors like agro-processing.¹² Similarly, Gelb suggested that investment from the South employs business models that are “less corporatized and more informal,” and therefore more appropriate to the host country context in Africa.¹³ With one of the few exceptions being Brautigam, Weis, and Tang’s investigation into Chinese linkages in Ethiopia’s leather industry, in which they explored how the Ethiopian government has cultivated a thriving leather industry by attracting leading Chinese investments and building capacity in the local supply chain, insufficient study has focused on the impact of “South-South investment” in a specific industry.¹⁴ By analyzing how Chinese investors have set up and operated the plastic recycling sector in Tanzania, this paper adds empirical evidence to understand how Chinese investment has created backward and forward linkages with the local economy, and to what extent the national and international regulatory environment has an impact on Tanzania’s role in the global plastic recycling value chain.

RESEARCH METHODOLOGY

PLASTIC AND RUBBER ARE CONSIDERED ONE OF THE MOST dynamic and fast growing manufacturing sub-sectors in Tanzania, in terms of output, export, and product diversity.¹⁵ A 2013 survey on industrial production conducted by the Tanzania Bureau of Statistics (TBS) found that there were sixty-five companies in the plastic and rubber sector, making it the second largest exporting sub-sector, accounting for 14.5 percent of Tanzania's total exports.¹⁶ The sector employed 4,342 workers as of 2013, 4,104 being Tanzanian employees and 238 non-Tanzanians.¹⁷ The entire sector depends primarily on imported raw materials, like virgin plastic pellets made from petroleum. In terms of value, these plastic pellets accounted for 91.8 percent of all raw materials used in production.¹⁸

There is limited information available in public sources about the plastic recycling and manufacturing industries in Tanzania, and what information is found makes little mention of the growing number of Chinese investments.¹⁹ A possible reason for this is that Chinese investments in the plastic industry are smaller and more recent, which can explain why they were not included in previous industry surveys. Moreover, Chinese companies are often reluctant to participate in industrial associations or other forms of collective actions, in part because of language barriers, which makes them less visible to authorities and the public. The Tanzania Confederation of Industries (CTI), the largest non-governmental industrial association in Tanzania, currently has forty-one members in the plastic and rubber sector, of which only four are Chinese. Yet, during our July 2017 scoping study of Chinese manufacturing projects in Tanzania, we identified a growing number of Chinese investments in plastic bags and slipper production. In January 2018, we decided to come back to Tanzania and study this plastic cluster more closely. Starting with existing contacts with Chinese plastic manufacturers, we were connected to local suppliers and Chinese investors' business partners. We also reached out to local government authorities and industrial associations, in particular, Tanzania Investment Center (TIC) and CTI, which confirmed that a majority of large, longstanding plastic manufacturers in Tanzania are foreign investments - mostly Indian, Pakistani and Turkish - rather than local, and that small-to-medium sized producers are predominantly Chinese. But neither was able to produce a full list of plastic firms. We also checked the business directory in the local yellow pages and advertisements in local newspapers to make "cold calls". Unsurprisingly, very few companies were willing to take interviews.

In total, we interviewed thirty-one companies, fifteen Chinese, ten Tanzanian, and six other foreign investments. It is estimated that there are fifty to sixty Chinese plastic manufacturers operating in Tanzania, which are dispersed into plastic recycling, granulation, and manufacturing of packaging materials, plastic footwear, and household products such as plastic buckets and pipes. Two Tanzanian plastic factories interviewed, Omar Packaging and Muzah Wilmar, are longstanding establishments in the industry. Each employs several hundreds of workers, produces plastic packaging and containers mainly for the use of their own products such as drinking water and detergent, and have no direct linkages with Chinese investors because of market segmentation. Other Tanzanian business owners interviewed were either acting as

Table 1: Interviewed Chinese Plastic Manufacturers in Tanzania

Manufacturer	Owner's Origin	Year Established	Number of Employees	Investment Value (US\$ millions)	Products
Amani Plastic	Zhejiang	2015	115	0.5	Plastic woven sacks
Changyou Plastic	Fujian	2013	80	0.6	PET flakes and plastic shopping bags
Changzhou PP	Jiangsu	2007	300	1	PET flakes and granules
Chengxin Plastic	Fujian	2013	150	1	PET flakes and granules
F&S Manufacturers	Zhejiang	2017	150	1	Plastic slippers
GZ International	Zhejiang	2017	120	1.5	Plastic woven sacks
Jiafeng Plastic	Zhejiang	2009	100	0.8	PET flakes and granules
Lilai Investment	Liaoning	2004	800	5	Plastic slippers and woven sacks
Liu Plastic	Unknown	2014	100	-	Plastic flakes and granules
Oceankiss	Hebei	2015	50	2	Foam mattresses
Samaki Plastic	Jiangsu	2012	120	1	Plastic woven sacks
Tropical Plastic	Hebei	2007	120	1.5	Plastic woven sacks
Wang Investment	Zhejiang	2014	65	0.7	Plastic shopping bags
Wenxing Plastic	Fujian	2011	200	2	Plastic woven sacks; plastic shopping bags; plastic pipes
WLG Plastic	Zhejiang	2010	100	1	PET flakes
Xue Plastic	Zhejiang	2014	100	0.9	PET flakes and granules
Xu Manufacturers	Unknown	2015	30	-	Plastic containers
Zhongfu International	Fujian	2009	500	10	Plastic slippers

suppliers by running small plastic recycling plants, sub-contractors for Chinese plastic factories, or had upgraded to making plastic products to supply the local market. All major production factories are located inside or at the outskirts of Dar es Salaam, and

SUB-SECTORAL INVESTMENT DISTRIBUTION

local recycling plants are scattered in remote areas including Zanzibar, Shinyanga, Moshi, and Tanga, *etc.*

COMPARED TO OTHER FOREIGN INVESTMENTS IN TANZANIA, which have been operating for thirty years or longer, the majority of Chinese investors in the plastic industry arrived around 2010. Unlike these longstanding foreign companies, which almost exclusively use imported virgin plastic granules to produce industrial and household plastic products, many Chinese companies have targeted low-end markets by investing in the recycling and reprocessing of waste plastics. There are twenty-five to thirty Chinese factories producing plastic woven sacks and shopping bags using locally recycled materials, and another five plants concentrated in granulation. There used to be more than fifteen Chinese investors focusing on recycling polyethylene terephthalate (PET) bottles and exporting plastic flakes to China, but they were the most affected by China's foreign waste ban. About ten Chinese companies are engaged in the manufacturing of plastic slippers, targeting local and regional markets. They mainly use imported raw materials and occasionally use their production waste or waste from other Tanzanian plastic factories. Chinese investors producing plastic packaging and plastic slippers have reported more competition from other foreign investments - most are Indian investors - than those in PET recycling, but in general, other foreign invested facilities are larger than Chinese facilities, and aimed at high-end buyers. For example, in plastic packaging, Indian investments produce food packaging for reputable brands and supermarkets, whereas Chinese investors produce shopping bags for small retailers and hardware stores. So far, very few Chinese investors have been found in the manufacturing of industrial or household products such as pipes and containers, but it is likely that more Chinese investors in the PET recycling sub-sector will be motivated to invest in granulation or in manufacturing plastic products. A sub-sector distribution of Chinese plastic investments is provided in Table 2.

PET RECYCLING

CHINESE INVESTORS RECYCLE AND REPROCESS THREE TYPES of plastic materials: polyethylene terephthalate (PET), polypropylene (PP), and polythene (PE). Before China's "foreign waste" ban, PET materials, that can be used to produce polyester fiber, were shredded, made into plastic flakes, and exported to China. PP and PE materials are made into granules for the manufacturing of plastic packaging or household products to be sold in the local market.

There were about fifteen factories focusing on PET recycling before the Chinese foreign waste ban, of the fifteen two were Indian while the rest were Chinese-owned. Since 2017, following tightened tax enforcement in Tanzania and the announcement of

Table 2: Sub-Sectoral Distribution of Chinese Investment in the Plastic Industry*

Sub-Sector	Number of Chinese investors interviewed	Total number of Chinese investments (estimate)	Number of non-Chinese investments (estimate)	Average investment value (US\$ millions)	Average number of local employees
PET Flakes	6	10	3	0.5	100
Plastic footwear	3	10	5	1.5	200
Plastic woven sacks	7	12	5	1	120
Plastic wrappers & shopping bags	3	25	10	0.7	100
Granulation	4	6	5	0.75	50
Other plastic products	3	6	15	1	60
Total	26	69	43	N/A	N/A

*Note: Several Chinese firms interviewed are engaging in the manufacturing of multiple plastic products and are therefore listed in more than one sub-sector.

the Chinese ban, half of the Chinese plants have closed, leaving six or seven still in operation. The large plants process over 500 tons *per* month and production capacities of other Chinese-owned factories range from 200 to 400 tons. Together, these Chinese factories process over 2,000 tons *per* month or about 25,000 tons *per* year. All Chinese investors had previous experience in the plastic recycling and production industries in China and came to Tanzania because of increasing competition back at home. Most investors are from Wenzhou, Zhejiang Province and Fuqing, Fujian Province and know each other well. Some started as business partners, while others were brought in through family connections. Currently, all PET flakes are exported as no local production uses recycled PET materials. According to a Tanzanian interviewee, the local conglomerate, AZAM Group, used to operate a recycling plant that produced spring water bottles with PET flakes recycled from its own production, but the plant was shut down three years ago because after the international oil price plummeted the company preferred importing virgin materials over recycling.²⁰

GRANULATION

GRANULES OR PELLETS ARE SEMI-PROCESSED PRODUCTS that are used in further manufacturing of finished products such as flexible films and pipes. About ten factories are producing granules with recycled PP and PE materials as their major inputs, half are owned by Chinese investors and the other half by Indians or Tanzanians of Indian descent. Because granulating machines are more expensive and

automated than machines used for cleaning and crushing in PET recycling plants, granulation factories are smaller in size. Each granulation factory normally employs fifty to sixty local workers, processing about 300 tons of materials *per* month. Some factories, like Changyou Plastics, were also exporting PET flakes to China before the Chinese foreign waste ban. Most of its granules were sold to other Chinese plastic plants in Tanzania, and occasionally to local factories. There seems to be few or no interactions between Chinese and Indian granulation factories.²¹

PACKAGING MATERIALS

IT IS ESTIMATED THAT MORE THAN TWENTY CHINESE PLANTS are making plastic wrappers and shopping bags in Tanzania. Some of these plastic film factories produce granules themselves, but they also rely on other recycling and granulation plants to supply raw materials. They use a portion of virgin materials, about 20 percent to 30 percent, to combine with recycler materials in order to make products more durable. Most of their products are sold to small retailers and vendors instead of supermarkets, which require all plastic bags to be made with 100 percent virgin materials. These factories normally employ fifty to 100 workers and have eight to ten film blowing machines. Due to increasing competition among these Chinese plants, an industrial association was established to coordinate pricing strategies and resolve disputes. However, as one member of the industrial association has noted, these efforts are not always effective because thus far they have mainly relied on reputational sanctions.²²

In addition, there are about a dozen Chinese factories producing plastic woven sacks using recycling PP materials, which come from used woven sacks from recycling plants and other companies and factories. The earliest investments can be dated back to around 2008, and later on, more plants were established by former employees, previous business partners, relatives, and family friends. Most factories employ fifty to 100 local workers and possess about thirty weaving machines. Capital investments are normally between US\$ 50,000 and US\$ 1 million. Their products are sold to small-scale traders for the packaging of agricultural goods, such as maize or wheat, but are not suitable for the packaging of industrial products like cement, which have special requirements such as waterproof laminate. However, one recent Chinese investment, GZ International, is committed to producing woven sacks with higher qualities. GZ International is a joint venture between a Chinese plastic manufacturer from Hunan Province and a subsidiary of GSM Group, a Tanzanian-based multi-conglomerate. The company has already invested US\$ 2 million in sixty weaving machines, as well as machines to laminate and print in color. Unlike other Chinese woven sack producers, they are targeting Chinese and other foreign industrial producers in building materials and commodities like cement and detergent as their main clients. According to one of the Chinese investors from TZ International, “producing the same products for the same sub-market only results in greater competition and lower profit margin for all, and therefore, it is important for newly arrived investors to differentiate themselves in market competition.”²³

By cooperating and interacting with Chinese plastic factories in Tanzania, an increasing number of local Tanzanian entrepreneurs have accumulated knowledge about the global plastic recycling value chain, which has facilitated their investment in plastic manufacturing.

According to a 2013 industry survey by the Tanzania Bureau of Standards, many non-Chinese plastic packaging manufacturers in Tanzania were established in or before the 1990s, and some of them, such as Silafrica, even dated back to the 1960s.²⁴ For example, Omar Packaging, a subsidiary of AZAM Group, has been producing a variety of products including bags or wraps for food products, flexible labels, and pillow packaging, since the 1980s. Omar Packaging is the largest of all ten factories in this particular line of business and currently employs 100 workers, with a production capacity of 600 tons *per* month.²⁵ Currently, they sell over 70 percent of their products to sister companies in the AZAM Group and have only been developing clients outside the conglomerate since 2013. Modern Flexibles is one of five Indian investments producing plastic labels in Tanzania. Since 2001, they have imported machines and flexible films from the Middle East and East Asia to produce flexible labels and packaging materials for food products. Its Tanzanian operations include color printing, laminating, cutting, and sizing. They currently employ 105 workers, including fifteen managers and technicians from India. Neither of the two factories use recycled plastic materials from the local market.

PLASTIC FOOTWEAR

THERE ARE ABOUT TEN CHINESE PLASTIC FOOTWEAR producers in Tanzania. Previously BBG Shoes, Zhongfu International opened in 2008 as one of the earliest, and arguably largest, Chinese investments in plastic footwear. Weng, Zhongfu's owner, is originally from Fujian Province, and was working in the plastic slippers import and export business in Cameroon and Tanzania before investing in manufacturing. Later on, Weng's sister, daughter, and in-laws followed his lead and opened factories producing similar products. Weng claims to have invested US\$ 10 million in acquiring land, machinery, and building a new plant to produce putty powder, an ingredient of paint. His plastic slipper factory now employs 400 local workers and produces 50,000 pairs of slippers *per* day, and mainly relies on ethylene-vinyl acetate (EVA) or foam rubber materials imported from East Asia, with a small portion coming from its own production waste. Currently, 70 percent of Zhongfu's products are exported to East Africa's regional markets. F&S Manufacturers, on the other hand, is the newest member in the plastic slipper production business. Fu, the owner, is from Zhejiang and had four years of trading experience in plastic footwear in Tanzania prior to opening the factory in early 2017; he explained that his aim in opening the business was to avoid import duties and secure a higher profit margin. Within one year, the factory expanded from 100 workers and four molding machines to 260 workers and twelve machines, suggesting a healthy profit. Fu also claims to have the only Chinese plastic shoe factory producing PVC slippers, which use injection molding and air blowing techniques and are more durable than less expensive EVA slippers. Similar to Zhongfu, Fu also imports raw materials from China and Korea. According to Fu, several Chinese plastic footwear factories have moved to countries like Ethiopia and Ghana in the past few years due to increasing competition, stricter tax enforcement in

To some degree, supplier relationships are developed and maintained based on geographic proximity and long-term cooperation, but all factories buy from as many local recycling centers as they can to secure a stable supply of raw materials, and in most situations, the level of transparency in plastic recycling is relatively high

Tanzania, and preferential investment policies offered by the Ethiopian and Ghanaian governments.

Bora Industries is a British investment that has been manufacturing plastic footwear since 1997. Its predecessor was a state-owned enterprise established by the socialist government of Tanzania in the 1970s. Bora now makes plastic footwear such as flip flops and sandals. About 70 percent of its raw materials are imported from the Middle East and East Asia, while 30 percent comes from its own production waste or that of other Chinese plastic shoe plants in Tanzania, as well as granules produced by a Pakistani-owned carrier bag manufacturer. Bora employs 300 local workers and ten foreign managers. The owner, Sajnani, and his wife have also been running a non-profit project over the past decade, teaching Tanzanian women to use discarded flip-flops and sandals recycled from beach areas to make toys and statutes. Compared to other Chinese plastic footwear factories in Tanzania, most of which are not differentiated from one another, Bora has established its brand name through decades of operation and production of a variety of products. However, due to increasing competition from Chinese plastic footwear manufacturers, as well as footwear products imported from China, since early 2017 Bora has also been exploring new products including PVC shoes, leather shoes, and work safety shoes. These new production lines all use molding machines from China and India, and raw materials imported from the Middle East and neighboring African countries.

OTHER INDUSTRIAL AND HOUSEHOLD PRODUCTS

WHILE MOST IDENTIFIED CHINESE PLASTIC FACTORIES are concentrated in the production of plastic packaging and footwear, a small number of factories have diversified their production to include household products. Established in 2011, Wenxing Plastics began by exporting PET flakes to China and now has multiple operations including the production of plastic shopping bags, woven sacks, and plumbing pipes. The owner, Yang, closed his plastic factories in Fujian, China, and shifted all his operations to Tanzania in 2016. Yang's plant used to employ 200 local workers, but that number has since been reduced to eighty due to the import of automatic machines from China in 2015 to reduce labor costs. Now, ten workers are employed in PET recycling, thirty in woven sack weaving, thirty in film blowing, and another ten in pipe extrusion. Another Chinese investor, Xu, owns a small factory producing household plastic containers, like buckets and basins, with locally recycled plastic materials. He currently employs around thirty local workers and sells mainly to the Dar es Salaam region. A third Chinese investment, Ocean Kiss, manufactures foam mattresses. The owner, Lei, had invested in furniture making and construction before expanding his business to include foam mattresses in 2017. Ocean Kiss stands as the only Chinese investment in the foam mattress business, competing with six other Indian or Indian-Tanzanian investors.

Mostly owned by foreign investors, there are around ten large plastic manufacturers in Tanzania, including Silafrica, Simba, Jambo, and Cello, among

INDUSTRIAL CLUSTERING & LOCAL LINKAGES

others.²⁶ Their products include a variety of household and industrial plastic products such as plastic tables and chairs, water storage, and crates. Most of these factories use imported virgin plastic materials for production. For example, Simba Plastics, the largest manufacturer of pipes for industrial use, imports virgin granules from Saudi Arabia, and only 5 percent of its raw materials come from its own production waste. Simba Plastics sells 70 percent of its products to government agencies, like the Ministry of Water and large mining companies. Princeware, established in 2009 by an Indian plastic manufacturer in Tanzania to produce plastic furniture and plastic household containers, also has a preference for imported materials. According to Benadetha, Princeware's HR manager, they prefer to use imported virgin raw materials and their own product waste instead of locally recycled plastic waste because they consider the quality of sorting and cleaning in local recycling plants unsatisfactory. Sometimes, Princeware also sells their scrap plastics to small Chinese and locally-owned factories that produce plastic containers and packaging materials. In addition, some large food and consumables manufacturers have their own plastic divisions, which produce containers and packaging materials. Examples include Muzah Wilmar, an international edible oil producer from Malaysia, and AquaPure, a Zanzibar-based brand producing packaged drinking water. They both import virgin raw materials from overseas and have no linkages with local suppliers or buyers.

THOUGH CHINESE INVESTMENTS IN TANZANIA'S PLASTIC INDUSTRY are still recent, over the past decade we have seen evidence of the creation of various linkages with the local economy. These linkages include not only employment and training opportunities inside those factories, but also supply chain development backward linkages. In addition, by cooperating and interacting with Chinese plastic factories in Tanzania, an increasing number of local Tanzanian entrepreneurs have accumulated knowledge about the global plastic recycling value chain, which has facilitated their investment in plastic manufacturing. Finally, the Chinese foreign waste ban has brought various challenges and opportunities to the plastic recycling industry in Tanzania. On the one hand, reduced demand for local recycling has resulted in a significant price decrease and deteriorating conditions for plastic recyclers. On the other hand, some Chinese and Tanzanian investors have managed to turn this challenge into an advantage, by investing in more value-added manufacturing activities.

COMPETITION AND COOPERATION

ALTHOUGH THERE ARE SOME NON-CHINESE INVESTMENTS in the plastic industry in Tanzania, because their products are not differentiated and many prefer price-cutting as the primary competition strategy, Chinese investors felt that competition was most fierce among the Chinese manufacturers themselves. Factories that are

"It is difficult to partner with both Chinese and Tanzanians, but for different reasons. Working with Chinese runs the risk of nurturing future competitors who will poach my workers and clients, while collaborating with Tanzanians may lead to miscommunication and inefficiency due to difference in cultural and social values."

exporting PET flakes to China compete over the local supply of waste plastics, and factories producing for the local market compete for both supplies and buyers. To some degree, supplier relationships are developed and maintained based on geographic proximity and long-term cooperation, but all factories buy from as many local recycling centers as they can to secure a stable supply of raw materials, and in most situations, the level of transparency in plastic recycling is relatively high. For example, a recycler based in Zanzibar stated that, "I sell most of my materials to three Chinese (factories). One offers a lower price than the other two, but that manager loaned money to me before and I've known him as a friend for years, so I like doing business with him."²⁷

It is very common for new investors entering the business to try and attract buyers by cutting prices. According to one Chinese investor in plastic packaging, the price for shopper bags has fallen by 30 percent over the past three years due to increasing market competition. As mentioned earlier, price coordination and self-regulation by the industrial association among the Chinese packaging producers has largely failed due to a lack of enforcement. Some established firms were said to have engaged in more aggressive measures to sanction violators of the "rule of the game", such as tipping off host government authorities about their competitors' tax and immigration violations. One Chinese investor who has been in Tanzania since 2014 noted, "there used to be many Indian factories in the plastic recycling business, but now only one or two are still operating. Many Indian plants are outperformed by us since we use newer and more efficient machines. Besides, Indian investors have higher expectations for profits and shifted away from plastic recycling because of thinning margins, but we (the Chinese) stayed because it is still more profitable than the same business in China."²⁸

As Michael Porter pointed out, competition can coexist with cooperation because they occur on different dimensions and among different players.²⁹ Chinese investors are not merely competitors in the market, but also members of the same business networks and some are relatives or former business partners. Cooperation and joint actions take place when they are beneficial for all the investors. For instance, pre-shipment inspection by China Certification and Inspection Group Co. (CCIC) is required for exporting PET flakes to China, but CCIC's branch in Sub-Saharan Africa is located in South Africa; therefore, Chinese plastic recyclers in Tanzania often file joint applications in order to save on CCIC inspection costs. Another example of cooperation is the occasional borrowing and lending of spare machine parts among Chinese factories, as ordering the parts from China can take a long time. Cooperation between Chinese plastic factories in different sub-sectors is even more common. For example, Chinese PET recyclers often supply PE and PP flakes to Chinese granulation plants, while the granulators in turn sell their granules to Chinese plastic packaging and household items manufacturers. One Chinese investor explained that he preferred doing business within the Chinese community because selling to people he knew personally helped reduce default payment risks.³⁰ Therefore, reputation has also played a role in enhancing cooperation among the Chinese business community.

JOINT OWNERSHIP

"I consider myself as a social engineer or social glue, because someone has to fill the gaps in culture, training, and management. My Chinese colleagues are good at making plans for production and setting targets for the company to grow but I am [here] to make sure that this message is successfully conveyed to the workers and to create a motivating environment where everybody feels that he or she is engaged and respected. This takes time because investment cooperation between China and Tanzania is still new."

CURRENTLY, JOINT OWNERSHIP IS NOT COMMON AMONG Chinese investments in the plastic industry, even though many owners started as former employees or minority shareholders in others' plants. As one investor complained, "it is difficult to partner with both Chinese and Tanzanians, but for different reasons. Working with Chinese runs the risk of nurturing future competitors who will poach my workers and clients, while collaborating with Tanzanians may lead to miscommunication and inefficiency due to difference in cultural and social values."³¹ Therefore, most Chinese plastic companies remain family businesses.

Nevertheless, the owner of GZ International stands as an exception. GZ International is a joint venture between Chinese and local investors. The Chinese investor has more than twenty years of experience producing industrial plastic packaging in Hunan Province. When China's recent capacity reduction and environmental enforcement policies forced many building material factories to close down, he decided to come to Tanzania. The Tanzanian partner is a former client as well as a subsidiary of the GSM Group, a local business group that operates in logistics, retail, and manufacturing. The joint venture is considered a "win-win" partnership, with Chinese staff supervising technology and production while Tanzanian staff is in charge of local marketing and government relations. Tariq, GZ's vice manager, is responsible for coordinating Chinese and Tanzanian management as well as local workers. "I consider myself as a social engineer or social glue, because someone has to fill the gaps in culture, training, and management. My Chinese colleagues are good at making plans for production and setting targets for the company to grow but I am [here] to make sure that this message is successfully conveyed to the workers and to create a motivating environment where everybody feels that he or she is engaged and respected. This takes time because investment cooperation between China and Tanzania is still new."³²

EMPLOYEE TRAINING

IN GENERAL, PLASTIC FOOTWEAR AND PET RECYCLING requires less training than granulation and other manufacturing activities. In Chinese plastic footwear factories, the formula is developed by Chinese technicians and a majority of the local workforce is assigned to packaging and transportation, while a small number of workers are responsible for the operation of automatic molding machines under Chinese management supervision. Similarly, most work in PET recycling plants is also labor intensive, such as sorting and washing. Training includes the introduction of general knowledge about plastic materials, basic sorting techniques, as well as the operation of shredding machines, *etc.* Because plastic recycling was almost non-existent before Chinese factories opened, all the local workers have to be taught from the beginning. As one Chinese investor mentioned, "knowledge needs to be accumulated through practice. For example, you need to teach local workers how to identify different types

of materials by their different characteristics, and that bottle caps, seals, and adhesive labels, which are made of PP and PE materials, need to be removed before PET bottles can be loaded into the shredding machines. Otherwise, it will cause inefficiency in further processing.”³³ Some of these factories have trained Tanzanian technicians or workshop supervisors to do machine maintenance and repair, but most of the time, mechanical work is supervised by Chinese technicians. Granule-making and plastic packaging factories use more complicated machines and equipment, so local workers in those factories normally receive additional training on formula implementation, temperature control, and safety issues related to machinery operation. The division of labor based on gender is common in those factories, where female workers are responsible for washing and sorting, and male workers are in charge of machinery, weighing, and transportation.

Given the high unemployment rate in Tanzania, finding workers is usually not a problem. Since wages offered are not attractive to college graduates and most Chinese managers consider formal training programs in Tanzania as impractical or irrelevant, Chinese plastic factories rarely hire graduates from colleges or vocational training institutions. Instead, experienced electricians and other technicians in the same or similar industries, as well as drivers and marketing staff familiar with the local supply and distribution networks, are greatly desired. As a result, poaching of those employees is frequent, which has also created a disincentive for Chinese companies to invest in additional training and has become an obstacle to building trust between employers and employees. Nevertheless, some Chinese factories believe that piece rate or performance-based bonus pay has helped improve efficiency and retain skilled labor.

SUPPLIER NETWORKS

EXCEPT FOR PLASTIC FOOTWEAR MANUFACTURERS, all Chinese plastic factories use locally recycled plastic wastes for their production. Local recycling in Tanzania is largely stimulated by the demand from these Chinese recycling plants. In the past decade, export of PET flakes from Tanzania to China has grown over tenfold, from 2,000 – 3,000 tons to nearly 30,000 tons every year, as estimated by one Chinese investor.³⁴ About a hundred recycling transfer stations have been established across the country to meet this rising demand.³⁵ More than half of the interviewed Chinese plastic recycling and manufacturing plants reported that Tanzanians who used to work for their factory left to set up their own trash collection centers. In most cases, these former workers became suppliers for their previous Chinese employers. Chinese buyers, through the practice of sub-contracting and quality inspections, teach their suppliers knowledge about plastic materials as well as waste plastic sorting and cleaning techniques.

Since the entry barrier for recycling is relatively low, there are several hundreds of these trash collection centers across Tanzania, most of which have fewer than five employees responsible for sorting, cleaning, packing, and transportation. Over the

More than half of the interviewed Chinese plastic recycling and manufacturing plants reported that Tanzanians who used to work for their factory left to set up their own trash collection centers. In most cases, these former workers became suppliers for their previous Chinese employers.

years, some of them have been able to upgrade their activities and set up recycling plants or workshops that act as suppliers or sub-contractors for Chinese factories. Chinese investors interviewed reported that at least twenty to thirty local recyclers have bought used machines from Chinese factories, while another dozen or so have bought machines from Indian factories. Most local recycling plants are located in rural Tanzania, which is convenient because shipping plastic flakes to Dar es Salaam is significantly cheaper than shipping empty bottles and containers. In addition, since Chinese factory owners have to update their machinery every other year to improve productivity, they are glad to be able to sell their used machines to local recyclers. Chinese factories sell their used shredding and washing machines for about US\$ 3,000 each, or half the price of new ones. Some Chinese investors also provide local recyclers with installment loans when they were unable to make upfront payments.³⁶ Of course, it is understood by both parties that Chinese factories providing the machines shall retain “a preserved right to buy” plastic flakes from the local recyclers who buy their second-hand machinery.³⁷

One Chinese investor, Jiang, sold used machines to eight Tanzanian recyclers in Zanzibar, Arusha, Singida, and Morogoro, all of whom are suppliers or former suppliers of his factory. Jiang visits these local plants every few months to “provide technical support and strengthen cooperation”. Four or five other Chinese investors in plastic recycling, granulation, and woven sacks manufacturing also confirmed that they have provided machines as well as financial and/or technical support to their local suppliers. Although written agreements are signed in most cases, few have actually resorted to formal legal procedures when default happens, and enforcement has mainly relied on *ex ante* due diligence investigation and reputation accumulated through repeated dealings. Chinese investors also acknowledged that, although most agreements provide that repayment shall be guaranteed by future supply of raw materials by local plants to Chinese factories, this is normally a general statement lacking enforcement mechanisms, and in practice, Chinese factories still offer market-based prices to retain suppliers.

Riziki is one of the eight Tanzanian recyclers that have benefited from cooperating with Jiang. After serving as Jiang’s supplier for over two years, in 2014 he decided to set up his own recycling plant in Zanzibar to reduce shipping costs, making Riziki’s one of the earliest plastic recycling plants in Zanzibar. An agreement was reached between Jiang and Riziki, under which Jiang would provide his old shredding machines to Riziki with an installment loan, and periodic payments were guaranteed by supplying Jiang’s factory. This arrangement was beneficial for both parties, making it possible for Riziki to reduce operation costs and increase output while Jiang could ensure ample supplies for his factory. Riziki said that he learned how to repair and perform daily machine maintenance after several visits to Jiang’s factory. “One day I saw in Mr. Jiang’s factory how the shredding machine is attached to the washer and dryer, and that arrangement helps save a lot of labor for manual handling of loads. So, when I came back, I bought a used dryer from Jiang and a second-hand washing machine from an Arab factory in Moshi and assembled them in the way I learned from Mr.

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Jiang." Spare parts for general purposes can be found at local hardware stores, while special parts, like blades, are provided directly by Jiang. Because of the long-term relationship, Jiang has also provided Riziki with financial assistance on certain occasions. In 2017, the local government suspended Riziki's recycling facilities operation because of the noise and air pollution they were generating in a residential neighborhood. Jiang loaned Riziki US\$ 12,000 to relocate his operations, with the payment again serving as a guarantee of a future supply of PET flakes for Jiang's factory.

When Riziki started his business, he had three workers. In five years, his plant had expanded to twenty-two workers, and its production capacity also increased fivefold, reaching five tons *per* day or a hundred tons *per* month. PET flakes are sold to Jiang, pursuant to their agreement, while PP and PE flakes are sold to Amour, a local plumbing pipe producer in Zanzibar. He also occasionally sells some materials to C-re-a.i.d., a social architecture NGO based in Moshi, which makes furniture with recycled hard plastics for local schools. Raziki's recycling business has not only led to personal prosperity but has also been inspiring to others. When Michael and Masoro were trash collectors they asked Riziki to shred their plastic waste to reduce shipping costs to the Tanzanian mainland. Now, both have their own recycling workshops and are using shredding machines purchased from Jiang. Each employ about fifteen workers. When Riziki obtained a larger shredding machine from Jiang in early 2017 to replace an old one, Haji, a friend of Riziki's, bought the old machine and started a recycling plant in Tanga. All three of them are still collaborating with Riziki, sharing information and knowledge on marketing, pricing, and machinery maintenance, *etc.*

George is an example of a young entrepreneur in the local plastic industry. Trained as an engineer in Kenya, George got into the plastic industry because of his family connections. His uncle has a plastic factory that makes electrical switches from waste plastics, and his brother owns a recycling plant in Kenya with machines imported from China. He worked with his brother for a couple of years and came to Tanzania in 2015, when a campaign against the use of plastic packaging materials was underway in Kenya, to explore alternative sources for supplies. At first, waste materials were transported to his brother's plant in suburban Nairobi to be shredded, but George soon began supplying some of the Chinese firms in Tanzania. In 2016, he bought a used shredding machine from Xue, one of his Chinese buyers.

Trained as an engineer, George performs daily maintenance and repairs machines himself. After teaching himself the mechanics of the shredding machine he bought from Xue, George went on to build two smaller machines on his own, using components and spare parts he bought from local retailers and other factories. Together, the three machines can process up to ten tons per day, making George arguably the largest recycler in Shingyanga, a northern region in Tanzania. When all the machines are put into full operation, George expects to buy waste plastics from neighboring regions like Mwanza, as well as Uganda and Burundi. Moreover, having learned about the Chinese foreign waste ban, George has also ordered molding machines from China and plans to make plastic buckets for the local market. "After

China imposed the plastic waste ban, the Chinese recycling plants in Dar have lowered their purchasing prices, and it's becoming less and less profitable for me to sell PET flakes to the Chinese factories, so I have to find other ways. I decided to invest in the production of plastic buckets because I know the local market, and a friend from a Chinese company in Dar who helped order the machines from China.”

Moreover, an increasing number of non-Chinese plastic factories have begun to use machines imported from China, including Bora Industries, Omar Packaging, Princeware, and Simba Plastics. Although these factories previously used machines from Europe, they have since learned from Chinese machinery suppliers and plastic factories in Tanzania that Chinese machines are more modern and have lower maintenance costs.³⁸ When they order machines from China, they send their own technicians, who are usually from India, to China to receive instructions and training on installation and maintenance directly from the suppliers. There are also an increasing number of small plastic producers that have started to import machines from China. Besides George, who has imported molding machines to make plastic buckets in Shinyanga, Amour, a local plumbing pipe-making factory in Zanzibar, also uses Chinese machines. Amour started with recycling plastic wastes like Riziki and, through his interactions with Chinese and Indo-Tanzanian plastic factories in Dar es Salaam, has learned that plastic manufacturing is more profitable. Amour then imported machines from an online Chinese vendor and started to produce pipes for the local market in 2015. He buys plastic waste from local recycling workshops, including Riziki's workshop. Although he used the Internet to consult with his machine suppliers in China for technical issues and ordering spare parts, he doesn't have much of a relationship with Chinese plastic factories in Tanzania.³⁹

OPPORTUNITIES FOR INDUSTRIAL UPGRADING

IN JULY 2017, THE CHINESE GOVERNMENT ANNOUNCED that it would stop importing twenty-four types of solid waste including unprocessed waste plastics as of January 1, 2018. Additionally, Chinese plastic recyclers in Tanzania reported that the government had stopped renewing waste import licenses or issuing new ones since the policy was announced. At the time of this research, many plants were closed down or had suspended their operations because of the loss of their export market. China has acted as the single largest importer of recyclables since the 1990s - China imported over seven million tons of waste plastics or nearly half of the world's waste plastic exports in 2016.⁴⁰ The impact of the Chinese foreign waste ban on the global recycling industry is thus profound. Following this policy change in China, many waste shipments have already been diverted to other developing countries in Southeast Asia and Africa, which has presented both opportunities and challenges for these countries.⁴¹

Since exporting unprocessed PET flakes to China is no longer allowed, recycling plants in Tanzania have been looking for alternative markets for their products. Several Chinese investors have established connections with plastic manufacturers in Southeast Asian countries, India, and South Africa. Most of these new buyers are also

Chinese who have relocated their operations overseas due to increasingly stricter environmental enforcement in China. Nevertheless, since the capacity of these emerging waste plastics importers are much smaller than China, the market price for plastic recyclables has plummeted. More recently, several Southeast Asian countries such as Malaysia, Thailand, and Vietnam have moved to restrict waste plastic imports due to rising concerns of environmental violations in the plastic recycling industry, adding more uncertainties for Chinese plastic recyclers interested in exporting to these alternative markets.

In order to cope with these regulatory uncertainties and to sustain their profit margin, some Chinese investors have decided to upgrade their manufacturing activities in Tanzania. Three Chinese factories have imported granulation machines from China to make PET granules, which can be exported to China as semi-manufactured inputs for polyester fiber factories. Other companies have moved to producing plastic products for the local and regional market. For example, one investor planned to make plastic packaging straps in Tanzania, which can be sold locally or exported to China, and another investor was interested in producing plastic furniture for customers in Tanzania and neighboring countries.

Although most Chinese plastic plants aimed at mitigating the negative impact of the export market loss since the foreign waste ban, some viewed the loss as an opportunity to play a larger role in the global recycling value chain. Since waste plastics from Europe and the US can no longer be exported to China, several factories in Tanzania have started to import plastic waste from Europe and the US to process into granules. For example, three Chinese investors claimed to have invested US\$ 500,000 each to expand production. Additionally, a more aggressive plan to set up a polyester fiber factory in Tanzania was discussed between one Chinese investor and some local investors. Establishing a polyester fiber factory would be a critical step toward local value chain integration because it could help set up a linkage between plastic recycling and garment manufacturing industries. However, other Chinese investors expressed their skepticism about the viability of the project, since polyester fiber factories have much higher technology and financial investment requirements.

CHALLENGES: INDUSTRIAL UPGRADING AND EXPANDING PRODUCTION

WHILE THE CHINESE FOREIGN WASTE BAN HAS CREATED various opportunities for industrialization in Tanzania, as previously discussed, there are some noteworthy economic and environmental implications. First, industrial upgrading and production expansion are not necessarily associated with employment creation. In fact, several Chinese plastic manufacturers reported that they had cut down their local employment by up to 30 to 40 percent because newly imported machines had helped improve productivity and efficiency. Besides, because imported waste plastics are cleaner and better sorted than locally recycled materials, the import of waste plastics from Europe also reduces the workload in labor-intensive activities such as sorting and

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cleaning.⁴² Therefore, it is likely that these industrial upgrading efforts will boost demand for local technicians but reduce demand for laborers.

Secondly, the expansion of plastic recycling in Tanzania is accompanied by a foreseeable environmental cost. Since mid-2018, rising environmental concerns about the operation of plastic recycling factories in Southeast Asian countries have driven their governments to adopt more restrictive measures on waste imports.⁴³ In Tanzania, most plastic recycling facilities visited haven't installed any waste management systems, nor did they provide any protective health and safety equipment for their workers. Many local workers we saw in granulation and wire drawing workshops, where waste plastics are melted and reshaped, had burn or scalding scars. Conditions at small recycling workshops in rural areas are even more precarious. Many workshops are located within or near residential areas, where they can easily find temporary workers. There was even one facility we visited that was dumping their discarded materials, like flexible labels, into an open well near a local school's soccer playground.

Besides controversies over plastic recycling facilities' environmental compliance, increased waste plastic imports may have the long-term effect of discouraging domestic recycling in Tanzania. The three Chinese recyclers that have started importing waste from Europe confirmed that they have already reduced their purchasing from local recycling facilities. One investor commented, "processing waste plastics imported from developed countries saves a lot of time and labor because European countries have established advanced recycling systems and the [waste] materials are cleaner and easier to sort. Good recycling habits and awareness takes years to foster, and both China and Tanzania have a long way to go."⁴⁴ This also resonates with the Chinese foreign waste ban's policy objective, which is to prioritize domestic recycling and reprocessing. Therefore, if more plastic manufacturers begin importing waste plastics, the market price for local recyclables is going to be further suppressed. Some local recyclers like George have moved into manufacturing, but others who don't have the financial capacity or connections to upgrade are likely to remain frustrated, at least for the time being.

ROLE OF THE HOST GOVERNMENT

DESPITE TANZANIA ADOPTING THE ENVIRONMENTAL MANAGEMENT ACT in 2004 and the Solid Waste Management Regulations in 2009, scholars and NGOs have pointed out constant Tanzanian violations in recycling and waste disposal practices.⁴⁵ Information about environmental and health legislation, as well as their implementation, is very difficult to access. During our visit, neither the National Environmental Management Council nor the City Council of Dar es Salaam were able to provide up-to-date information related to the enforcement of relevant environmental laws and regulations. In practice, Chinese investors reported that local governments were more interested in enforcing tax and immigration regulations than regulations geared towards health and environmental protection. Even when health and environmental violations have been found, local authorities have put a greater

emphasis on the monetary penalty than a requirement for the violation's correction and rectification.⁴⁶

Looking to the future, the Tanzanian government needs to play a more active role in clarifying its policy priorities and enforcing environmental and health regulations. Plastic recycling industry experience shows that wealth can be made from waste. Historically, the waste trade and recycling has contributed to industrialization in the US, Japan, and more recently in China. In Tanzania, Chinese plastic manufacturers have also facilitated technology spillover to the local recycling industry, as evidenced by Riziki and George's stories. Moreover, a 2013 study on the informal recycling industry in Dar es Salaam found that informal waste pickers on average reported a monthly income of US\$ 108, which is 40 percent higher than the national minimum wage in Tanzania for formal employment.⁴⁷ On the other hand, more investment in plastic recycling and waste imports following the Chinese foreign waste ban may cause greater environmental and health hazards for both employees in the industry and the host communities, if they are not properly regulated.

CONCLUSION

USING EMPIRICAL EVIDENCE, THIS PAPER INVESTIGATES the sub-sectoral distribution of investments in the plastic industry in Tanzania. Chinese investments primarily focus on the recycling and manufacturing of packaging materials and footwear, while many non-Chinese investments focus on higher end markets and produce a greater variety of products for industrial and household use, mainly using imported virgin plastic materials rather than recycled plastics. I found that Chinese investments in plastic recycling and reprocessing have created stronger backward linkages with local suppliers. Through supply, sub-contracts, and machinery cooperation networks, many local waste transfer stations have obtained technical and financial support to engage in preliminary processing activities, such as crushing and grinding, and have been able to increase their profit margins. A small number have also taken advantage of their connections with Chinese plastic factories and machinery suppliers to set up manufacturing plants of their own.

China's recent adoption of the foreign waste ban has multiple implications for Tanzania. Some Chinese investors in Tanzania have already started importing waste materials from European countries and expanded their reprocessing and manufacturing activities in Tanzania. While this may bring benefits such as industrial upgrading and employment, there is also increasing pressure for the host government to undertake more effective measures to mitigate negative environmental and health consequences of the plastic recycling industry – in Southeast Asia, for example, several governments have moved to restrict waste imports because of rising environmental concerns.⁴⁸ In order to balance economic and environmental interests and ensure that more local recyclers and workers in the recycling industry can harness more benefits from the expansion of the recycling industry, the Tanzanian government should

develop a strategy in response to the regulatory change in China as well as the international waste trade regime. ★

ENDNOTES

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