PLASTICS AROUND US: A CULTURE OF WASTEFULNESS?

Roslinda Ithnin[a] and Teratani Shousuke[b]
[a]Pusat Asasi Sains, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[b]Professor Emeritus,Tokyo Gakugei University, Japan

ABSTRACT

Both Japan and Malaysia are surrounded by waters that play an important role in terms of economic and transport. Water pollution will have a negative impact on both countries. One of earth's current main concerns is the pollution caused by plastics. Plastics are widely used for packaging of goods but it is not appropriate when the goods are packed repeatedly or layered as this is considered wastage which can cause plastic pollution. This article discusses the escalating problem of plastic contamination and the strengthening of *furoshiki* culture and the sense of *mottainai* which can help reduce the use of plastic as a wrapper of goods in Japan. The Educational Co-Research for Sustainability (ECoS) group which was formed in Tokyo, Japan under the program of Grants-in-Aid for "KAKENHI" tries to infuse the concept of Green and Sustainable Chemistry into chemistry education. ECoS suggests that one of the ways is to educate the students regarding the topic of plastics in classrooms are also discussed. With the escalating amount of waste generated in urban areas, we need to come up with such solutions soon.

Kedua-dua Jepun dan Malaysia dikelilingi oleh perairan yang memainkan peranan penting dari segi ekonomi dan pengangkutan. Pencemaran air akan memberi impak negatif kepada kedua-dua negara. Salah satu kebimbangan utama semasa bumi ialah pencemaran yang disebabkan oleh plastik. Plastik digunakan secara meluas untuk pembungkusan barang tetapi tidak sesuai apabila barang itu dibungkus berulang kali atau berlapis kerana ini dianggap sebagai pembaziran. Pelepasan plastik yang berlebihan dan proses pembalut plastik yang mahal tidak membantu pencemaran plastik. Artikel ini membincangkan masalah pencemaran plastik yang semakin meningkat dan pengukuhan budaya *furoshiki* yang dapat membantu mengurangkan penggunaan plastik sebagai pembungkus barang di Jepun. Kumpulan Penyelidikan Koordinasi Pendidikan untuk Kelestarian (ECoS) yang dibentuk di Tokyo, Jepun di bawah program Bantuan Grants-in-Aid untuk *"KAKENHI"* cuba untuk menanam konsep Kimia Hijau dan Mapan (GSC) ke dalam pendidikan kimia. Salah satu cara yang dicadangkan oleh ECoS adalah agar topik berkenaan plastik dibincang di kelas. Dengan peningkatan sampah yang dijana di kawasan bandar, kita perlu membuat penyelesaian dalam masa terdekat.

Keywords

Plastic pollution, culture of wastefulness, Green Chemistry, eco-friendly

1.0 INTRODUCTION

Japan used to be one of the most polluted countries but Japan is able to reduce the pollution to acceptable. In Japan, the process of "reduce, reuse, recycle," is taken as a noble routine. The websites on government homepages usually show a video regarding each locality's recycling activities. PET (polyethylene terephthalate) bottles and plastic bags have to be sorted out, some being turned into consumer items or degraded to their constituent elements. The term "*shigen gomi*" (recyclable garbage) was used when referring to plastic waste in Japan. In general, the *gomi shobun* or *gomi shushu* (garbage collection) in Japan is a systematic service with specific days of collecting flammable, nonflammable or oversized garbage. This strictly enforced rule on separating wastes helps Japan to maximize the reuse and recycling on garbage. According to Japan's plastic waste Management Institute more than 20% of Japan's plastic waste is recycled and majority of the rest are either burnt as fuel to generate power or heat. This is alarmingly equivalent to a whole garbage truck of plastic being dumped into the ocean every minute. Of course not just in Japan, the whole world is generating a staggering amount of plastic, and an alarming quantity is finding its way into the planet's ecosystem. According to Chiba et al (2018), "there is growing concern that deep-sea ecosystems are already being damaged by direct exploitation of both biological and non-biological resources – through deep-sea trawling, mining and infrastructure development, for example". Researchers are working on a global level to solve the plastic pollution issues. Perhaps it is best to decrease the production and consequently the usage of plastics since this could lessen the plastic wastage which pollutes our environment.

Like many other countries, Japanese water is also contaminated by industrial and residential chemical residues. Therefore agencies such as the Global Oceanographic Data Center (GODAC) of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) launched the Deep-sea Debris Database for public use in March 2017. These data have been collected since 1983. In May 2018, the GODAC team of JAMSTEC discovered the image of a plastic shopping bag at the bottom of at Mariana Trench near the Philippines, 10898 m below sea level (Brasor, 2018). This image was recorded in 1998 and it surely warned us that even more plastics have accumulated at the bottom of the deepest point in the earth's oceans by now. The Japanese researchers discovered that more than 33% of the underwater debris was macro-plastic of which almost 90% was single-use and not multipurpose products. The issue of plastic pollution and human impact on the oceans has captured the public's attention. Thus, numerous other international teams are also monitoring the ocean including the deep-sea remote vehicles to forage the ocean beds. Not that far from the Philippines water, Bali declared a "garbage emergency" or the clean-up of beaches which yielded 100 tons of rubbish in 2017. In 2018, volunteers led by Reef Check Malaysia, collected nearly 14,000 plastic bottles, 6,200 plastic bags and 1,700 straws from various Malaysian beaches (Metro News, 2018). This was indeed a horrifying scene.

Plastics biodegrade slowly and the mismanagement of plastic wastage endangers the wildlife through entanglement and consumption. Many recent reports highlight the dangers posed by the chemical toxicity in ecosystem by plastic odors that mimic the natural scents of some food. More research has to be conducted in order to identify the chemicals. In this sense, Japan can facilitate the export of recycling technologies and social systems that promotes recycling in other countries. This is where Japan can help make a most effective contribution. The Japanese

dependency on the oceans for their survival and their ways of promoting recycling could make Japan a role model.

The first plastic was made in 1907 primarily for military purposes but mass production began after World War II for daily use. Estimated globally, 9.1 billion tons of plastic have been produced since 1950. One million plastic bottles are bought worldwide every minute, and the figure is projected to grow over the next few years. Unfortunately, it requires plastic more than 400 years to degrade. Annually, slightly less than 15% of the plastic waste is collected and recycled. Less than 10 % are burned and the rest ended in the environment (Parker and Elliott, 2018). It is estimated that the seas are being polluted by 5 to 14 million tons of plastic each year. If the current trend continues, a predictable forecast is that by 2050, there will be more plastic than fish in the world's waters. It is estimated that 75 percent of land-borne maritime pollution comes from just 10 rivers, eight of which are in Asia. If the amount of plastic in these rivers was cut in half, the influx of plastic pollution into the oceans worldwide would be reduced by 37 percent. Japan is also making other efforts at reducing pollutions including reforestation that has successfully reduced soil erosion into its ecosystems to a certain extend. On a smaller but important scale, each citizen can assist in this effort by reflecting on the concept of *mottanai*, replacing plastic packaging by using *furoshiki* and become less of a throwaway culture. The move towards this lifestyle could start by educating students regarding plastic, the recycling process and how to avoid plastic pollution.

2.0 DISCUSSION

2.1 Recycling plastic

Any tourists would agree that Japan's specific collection days for wastes are incomparable to others. In Japan combustible waste, noncombustible waste, glass bottles and cans, plastic bottles and hazardous trash, such as light bulbs and batteries are collected on specific days. Japan is also careful about recycling PET bottles. Their quality is so pure that the uniforms of several soccer teams are made from bottles collected from Japanese landfills. Specifically since 2010 all nine of Nike's national football teams - including Portugal, Brazil, The Netherlands and the U.S.A - sport jerseys were made entirely from recycled plastic water bottles diverted from landfills in Taiwan and Japan. Each jersey uses approximately eight water bottles from those landfills. Therefore since 2010, nearly two billion bottles which were enough to cover 3,500 football pitches have been salvaged and spun into excellent recycled polyester products. However, many people are still unaware that some of the plastic wastes are recyclable. Waste-to-energy processes recover the energy from the waste through either direct combustion processes including incineration, pyrolysis, and gasification or production of combustible fuels in the forms of methane, hydrogen, and other synthetic fuels. Incineration and gasification are the two primary waste-to-energy technologies that have been used successfully throughout the world including in Japan. However, the process is still expensive.

Since 1992, many countries shipped their recycled plastic waste to China and other developing Asian nations (Parker and Elliott, 2018). China imported the recycled plastic waste because it became the world's leading manufacturer in the 1990's and it was able to process the recycled

plastic waste materials into other goods. However, one of the unfavorable conditions that came out of this process was the increase in China's health and environmental problems due to the low quality recycled plastic. By middle of 2018, China announced that it would no longer accept imports of waste plastic for recycling because their storage for plastic waste has reached saturation levels in many places (Ryall, 2018). China's announcement has sent shock waves throughout the world. This resulted in the European Union to propose much stricter standards for one-use plastic packaging and other miscellaneous plastic items, including a possible ban on plastic straws and stirrers. Japan has announced no similar countermeasures even though China's move affects Japan more directly. Japan exported 72 percent of its waste plastic to China in 2017 and Japan will now either have to find a new destination for this refuse or handle it on its own. China's standard of living has improved greatly in recent decades and the damaging effects of plastic consumption on the environment have increased. China thus has to tighten its regulations to cease its import of the world's plastic waste. This new regulations affect not just Japan but also other countries which used to export their plastic waste to China. It is obvious that all these affected countries will have to increase their own plastic recycling as well as perform other measures to improve their environment even though the process of recycling plastic may cost much more than producing the plastics and it requires a lot of energy, water and manpower. Japan, Germany, United Kingdom and Canada have not only implemented the 3Rs (reduce, reuse, recycle) but they have also extended process to include the 6Rs (reuse, recycle, redesign, remanufacture, reduce, recover) since more than two decades ago. The current recycling methods being expensive, the process can damage the material to allow for continued use. There are efforts by scientists to improve and make recycle plastic easier.

2.2 The idea of *mottainai*

According to Siniawer (2014) not only the Japanese government ministries, corporations, and nongovernmental organizations advocated the word "*mottainai*" in the first decade of the twenty-first century, but the Japanese, mass market nonfiction, magazines, newspapers, songs and even the children's literature, deliberately used and and try to define the term as "wasteful". Siniawer argued that discourses about wastefulness at that time, were trying to describe an "articulation of values, a search for meaning and identity, and a certain conception of affluence in millennial Japan". The "idea of *mottainai* reflected wide-ranging principles and beliefs that were thought to define what it meant to be Japanese in the twenty-first century, at a time when there settled in an uneasy acceptance of economic stagnation and a desire to find meaning in an economically anemic, yet still affluent, Japan". The word "*mottainai*" dates back to at least the thirteenth century, when it was used in a collection of tales to suggest trouble, harm, and impropriety (Matsumura et al, 1994). In premodern times the word "*mottainai*" was used to express regret and disappointment or even graciousness. In more modern usage, "*mottainai*" could mean unworthy or irreverent. Siniawer (2014) advocates Hiroi Yoshinori's theory that "the era of single-minded obsession with growth has ended….. more attention had to be geared towards the spread of the kinds of human activities and desires that could not be measured by money". Hiroi who is the Vice Director of the Kokoro Research Center, Kyoto University, focuses on the social policies in health care, welfare, and social security including the environment and communities to realize Japan as a sustainable welfare society. According to Siniawer (2014), Hiroi's interpretation of *mottainai* in the contemporary spotlight was one indication towards Japan's reexamination of the meaning of affluence. The idea of *mottainai* can be readopted and

emphasized to reduce Japan's obsessiveness with material goods which include the habit with pristine packaging. Thus the idea of *mottainai* can easily be linked to the increase in using *furoshiki*.

2.3 Increase the usage of *furoshiki*

In general, wrapping is used for hygienic purposes for example, to protect goods from impurities including dirt and to keep the content of goods together while the goods are being transported. Certain vegetables and fruits are being wrapped to keep them fresh longer. Lack of wrapping in a pre-packaged world could be seen to stand for non-standardization. There can also be cultural variation in attitudes towards wrapping goods. The current Tokyo Govenor, Yuriko Koike's special project which is aptly called the *Mottainai Furoshiki* (Nikkei Asian Review, 2017) is aimed to curb waste by promoting *furoshiki* made with a fiber derived from recycled PET bottles. The promotion of *furoshiki* could also promote Japanese fine culture to the world. Normally, the *furoshiki* is a traditional Japanese cloth used to wrap and carry objects. The word *mottainai* in this case expresses regret for wastefulness and not just the act of wasting, but the principles and feelings associated with the consciousness of wastefulness. Koike explained that the reusable and multipurpose *furoshiki* can be used to can wrap almost anything regardless of size or shape. She added that the cloth is a symbol of Japanese culture, and "puts an accent on taking care of things and avoiding waste". Japan has made its nation to re-categorize a valuable object as waste by the person who has used it or discarded it. Prior to being the Tokyo Governor, Koike served as the environment minister and managed to conduct "Cool Biz" campaign, another environmentally friendly campaign which urged the Japanese nation to reduce air conditioning usage by dressing casually during the summer.

2.4 Reduction of *reji-bukuro*

Although plastic bags are convenient to consumers, the bags can cause excessive usage, and inadequate recycling can cause environmental pollution. Even with its problematic plastic bag habit, Japan is still more superior than most developed countries in areas of waste management. Is it important to break this habit? Most plastic bags are difficult to recycle because they are made from different types of compounds with different melting points. PET bottles are made with an easily recycled plastic resin called polyethylene terephthalate. Not all plastic bottles are as such. Although plastic bags can be burned, but not all districts in Japan choose to burn them because if the bags are not properly disposed, the residues are often blown into rivers and streams. Do plastic bags represent a culture of wastefulness? It is economical to reduce plastic bag consumption due to the increasing price of plastic materials. Some Japanese local governments choose not to ban but discourage the use of plastics by not providing the customers plastic bags, *reji-bukuro*.

An effective way to deal with the plastic pollution, is to limit and reduce its use. The single largest market for plastic is packaging, an application whose growth has expanded in tandem with economic development and the movement from reusable to single-use containers. For many, this can often be seen as a sign of affluence since we can afford to tailor-made the production of plastic according to our needs or according to the current trends. Due to the massive amounts of plastic goods, consumers can help to reduce plastic pollution by doing more

to recycle the plastics they have and by refusing the producers and service providers the wrappings and packaging that are often taken as quality service.

Recycled PET packaging can also be turned into new bottles, sheeting, industrial materials, fiberfill for sleeping bags and winter coats, and a range of car parts. In 2014, 93.5% of PET bottles distributed nationwide were recycled, according to the Council for PET Bottle Recycling. But while Japan is a country of religious waste sorters, there is a trendy counteraction in Japan which is against over-packaging. In Japan, it is common to package an item in multiple layers of plastic. It is common for food items to be covered with a transparent plastic before being placed in a paper bag, which will then be inserted into a plastic carrying bag. This raises a question: Is Japan eco-friendly or eco-hostile? There has been an ongoing debate about charging for plastic bags which challenges Japan's conservation contradictions. The Tokyo Metropolitan Government has announced its goal of getting all retailers to charge a small fee for plastic shopping bags by 2020. In doing so, it sought to end a debate that had been dragging on for years between the government advocates and corporate influences. Some stores have already reduced their plastic usage or charging for bags, including supermarket chains Aeon, Ito-Yokado and OK Store.

Yasuo Furusawa, director for sustainable materials management at the Tokyo Metropolitan Government (Nikkei Asian Review, 2017) is of the opinion that there must be a nationwide ban of free bags in Japan. The abundance of convenience stores is one reason why Tokyo's annual per capita plastic bag consumption is higher than most other towns, and higher than the average in Europe. He estimated that the average shoppers in Tokyo use around 200 bags per year. However, there are oppositions from convenience stores in Japan that are concerned about charging for bags which would make customers refrain from stopping by their stores for a drink or snack.

There is an increase in demand for bio-based plastics which are produced from renewable carbon resources (Iwata, 2015). The renewable carbon resources are extracted from plants including starch and cellulose. Bio-based plastics which can be burned after use are considered as eco-friendly materials based on the concept of carbon-neutrality which means the generated carbon dioxide is again converted into biomass by photosynthesis. Therefore, most bio-plastic are biodegradable. Such plastics are labeled as "green plastic" by Japan Bioplastic Association (JBPA). Japan has also begun the use of garbage bags, shopping bags and former products from bioplastics by all levels including by big companies and this is Japan's efforts to enhance their eco-friendliness in order to reduce plastic pollution to the environment. The customers could learn to appreciate the changes in packaging.

2.5 Avoid throwaway culture

The throw-away society is a human society strongly influenced by consumerism. The term describes a critical view of overconsumption and excessive production of short-lived or disposable items over durable goods that can be repaired (Hall, 2017). Addressing the plastic bag issue may be only a small step toward sustainable living, but it presents a valuable opportunity to examine other wasteful practices and further lighten the country's environmental footprint. Japan's throwaway culture can be witnessed by the individually wrapped produce in

grocery stores. Gifts are covered in layers of decorative packaging. Electronics are retired prematurely to be replaced by newer models. As long as this continues, it will blunt the impact of all the sorting, washing, melting, burning, compacting and repurposing. The local government of Miyagi Prefecture subsidizes enterprises that convert plastic waste into something else. Monetary gain is the incentive, and some companies have created household and industrial products from recycled plastic waste, however these items are still plastic and they will need to be converted into waste that once again has to be processed.

Jambeck *et al* (2015) reported that Malaysia was the eighth worst country worldwide for plastic waste. It was estimated that Malaysia produced almost one million tons of mismanaged plastic waste in 2010. The chances of these wastes to end up in the oceans and poisoning or choking marine life and sea birds are huge. Can we change our way of living? Malaysia's rapid development, economic and population growth have increased the amount of plastic waste by households, industries and trade sectors. The careless disregard for the environment is worrying. Unfortunately, many Malaysians are unaware of recyclable plastics therefore there are still many plastic wastes that are not being separated from each household or even companies. The National Solid Waste Management Department, Malaysia (JPSPN) and Malaysian Plastics Manufacturers Association (MPMA), is advising the nation to separate plastic wastes into either thermoplastics (recyclable plastics) or thermosets (non-recyclable plastics). However, even when plastic bags can be recycled, the demand in the market is still low and the cost of recycling plastic waste is higher than producing a new plastic. Could this be the core issue of why plastic waste is not really recycled in Malaysia? Apart from steering away from the throwaway culture, there must be an improvement in the attitude, awareness and knowledge regarding the proper waste management system in Malaysia.

Although many may think that it is unimaginable for us to stop using plastic bags, several countries in Africa have banned plastic bags. The world has seen some successful changes. Several other governments have taken action to reduce single-use plastic bags. Bangladesh instituted a ban in 2002 after it was found that major floods were caused by plastic bag litter caught in waterways and the sewerage system. Mauritania banned plastic bags because cattle were getting sick from eating them. In many western European countries, there is a charge for bags, which has led to consumers bringing their own bags. Some German shops only sell reusable bags. With some incentive by the government in Germany, almost 99% of refillable plastic bottles are collected for recycling or re-use. Beginning 2020, France will be the first country to ban plastic plates, cups and utensils. Earlier in 2016, France started to ban retailers from distributing thin plastic bags (Hall, 2017). This caused the nation to resort to reusable and recyclable biodegradable bags. Comparatively, in the United Kingdom, forty-two British companies including the country's biggest supermarkets and retailers have pledged to make sure all their plastic packaging to be reusable, recyclable or compostable by 2025. "U.K. Plastic Pact" which is responsible for over 80 percent of the plastic packaging on products sold in the UK's supermarkets aims to ensure that 70 percent of plastic packaging is recycled or composted. Japan could reinforce these tendencies by encouraging recycling and restricting the nonessential use of plastics. Perhaps there should be a policy to restrict the use of plastic which will encourage the society to be more careful and selective about plastic usage and this in turn can lessen the throwaway culture. Such policy should also concern the problem of water-born pollution due to the damage that plastics do once they enter the marine ecosystem.

2.6 Chemistry lessons and research

The role of an educator is to provide an understanding of the importance of Green chemistry for everyday use and not just in innovation, application and teaching. Educators also need to provide appropriate educational materials for different curriculum instruction levels. It is hoped that funding of scientific activities globally be encouraged by giving priority to the development of green science and technology. Policy makers must understand the role of science and technology and make pollution prevention to ensure global environmental protection while maintaining scientific and economic development as a major. Many industries and research organizations have yet to implement Green Chemical principles, but some of them are beginning to realize that 'think green' (Chhipa, 2013) should be exposed to everyone including the students, community, industries and policy makers.

Experiments for high school students can be in the form of introducing them to the definition and types of thermoplastics that can be recycled which are PP (polypropylene), LDPE (low density polyethylene), HDPE (high density polyethylene), PS (polystyrene), PVC (polyvinyl chloride) and PET (polyethylene terephthalate). Chemistry students are taught about the structures of plastics. Students can be exposed to topics regarding plastics formation, their functions and utilities. Students can be taught to describe a model of hydrometer with the assistance of *TEIKEI* (assisted Model-based Learning), design the experiment to test the model, analyze the collected data and draw their conclusions and write a report concerning plastic materials (Teratani, 2017). Professor Teratani of ECoS has developed such an educational material to infuse the concept of Green and Sustainable Chemistry (GSC) into high schools. It is expected that plastic samples sink more than expected from density, negligible for PP and HDPE rods but not for a LDPE tube. However, there must be a concerted effort by all schools to make students understand and differentiate between the recyclable plastics, plastic wastes and how to avoid plastic littering. There must also be a concerted effort by all schools to educate students through relevant projects regarding the aspects of plastic pollution.

The first type of thermoplastic is Polyethylene terephthalene or commonly abbreviated as PET, is a polymer that used in synthetic fibers for beverage, food and other liquid containers. Next we have, High Density–Polyethylene (HDPE) which is the high density version of Polyethylene plastic but it is harder, stronger and a little heavier than LDPE, but less ductile. Some of the examples of HDPE are gasoline tank, milk bottle and children's toys. Next one is Polyvinyl Chloride (PVC) which is one of the most widely used plastics due to its low cost and wide range of properties. The examples of PVC are pipes, sheets, cable insulation and mineral drinking water bottles. The forth type is Low Density–Polyethylene (LDPE). It is more flexible than HDPE, light-weight and easily cleaned. Shrink wraps, cling films and cleaning garments are some of the examples of LDPE. Follow by, Polypropylene (PP) which is the fifth type of plastic coding. PP plastics are widely used in textiles, packaging, stationeries and loudspeakers. Polystyrene (PS) is another type of plastics which is strong and best known to be styrofoam for manufacturing products and food packaging material.

Meanwhile, there are efforts at the tertiary academic level by other scientists to improve and make recycle plastic easier. Recycling has become a fundamental activity to several nations' environmental movement and since then, society has become too dependent on recycling. Thus, research must continue to improve the recycling methods. Although an American research team has successfully recycled plastic repeatedly without degrading the polymer, the system is still expensive. Another prospect is the development of a useful bacteria. Researchers at the Kyoto Institute of Technology and Keio University have discovered bacteria that eats PET plastic using their enzyme which can assist in the breakdown of plastic. This is indeed useful but there needs to be further research in this matter to improve the cost of the process. Technology must also be improved to produce more effective recycling efforts which in turn will produce goods that can be made from waste plastic.

Japan's 2018 Science and Technology in Society (STS) forum in Japan is held in Kyoto in October. This forum showcases how Japan uses science and technology for the benefit of the society. "Society 5.0" is Japan's a super-smart, high-tech new creation defined as "a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space". This concept was firstly explained by Prime Minister Shinzo Abe in 2018 (Abdul Hamid, 2018). One of the goals of Society 5.0 is to address many issues in this new society that is an interconnection of people, things and systems. A Japanese observer mentioned that "traditionally, innovation driven by technology has been responsible for social development, but in the future, we will reverse our way of thinking, focusing on how to build a society that makes us happy and provides a sense of worth. That is why we focus on the word "society" as a foundation for human life" (Abdul Hamid, 2018). Perhaps Society 5.0 may fit into Japan's national plans, programs and strategies including those to solve plastic pollution.

3. SUMMARY

Although plastics are still needed in our society, there is a need to educate and prepare our next generation to establish a more sustainable way of living. There is also a need to cease adopting the throwaway culture which could give rise to plastic pollution among others. Students as well as the society should be educated about eco-friendly plastics which will cease to harm not only the land but also the oceans. Japan can assist in this endeavor especially when the beautiful traditional culture of *furoshiki* and the sense of *mottainai* to combat the wastefulness are strong amongst its society. There is hope that the attention to *mottainai* and the concerns it reflected will increase amongst the society. There must be a multileveled approach, with governments, producers, consumers, and even schools, all changing attitude and behavior towards the usage and disposing methods of plastics. The Japanese government will continue to address waste problems by implementing aggressive recycling policies. As apparent today, due to the control of air, water and waste pollution, Japan has become one of the cleanest cities in the world. Japan can act as a role model in this effort.

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