

Implementation of Environmental Education for Waste Management in Japan

Atsuko Hanashima¹

¹ Faculty of Design Engineering, Osaka-sangyo University, Osaka, Japan

Correspondence: Atsuko Hanashima, Faculty of Design Engineering, Osaka-sangyo University, 3-1-1 Nakagaito Daito-shi Osaka-fu 574-8530, Japan. Tel: 81-72-875-3001. E-mail: hanashima@est.osaka-sandai.ac.jp

Received: October 19, 2024

Accepted: December 2, 2024

Online Published: December 9, 2024

doi:10.5539/jsd.v18n1p1

URL: <https://doi.org/10.5539/jsd.v18n1p1>

Abstract

Exploring Japan's approach to environmental education, particularly in the context of waste management, offers valuable insights into the intersection of education and sustainability. Environmental education, implemented over an extended period, has played a pivotal role in shaping societal values toward sustainability. In Japan, such activities have been ongoing since the 1930s, yet the long-term impacts on societal behavior and policy development remain underexplored. This study presents an overview of Japan's educational framework, focusing on quantitative trends based on a nationwide survey of waste incineration facilities conducted in 2010, reflecting data from fiscal year 2009. The survey achieved a 94% response rate (731/775 facilities) and revealed that in fiscal year 2009, approximately 1.28 million people visited waste incineration facilities, with 69% being fourth-grade students participating in curriculum-based field trips. Extrapolating from these data, it is estimated that 44% (55 million) of Japan's current population has experienced environmental education through such visits during their elementary school years. This widespread participation underscores the extensive reach and societal impact of these initiatives in fostering awareness of waste management. By integrating the Sustainable Approach, which ensures intergenerational equity, with the Capability Approach, which empowers individuals for sustainable well-being, this study illustrates the potential of Japan's long-standing environmental education practices, particularly in fostering sustainable behaviors and policy innovations, to serve as a global model for sustainability efforts.

Keywords: capability approach, sustainable approach, incineration facility, elementary school, field trip, long-term

1. Introduction

There are two major approaches to considering a sustainable future. The first is based on the concept of sustainability introduced by the so-called Brundtland Commission (World Commission on Environment and Development, 1987) and is referred to as the sustainability approach. The second is the capability approach, which is based on Amartya Sen's concept of "capability" (Sen, 2013). The former, in brief, imposes certain material constraints on the current generation for the sake of future generations, while the latter posits that enhancing individual capabilities, such as through education, without restricting the freedom of the current generation, will ultimately lead to environmental conservation.

There are several previous studies suggesting that education has a positive impact on waste management. For example, a study involving 25 OECD countries (Halkosa G and Petrou KN, 2020) demonstrated that as education levels increase, the amount of waste generated decreases. One quantitative example of the effects of environmental education is provided by Maddox et al. (2011), who implemented a 2.5-year environmental education program for 6,700 primary school students in the United Kingdom, reporting an 8.6% increase in recycling rates. Additionally, in developing countries, there are several instances of environmental education programs aimed at improving waste management, although these initiatives tend to be short-term and primarily yield qualitative results. While there are many efforts to improve waste management through environmental education, the process of disseminating education across entire populations takes a long time, and the causal relationships are often indirect. As a result, there are no reports documenting the widespread implementation of long-term environmental education programs.

For nearly a century, Japan has had civic education aimed at improving waste management. Efforts to provide environmental education on waste management to the general public first began in the 1930s with round table discussions, exhibitions, field trips, and the creation of educational brochures and films. Although these

educational activities were halted during the Second World War, they resumed in earnest in the post-war period, culminating in the Ministry of Education incorporating education on waste management into the elementary school curriculum in the 1970s. As part of this initiative, for approximately fifty years, waste treatment facilities across Japan have hosted field trips for elementary school students, allowing them to experience first-hand the scale of waste issues and learn about waste disposal and its environmental impacts.

To date, however, no comprehensive quantitative studies have been conducted that summarize these efforts in Japan. This is partially due to the fact that studies on waste management have primarily focused on technical and regulatory measures, with limited attention given to civic education. Additionally, the separation of school education and social education from waste management under different government departments has contributed to the lack of attention to this issue. Bureaucratic siloing frequently hinders inter-ministerial collaboration when separate ministries oversee related areas. As a result, issues spanning multiple fields, such as waste management and school and social education, are often addressed less efficiently due to this administrative segmentation. In this context, this report first provides a brief overview of the historical background of environmental education for waste management as implemented in Japan. To elucidate the scale of long-term and wide-reaching environmental education conducted by waste management facilities, data from a nationwide questionnaire survey sent to these facilities are used for quantitative analysis of these educational activities.

2. History of Environmental Education for Waste Reduction in Japan

2.1 Origins of Environmental Education for Waste Reduction

Records of waste disposal regulations in Japan date back to around the 17th century with the implementation of regulations concerning waste disposal into rivers and street cleaning in 1637 in Osaka City (Osaka City Sanitation Department, 1921). More recently, in 1900, modern waste management laws were enacted by the Japanese government to address the spread of infectious diseases such as cholera and plague, and at that time municipalities became responsible for waste management. Over time, in response to increases in the amounts of waste being generated, municipalities not only strengthened the regulations but also began promoting citizen cooperation. Table 1 shows the origin of educational activities for waste reduction in the above municipalities. Each municipality started its unique environmental educational program for waste reduction.

The oldest educational activity for waste reduction on record is that of Osaka City (Osaka-shi Kankyo Jigyo Kyokai 2009), which organized “meetings for reducing trash” with a group of women’s organizations. Based on these meetings, the city distributed flyers, held lectures, and organized field trips to incineration facilities. The two pillars of the waste reduction education, introduction to cleaning facilities and encouragement for waste reduction by civil support, started around this time.

In the records of Tokyo, the annual municipal report in 1938 (Tokyo-to Kankyo Kosya 2000) has the following account. “The development of a clean and comfortable city cannot be solely achieved by the staff members of the municipality. This is impossible without civil cooperation, and it is therefore necessary to spread and promote the concept of cleaning.” In 1938, a talkies titled “cleaning and resources” was created in Tokyo City, and the concept of cleaning was introduced with the latest technology at that time. Moreover, 101 lecture and movie meetings, which called for city cleaning and resources protection (effective use of resources), were held with more than 148,700 participants. In addition, 2.63 million flyers and 20,000 posters were distributed in each ward, and 90,000 bookmarks with cleaning terminologies were distributed in women’s middle schools in the city.

Later, after the Pacific War from 1941 to 1945 and the following restoration, the municipalities in Japan tackled the increasing amount of waste again. In Sapporo City, a major city in northern Japan, people contributed lyrics for cleaning to promote the concept of cleaning in 1960 (Hokkaido Newspaper 1999). In addition, 3,000 songsheets with a song “for a clean town” were distributed in 1965. In the same year, the 16 mm film “Cleaning Sapporo City” (summer version) was created. Sapporo City excelled in educational activities using music and films.

In Fukuoka City, a major city in southern Japan, cleaning monitors and watchmen for illegal dumping were established with civil support in 1965 (Environmental bureau of Fukuoka city 2005). The city attempted to promote and enhance the concept of cleaning among citizens and companies and to curtail illegal dumping. In 1967, the policy of cleaning supervision by citizens was implemented for the first time in Japan. Fukuoka City made efforts in educational activities as well as regulations.

Table 1. Chronology of environmental education for waste management in Japan

Year	Administration	Activities implemented related to environmental education for waste management	Source
1933	Osaka City	Co-Sponsored with the All Kansai Women's Federation, a "Roundtable on Waste Reduction" and some tours of waste treatment facilities	1)
1934	Osaka City	Publication of a promotional brochure "Treatment of trash in the city"	1)
1935	Osaka City	Organize an exhibition called "Garbage Utilization Exhibition" to inform citizens that there are still valuable items in trash	1)
1938	Tokyo City	Year Book of Municipal Government (of Tokyo) "It is impossible to develop a clean and comfortable city without civil cooperation. It is necessary to spread and promote the concept of cleaning."	2)
1938	Tokyo City	Release of a film titled "Cleaning and resources"	2)
1940's		Activities halted during World War II and post-war recovery	
1950's			
1960	Sapporo City	Creation of a song titled "Song of cleaning" by asking the public for suitable lyrics as part of activities to promote cleaning	3)
1965	Sapporo City	Pressing of 3000 phonograph records of "Song of cleaning"	3)
1965	Sapporo City	Creation of a short film titled "Cleaning of Sapporo City (Summer version)"	3)
1965	Fukuoka City	Monitors appointed to oversee education related to waste reduction and to prevent illegal dumping	4)
1968	Fukuoka City	Started to award cooperators for cleaning	4)
1971	Ministry of Education	Ministry of Education implemented new educational guidelines for primary schools that recommend teaching about waste treatment	5)
1976	Sapporo City	Exhibition room with the theme of waste and cleaning opened at the Atsubetsu incineration facility	3)
1989	Ministry of Health and Welfare	Government subsidies are started for the construction of "Recycle Plazas", which are recycle facilities that also have an educational function.	6)

- Sources
- 1) Osaka-shi Kankyo Jigyo Kyokai (2009) History of environmental administration in Osaka city for 120 years (in Japanese).
 - 2) Tokyo-to Kankyo Kosya (2000) History of environmental administration in Tokyo for 100 years (in Japanese).
 - 3) Hokkaido Newspaper (1999) Waste and Recycle, edited by Educational board of Sapporo City (in Japanese).
 - 4) Environmental bureau of Fukuoka city (2005) Historical record of Environmental Administration in Fukuoka City (in Japanese).
 - 5) Ministry of Education: <https://www.nier.go.jp/guideline/>, accessed 20 June 2024 (in Japanese).
 - 6) Editors Noritoku Kojima, Sohei Shimada, Shozo Tamura, Kamon Nitagai (2003), Encyclopedia of waste, Maruzen Co., Ltd. (in Japanese).

2.2 Environmental Education through Field Trips to Waste Treatment Facilities

The Ministry of Education has made several revisions to the national educational curriculum guidelines with the aim of fostering an understanding of community-supporting systems in elementary school students. In the 1968 revision, implemented in 1971, the ministry began by adding a guideline establishing that third-grade social studies in elementary schools should include an understanding of sewage and waste management systems. Then, in the 1977 revision, implemented in 1980, a further guideline was revised to state that fourth-grade social studies should include an understanding of water supply, electricity, gas, and waste management. In the 1989 revision, implemented in 1992, the ministry strengthened its stance by including the phrase "visiting and investigating waste treatment facilities" in the curriculum, with the 1999 revision, implemented in 2002, further adding that the curriculum should cover how waste is utilized as a resource in collaboration with the then Ministry of Health and Welfare's waste policy.

Field trips have long been a common practice in elementary schools in Japan. In the 1930s, popular field trip destinations included newspaper companies, while in the 1940s, students visited newspaper and paper-making companies. By the 1950s, milk and bread factories had become common destinations. In the 1960s, confection factories were added alongside milk and bread factories. Starting in the 1970s, infrastructure facilities such as water purification plants, incineration plants, and sewage treatment facilities began to emerge as frequent field trip destinations. By the late 1980s, many schools incorporated visits to both infrastructure facilities, such as incineration and sewage treatment plants, and food-related facilities, such as milk, bread, confection, and beverage factories. Within this historical trend, the practice of elementary school students visiting incineration plants did not originate as a top-down directive from the Ministry of Education through its curriculum guidelines. Instead, it developed as a bottom-up initiative driven by schools and incineration plants across the country. These grassroots efforts gradually expanded, eventually prompting the Ministry of Education to incorporate such field trips into its national curriculum guidelines.

2.3 Civic Education Through Waste Treatment Facilities

Waste treatment facilities have provided not only school education but also civic education. According to records from the Osaka City Council (Osaka-shi Kankyo Jigyo Kyokai, 2009), ten incineration facility tours were conducted in Osaka City in 1933 as part of waste reduction education. In 1976, the Atsubetsu Clean Center, an incineration facility in Sapporo City, opened a permanent exhibition corner on the theme of waste management for public education (Educational Board of Sapporo City, 1999). The Machida Recycling Culture Center, completed in 1982, was built as an annex to an incineration facility. This center featured:

- an educational training room,
- a recycling corner where citizens could experience repair and crafts,
- an exhibition room for displaying and selling recycled products,
- a laboratory for waste reduction research open to the public,
- a storage area for recycled goods,
- a printing room for recycling activities, and
- a room for organizing materials.

The facility was designed to foster a new recycling culture among citizens, as indicated by its name. Around this time, the term “recycling” began to gain popularity in Japan, encompassing both reuse and recycling in this context.

Encouraged by these local governments initiatives, the Japanese government also began supporting civic education for sorting and recycling. In 1989, the Ministry of Health and Welfare began subsidizing the construction of additional facilities for citizen education on waste reduction when municipalities constructed resource recycling centers. The first subsidy was awarded to the Suita City Resource Recycling Center in Osaka Prefecture, which opened in 1992. This facility featured both a plant for shredding and sorting recyclable materials and facilities for citizen activities, education on a recycling-based society, and research conducted by citizens themselves. These facilities, which combined sorting plants with educational spaces, were designated as “Recycling Plazas” or “Recycling Centers” and were constructed in many municipalities across the country. In some facilities, unused items, repaired products, and cleaned furniture were sold. There are currently no statistics available on the number of facilities in Japan with such functions. As of 2022, Japan had 905 municipal incineration facilities and 853 recycling facilities nationwide (Ministry of the Environment, 2022). Many of these facilities host educational field trips and are equipped with resources and programs for civic education.

3. Quantification of Field Trips to Incineration Facilities in Japan

3.1 Survey Overview

To understand the state of environmental education conducted at waste treatment facilities in Japan during that period, a nationwide questionnaire survey targeting waste incineration facilities was conducted in December 2010. This study presents the findings of that survey, which focused on environmental education initiatives at waste treatment facilities that began in the 1970s, using data from fiscal year 2009. Although the findings remained unpublished for an extended period, they have now been compiled into this paper in 2024. Despite the time that has passed since the survey was conducted, as detailed in Section 4.2, the survey targeted nearly all incineration facilities in Japan, excluding only very small-scale ones, and achieved a remarkable response rate of 94%. These results provide unique and valuable insights into the state of environmental education at waste incineration facilities in Japan as of 2009.

The survey was conducted by mailing questionnaires to incineration facilities across the country in December 2010, with responses collected via mail or fax. For facilities that did not respond, the same questionnaire was sent again in February 2011, accompanied by a request for participation. Further details regarding the targeted facilities and survey items are provided in the following sections.

3.2 Target Facilities

The incineration facilities included in the survey were selected based on the following criteria. According to the Ministry of the Environment (Ministry of Environment 2012), there were 1133 facilities categorized as “incineration facilities (including melting facilities)” in Japan in 2010, of which 996 were categorized as incineration facilities with non-zero annual disposal weights (Table 2). These 996 facilities were further categorized as being fully continuous incinerators (520 facilities), semi-continuous incinerators (209), or batch-type incinerators (267). Fully continuous incinerators operate 24 h a day and have a high processing capacity per facility, whereas semi-continuous incinerators typically run for approximately 16 h per day. Batch-type incinerators cannot be continuously fed waste and instead operate using discrete cycles of loading, incineration, and cleaning. In 2010, fully continuous and semi-continuous incinerators together accounted for 97% of the total waste incinerated in Japan. Since there is a correlation between the amount of waste produced and the population distribution, focusing the survey on fully continuous and semi-continuous incinerators was considered sufficient to cover the vast majority of Japan’s population; thus, batch-type incinerators were excluded from the survey and analysis.

Table 2. Summary of incineration facilities in Japan and those targeted in the survey

	No. existing facilities ¹	Waste processed in 2010 (t) ¹	Proportion of total waste processed	No. facilities surveyed ²
Fully continuous incinerator	520	27 125 747	87%	566
Semi-continuous incinerator	209	2 924 051	9%	209
Batch-type incinerator	267	1 047 377	3%	0
Total	996	31 097 175	100%	775

¹Data from Ministry of Environment in 2010 ²Address list from Waste Management Research Foundation in 2006. Since the Ministry of the Environment data (2010) does not include facility addresses, the address list from 2006 was used for the survey. Therefore, the number of facilities listed by the Ministry in 2010 does not align with the number of facilities surveyed.

To conduct the survey, a questionnaire was sent by mail to each of the incineration facilities. However, as the Ministry of the Environment does not publish a list of the addresses of incineration facilities, the addresses used to send the questionnaire were taken from the Incineration Facility Register 2006 published by the Waste Management Research Foundation (2008). Unfortunately, since this register data was from 2006, it included facilities that had been decommissioned in the four years leading up to the 2010 government survey, which explains the discrepancy between the number of facilities listed by the Ministry of the Environment in 2010 and those targeted in the survey. Ultimately, questionnaires were sent to 775 fully continuous and semi-continuous incinerators, which were estimated to handle the waste generated by 97% of Japan's population.

3.3 Survey Items

The survey was conducted using questionnaires written in Japanese and covering the following items:

1. Number of visitors
 - Total number of visitors in fiscal year (FY) 2009
 - Breakdown of visitors by demographic categories for FY2009
2. Content of the elementary school student field trip program, if available
 - Overview of the field trip program
 - Individual responsible for designing the field trip program
 - Attributes of an explainer of the field trips
 - Availability of brochures written for elementary school students
 - Key features of the elementary school program
3. Facilities for visitors
 - Availability of educational rooms and other facilities for visitors
4. Changes in elementary school visits and feedback
 - Increase or decrease in visit requests from elementary schools (compared to five fiscal years ago)
 - Attitudes of elementary school students observed by facility staff
 - Perspectives of incineration facility staff on elementary school field trips
5. Visits to other waste management facilities in the same municipality
 - Availability of other waste management facilities in the same municipality that also accept visitors

Questions were asked on the above items, but due to space limitations, it is not feasible to present the results for each response in detail. In the following *Results and Discussion* section, the focus will be on quantitatively clarifying aspects of environmental education in incineration facilities. This includes the high population coverage of the survey, the number of visitors to incineration facilities revealed by the results, the proportion of elementary school field trips among these visitors, and the state of facilities prepared for accommodating visitors.

4. Results and Discussion

4.1 Response Rate

Out of the 775 facilities contacted, 731 responded (Table 3). The response rates were 95% for fully continuous incinerators, 92% for semi-continuous incinerators, and 94% overall. However, 21 of the responding facilities indicated that they had been decommissioned or their activities were temporarily suspended, so the number of facilities reporting usable data on visitors was 710. This high response rate demonstrates the strong interest in information about field trip programs. Despite this interest, no similar surveys have been conducted previously, resulting in a lack of comprehensive data on environmental education at waste treatment facilities. The cover letter accompanying the questionnaire included a URL where the preliminary results would be posted, and facilities were informed that they could request preliminary results via email; this may also partially account for the high response rate.

Table 3. Number of questionnaire responses and response rates

	No. facilities surveyed	Responses received	Response rate	No. facilities reporting decommission or suspension	No. facilities used as data
Fully continuous incinerator	566 (100%)	537	95%	9	528
Semi-continuous incinerator	209 (100%)	194	93%	12	182
Total	775 (100%)	731	94%	21	710

4.2 Number of Visitors to Incineration Facilities

The questionnaire responses revealed that 1 275 823 people visited waste incineration facilities in FY2009 (April 1, 2009, to March 31, 2010), which corresponds to approximately 1% of Japan's total population at the time (Table 4). The mean number of visitors per facility was 1799 with a maximum of 23 791. Two facilities recorded more than 20 000 visitors annually. The facility with the highest number of visitors (23,791) was located in a city with a population of approximately 80,000. This facility offers free public baths using the residual heat from waste incineration, which suggests that the visitor count likely included people coming for purposes other than field trips and environmental education activities. According to the breakdown of visitor numbers, the total included 860 elementary school students, 47 university students, 1,662 participants in waste reduction training programs designated by the local government, and 21,222 general visitors. Based on the number of elementary school students and participants in waste reduction training programs, it is presumed that the facility actively engages in environmental education. However, as no direct inquiry was made, it remains unclear to what extent the visitor count includes individuals who came solely to use the free public baths. The facility with the second-highest number of visitors (23 206) was located in a city with a population of approximately 420 000. This facility is known for its active environmental education programs and does not offer public baths, meaning the visitor count reflects only participation in tours and environmental education activities.

Table 4. Number of visitors to incineration facilities in Japan (FY2009)

Total number of visitors	1 275 823
Visitors per facility	Minimum 0
	Maximum 23 791
	Mean 1 799
	Median 1 040
n = 709	

4.3 Facilities for Visitors at Incineration Facilities

According to the survey results, 76% of the incineration facilities that responded had conference rooms or training rooms for visitors as of 2010. Exhibition corners were available at 54% of the facilities, and 54% also had dedicated visitor passage. Here, Figure 1 shows an example of exhibition corners. Visitor passage, as shown in Figure 2, are pathways designed to allow visitors to safely tour incineration facilities. These passages enable visitors to view plant equipment through glass or other barriers. Figure 3 shows the presence of visitor's passage by facility construction year. Over time, the number of facilities with visitor passages has increased, with 88% of facilities constructed between 2005 and 2010 having such passage.



Figure 1. Exhibition corners of incineration plants



Figure 2. Visitor passage within incineration facility

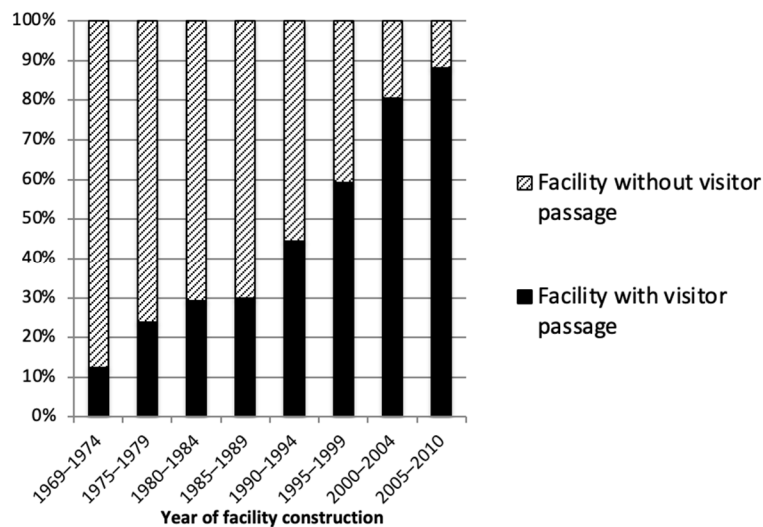


Figure 3. Annual changes in the percentage of facilities with a visitor passage

4.4 Estimated Visitor Rate of Fourth-Grade Students Nationwide

According to the questionnaire, 69% of the visitors to incineration facilities were fourth-grade elementary school students visiting as part of their school curriculum. The proportion of fourth-grade students nationwide who visit incineration facilities was estimated as follows. First, the number of elementary school visitors per incineration facility was obtained in this survey. Enrollment numbers for fourth-grade students are publicly available only at the municipal level. Some facilities are jointly operated by multiple municipalities, while others are run by a single municipality. In some cases, a single municipality operates multiple facilities. Therefore, data were obtained for cases where a single municipality operates one incineration facility, allowing for the combination of the number of enrolled fourth-grade students and the number of visitors. This resulted in a dataset of 275 municipalities.

Using this dataset, the fourth-grade visitor rate (visitors/enrollment) was calculated for each municipality, resulting in an average visitor rate across the 275 municipalities of 0.87 (SD, 0.326). Based on this, the nationwide rate for fourth-grade students visiting incineration facilities in 2009 was estimated to be 87%. It should be noted that some incineration facilities also accept visitors from neighboring schools, which can result in the fourth-grade visitor rate (visitors/enrollment) exceeding 1 in cases where neighboring schools are included.

Adding details about the circumstances of the visitors and the facilities, 94% of facilities reported positive impressions of elementary school students during their visits, with 34% responding *very good* and 60% *fairly good*. The number of valid responses to this question was 693. Additionally, when asked how they felt about hosting children for visits, 46% of the facilities indicated they were *very welcoming*, while 35% were *somewhat welcoming*, resulting in 81% expressing a welcoming attitude. Among the small proportion of facilities (1%) that responded they found it *highly burdensome*, reasons cited included insufficient staff for guiding visitors and challenges in ensuring the children's safety. The number of valid responses to this question was 692. Overall, the survey revealed that both the attitudes of the children and the feelings of the hosting facilities were overwhelmingly positive.

4.5 Estimated Number of People Who Have Visited an Incineration Facility as an Elementary School Student

This section presents an estimation made under bold assumptions to clarify the scale of educational activities related to waste management conducted at incineration facilities to date. The first major assumption is using 1980 as the starting point. In Japan, the national curriculum first introduced waste management education for third-grade students in 1971. Since then, some schools have organized field trips to waste treatment facilities, with these facilities increasingly adapting to accommodate them. The 1980 curriculum revision shifted waste management education to fourth-grade students, making such field trips a nationwide practice. Additionally, a report by the Waste Treatment Technology Review Committee, composed of plant manufacturers and municipal representatives (Miyoshi, Y. et al., 2013), noted that “while visitor routes were not installed in facilities around 1970, by around 1980, most facilities—except for some smaller plants—had established these routes.” Here, “visitor routes” refers to simpler walkways, distinct from the visitor passages described in Section 4.3. Based on this, it is assumed that by 1980, field trips for fourth-grade students to incineration facilities were already conducted in nearly their current form.

The second major assumption concerns the proportion of visitors. As described in Section 4.4, the current survey revealed that in FY2009, 87% of fourth-grade students visited incineration facilities. The same survey asked about changes in the number of school visit requests, and 59% of responding facilities (405 out of 692) indicated “no change,” suggesting stable visitor numbers at many facilities. Similarly, a survey conducted in 2021 (Hanashima A, 2024) revealed no significant changes in the implementation status of elementary school visits to incineration facilities. Based on these findings, it is assumed that the proportion of fourth-grade students visiting incineration facilities has remained constant at 87% from 1980 to 2024.

Using these two major assumptions, an estimation was made to calculate what proportion of Japan's current population had visited an incineration facility as fourth-grade students between 1980 and 2024. Children who were fourth graders in 1980 (aged 10) are now 54 in 2024. The population of this age cohort (those aged 10 to 54 in 2024) is approximately 62 million. Of these, 87%, or approximately 55 million, are estimated to have visited an incineration facility during their fourth-grade year. This figure represents a population coverage of approximately 44% of Japan's total population (Figure 4). This unparalleled scale and duration of environmental education on waste management has clearly been a key factor in shaping Japan's waste management policies.

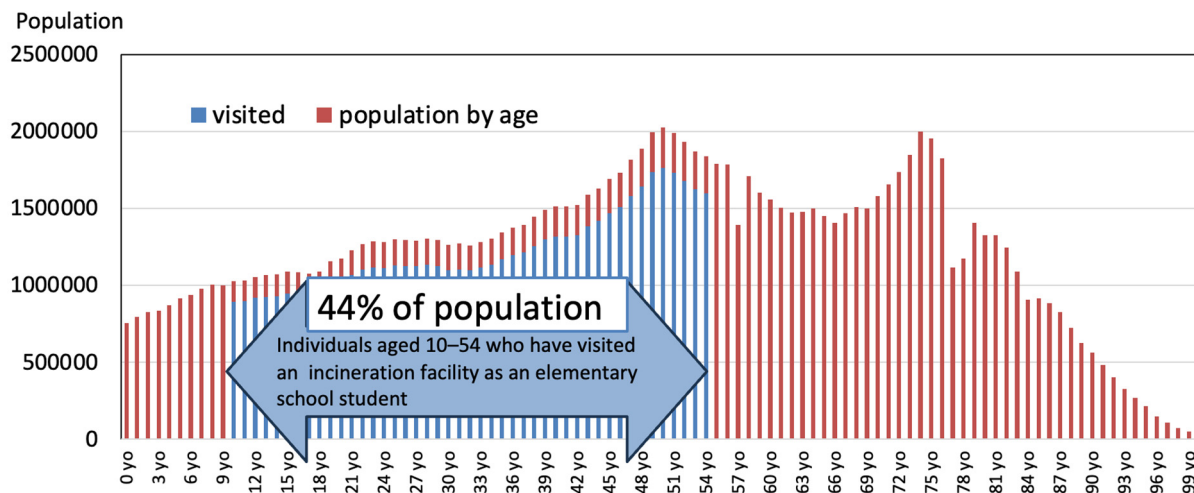


Figure 4. Estimated number of people who visited a waste treatment facility as a fourth-grade elementary school student Since 1980

4.6 Steady Decline in Waste Generation Per Capita in Japan

Figure 5 shows the annual per capita municipal waste generation in the G7 countries (except for Canada, for which statistics were unavailable). Although the definition of municipal waste varies by country, making direct comparisons of absolute quantities difficult, the trends in waste generation can be compared. In Japan, per capita waste generation has been steadily decreasing since 2000. Various factors, such as legislative changes and economic conditions, contribute to this decline; therefore, it cannot be solely attributed to environmental education. However, as highlighted in Section 4.5, Japan has a background of large-scale and long-term environmental education initiatives. As a result, many members of the public are aware of where their waste goes and the importance of reducing waste.

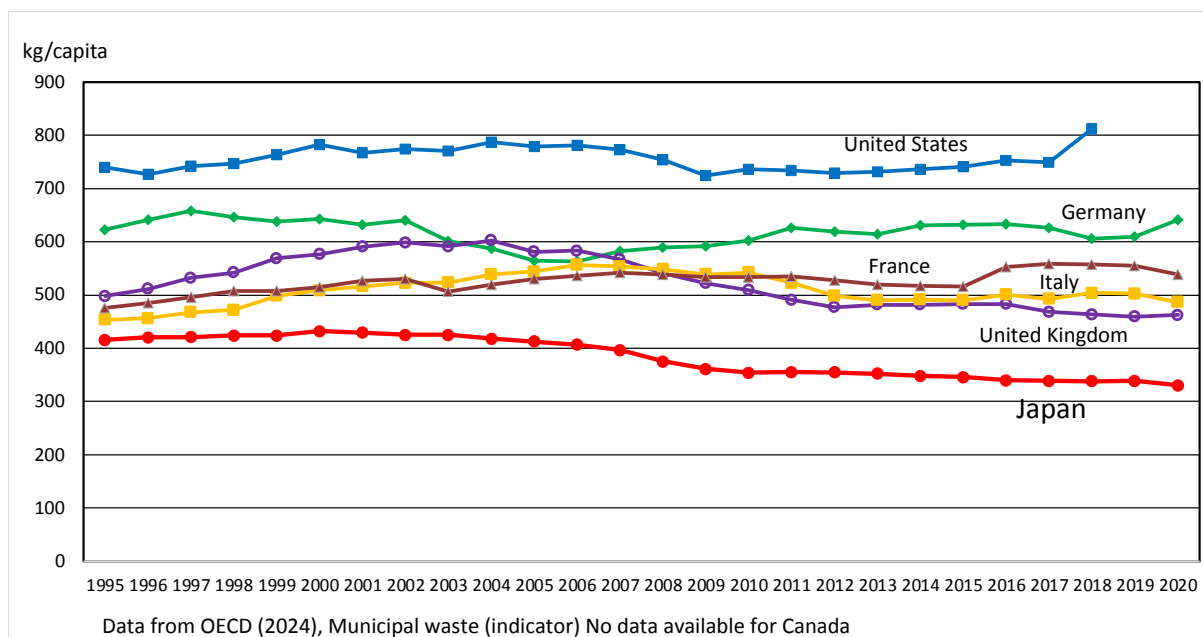


Figure 5. Annual per capita municipal waste generation in G7 countries

5. Conclusion

This study analyzed and quantified the scale of environmental education for waste management, focusing on

elementary school field trips to waste treatment facilities. To quantify these activities, a nationwide survey of incineration facilities was conducted, producing five key findings. First, the survey achieved a very high response rate, with 94% of the contacted facilities providing responses. This indicates a strong interest among incineration facilities in information related to environmental education. Second, it was revealed that in fiscal year 2009, a total of 1,275,823 people visited waste incineration facilities across Japan, accounting for approximately 1% of the national population. Third, incineration facilities have continuously improved their infrastructure for visitors, with 88% of facilities constructed between 2005 and 2010 equipped with dedicated walkways for visitors. Fourth, 69% of visitors to incineration facilities in FY2009 were fourth-grade elementary school students participating as part of their school curriculum. Based on enrollment and visitor data, it was estimated that 87% of all fourth-grade students in Japan visited an incineration facility in FY2009. Finally, assuming that 87% of each cohort of fourth graders from 1980 to 2024 visited incineration facilities, an estimated 55 million people—or 44% of Japan's total population—have participated in incineration facility field trips during their elementary school years. Fifth, among the G7 countries (excluding Canada, for which data were unavailable), Japan is the only nation that has continuously reduced per capita municipal waste generation since 2000.

Similar to policies adopted by many countries in Europe and North America, Japan's environmental policies adopt a Sustainable Approach, accepting restrictions on current activities to benefit future generations. At the same time, Japan has placed significant emphasis on environmental education for waste management since the 1930s. After enduring the hardships of war and public nuisances, waste management was formally incorporated into elementary school curricula in 1971 to familiarize citizens with the systems that underpin society, such as waste disposal. This initiative aims to cultivate an understanding of waste-related issues among children, who will become future citizens, aligning with Amartya Sen's Capability Approach: reducing environmental impact through investment in human capital.

Among G7 countries, Japan uniquely stands alone in achieving a gradual and sustained decrease in per capita municipal waste generation. While this reduction can be attributed to regulations and economic policies grounded in the Sustainable Approach, the Capability Approach, exemplified by environmental education reaching an estimated 44% of the population, is believed to play a significant role in supporting this trend. The goal of this education is not solely to reduce the amount of waste but also to convey the concept expressed by the Japanese term *mottainai*: the sense of regret when something of value is wasted without being fully utilized. This study highlights Japan's environmental education for elementary school students' field trips, a subject that has received limited attention. By positioning it as an integrated example of both the Sustainable and Capability Approaches, this study quantitatively elucidates its scale, setting a significant benchmark in understanding the role of long-term environmental education.

References

- Educational Board of Sapporo City. (1999). *Waste and recycle*. Hokkaido Newspaper. (In Japanese)
- Environmental Bureau of Fukuoka City. (2005). *Historical record of environmental administration in Fukuoka City*. (In Japanese)
- Halkosa, G., & Petrou, K. N. (2020). The relationship between MSW and education: WKC evidence from 25 OECD countries. *Waste Management*, 114, 240-252. <https://doi.org/10.1016/j.wasman.2020.06.008>
- Hanashima, A. (2024). Environmental education at waste incineration facilities in Japan: Educational activities continued even during the COVID-19 pandemic. *Journal of Sustainable Development*, 17(6), 17-24. <https://doi.org/10.5539/jsd.v17n6p17>
- Hokkaido Newspaper. (1999). *Waste and recycle* [Edited by Educational Board of Sapporo City]. (In Japanese)
- Kojima, N., Shimada, S., Tamura, S., & Nitagai, K. (Eds.). (2003). *Encyclopedia of waste*. Maruzen Co., Ltd. (In Japanese)
- Maddox, P., Doran, C., Williams, I. D., & Kus, M. (2011). The role of intergenerational influence in waste education programmes: The THAW project. *Waste Management*, 31(12), 2590-2600. <https://doi.org/10.1016/j.wasman.2011.05.010>
- Ministry of Education. (n.d.). Guidelines. Retrieved June 20, 2024, from <https://www.nier.go.jp/guideline/> (In Japanese)
- Ministry of Environment. (2012). *Technical information on waste treatment: Excel data on incineration facilities in FY 2010*. Retrieved June 26, 2024, from https://www.env.go.jp/recycle/waste_tech/ippan/h22/index.html (In Japanese)

- Miyoshi, Y., et al. (2013). The municipal solid waste treatment plant corresponding to the schoolchild's environmental education. In *The 24th Annual Conference of Japan Society of Material Cycles and Waste Management*. (In Japanese) <https://doi.org/10.3985/mcwmmr.24.62>
- Osaka City Sanitation Department. (ed.) (1921). *History of waste management in Osaka City*. (In Japanese)
- Osaka-shi Kankyo Jigyo Kyokai (Institute for Environmental Management). (2009). *History of environmental administration in Osaka city for 120 years*. (In Japanese)
- Sen, A. (2013). The ends and means of sustainability. *Journal of Human Development and Capabilities: A Multi-Disciplinary Journal for People-Centered Development*, 6-20. <https://doi.org/10.1080/19452829.2012.747492>
- Tokyo-to Kankyo Kosya (Tokyo Environmental Public Service Corporation). (2000). *History of environmental administration in Tokyo for 100 years*. (In Japanese)
- Waste Management Research Foundation. (2008). *Incineration Facility Register 2006*. National Diet Library. (In Japanese)
- World Commission on Environment and Development. (1987). *Our common future*. Oxford University Press.

Acknowledgments

I would like to express my sincere gratitude to each of the incineration facilities that responded to the survey. I am also deeply grateful to Professor Akihiro Tokai of the Graduate School of Engineering at Osaka University for his valuable guidance and warm support throughout the preparation of this paper.

Authors contributions

Not applicable

Funding

This research was supported by the Focused Research Funds of Osaka Sangyo University in 2010. I hereby acknowledge my gratitude.

Competing interests

Not applicable

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

Open access

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.