# Learning about SDGs from The Wisdom of Edo Period and Applying Them to The Future

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**The purpose of this study is to consider the SDGs through using the wisdom of Edo period as an example. We would like to refer to the model of the Edo period to re-examine the solution for modern climate change. Modern Japan is thought to be the hottest in the past 100 years due to global warming and the effects of heat islands. However, recent research has found that the Edo period, which was considered to be a globally cold period known as the "Little Ice Age," also had years that were as hot and cold weather as now.**

**In the Edo period, $CO_2$ emissions due to human activities were limited, so it has been rarely related to global warming. It was regarded as a natural periodic fluctuation. There is also a hypothesis that "heat islands" were occurring in cities of one million people like Edo at that time. This is because the people of Edo lived in a more densely packed environment than Tokyo today, using fire under black roof tiles on hot summer days. So how did the people of Edo stand such a hot summer? In order to keep people cooling in densely populated urban areas, Edo town houses were designed to cleverly utilize the power of nature. One example is the town house of merchants were not only their home but also their shop. Most town houses had their own backyards or courtyards, where the shade of tree planted there created humidity and cooled the air as well. Besides, this cooler air was carried by the wind and circulated throughout their house. It could effectively lower the temperature in all rooms. In addition, for enduring midsummer, people in Edo would sprinkle water on the roads to lower the surrounding temperature. Sprinkling water called "Uchimizu" on the roads is a traditional helpful method to lower the temperature by utilizing the heat of vaporization that takes away heat from the surrounding area when the water evaporates. The effect can last longer if sprinkled in the morning or evening when it is relatively cool.**

**Humans have acquired civilization and made full use of advanced science and technology, but they have never been able to contain severe disasters or climate change in the past. Therefore, it can be said that it is more important to learn from the wisdom of the Edo period and apply it to the future.**

***Keywords:*** *SDGs, wisdom of Edo period, climate change, natural periodic fluctuation, heat islands*

## Introduction

In 2023, unprecedented heatwaves were recorded around the world. In Japan, many regions saw a record number of annual heat days and midsummer days. Both Date City in Fukushima Prefecture and Komatsu City in Ishikawa Prefecture recorded temperatures of 40.0°C. Additionally, the lingering summer heat continued into autumn, with a temperature of 35.3°C observed in Kuwana City, Mie Prefecture on September 28th, and many locations in the Kanto region recorded summer-like temperatures on November 7th. Looking beyond Japan, the year of 2023 saw temperatures exceeding 45°C along the Mediterranean coast and in the southern United States. According to a report released by the National Oceanic and Atmospheric Administration (NOAA) on January 12th, 2024, the average temperature for 2023 was 1.35°C higher than the average before the industrial revolution.

While such abnormal high temperatures can be attributed to natural phenomena that have recurred throughout Earth's history, such as the El Niño event, there is no doubt that the impact of greenhouse gases, including carbon dioxide emitted from industrial activities of human beings, contributes to global warming. This viewpoint has been widely accepted by researchers in recent years. UN Secretary-General Guterres described this situation as "global boiling." The choice to use a term more extreme than global warming is intended to signal that the progress of global warming is in a crisis situation.

If global warming continues, the gradual changes we have seen until now could cross a "tipping point," leading to rapid changes. This could worsen climate change, resulting in more frequent natural disasters and making it impossible to revert to previous conditions. We are compelled to halt the progression of global warming before it reaches that point. Global warming does not only lead to rising temperatures but can also trigger various disasters. For instance, in 2023, the wildfires that occurred in Greece and on the Hawaiian island of Maui in the United States were caused by rising temperatures, and they can lead to heavy rainfall as well.

As temperatures rise, air can hold more water vapor, making it more likely for heavy rains to occur once clouds form. In Japan, from June 28th to July 16th in 2023, heavy rains swept across the country, leading to flooding in nine first-class rivers, causing damage to 3,082 homes and resulting in 14 fatalities. Additionally, Hong Kong experienced its heaviest rainfall since observations began 140 years ago.

The risks of heatstroke due to high temperatures, as well as the spread of infectious diseases, cannot be overlooked either. For other living organisms, this may also lead to the extinction of endemic species.Moreover, due to poor harvests caused by abnormal weather, issues related to the risk of food, water, and energy shortage will be likely to lead to increase the number of conflicts in the future.

## Materials and Methods

The title of this study is “Learning the SDGs from Edo and Applying them to the Future.” What do we need to do in response to climate change these days? We would like to consider the Edo period as a model from the perspective of SDG 13, “Climate Action.” This is also linked to Goal 11, “Sustainable Cities and Communities.” Below, we would like to examine whether there are elements from how people spent summer during the Edo period that can be useful in coping with the modern intense heat.

Modern Japan is considered to be the hottest in the past 100 years due to global warming and heat islands. The heat and cold alternate. However, recent research has shown that even the Edo period, which was considered to be a cold period around the world, called the “Little Ice Age,” also had years as hot as today.

Climate change should not simply refer to rising temperatures, but to alternating heat and cold. With this in mind, we must take measures to combat global warming.

Although the summer temperature in modern Tokyo has been rising year by year over the long term, there were also extremely hot years in the Edo period. It should be noted that the temperature data recovered from diaries and other sources contains errors in estimation, but at least the early 1850s were warm enough to be as warm as today.

So why were extremely hot years observed in the Edo period, which was said to be cold? In the Edo period, $CO_2$ emissions from human activities were limited, so it was not global warming. Cyclical fluctuations of nature are conceivable. An analysis of the time-series data for the average July temperature in Tokyo (or Edo) recovered from the weather records of the diary shows the effects of solar cycles (21 years, 10.5 years), El Niño-Southern Oscillation (ENSO: 6.3 years, 50 years, 32 years), and Quasi-Biennial Oscillations. It is possible that such a natural periodic rise in temperature had an effect during the period of the end of the Edo period. Apart from this, there is also the influence of weather phenomena that are unique to smaller regions. For example, in Yamagata, it is known that high temperatures are often observed due to the "Fern phenomenon" in which dry hot air blows down from the Sea of Japan over the mountains. Besides, there is also a hypothesis that a “heat island” has been occurring in a million cities like Edo since that time.

The German physician and naturalist Philipp Franz von Siebold (1796–1866), one of the three scholars of Deshima who influenced negotiations during Commodore Perry's arrival, established this hypothesis based on observations made using thermometers at the time. In his “Diary of Siebold,” he noted during his stay in Edo in 1861 that “in July and August, it is hot in Edo Bay and in Edo and the surrounding areas. Sometimes, even in the shade, temperatures reached 94°F (about 34.4°C).” He also mentioned that “there is a constant wind blowing from the south and southeast.”

Furthermore, he explained the cause as follows: one reason is the black and thick roof tiles. “This wind is a natural result of the air on Earth being heated abnormally by the black and thick roof tiles. These black tiles cover an area that stretches for miles over the vast city.” Figure 1 is a photo of the black and thick roof tiles. This is around the first year of the Keio era (1865) View from Mt.Atago (FeliceBeato). https: // www.oldphoto-japan.com/photos/189/atagoyamatokyo#. Indeed, black tiles have a high absorption rate of sunlight, which causes them to become very hot during the day and heat the surrounding air. This is widely recognized, and even today, the use of roof materials that have high heat insulation and reflectivity properties is recommended as a countermeasure against heat islands.

Figure 1 The black and thick roof tiles

Additionally, during the late Edo period, the population of Edo was much denser, exceeding 1 million in 1721 from 60,000 in 1600, and peaking at 1.14 million in 1846. When calculated as population density, this results in approximately 23,000 people/km², far surpassing the current population density of Tokyo, which is about 6,000 people/km² (according to the 2020 census by the Ministry of Internal Affairs and Communications). The people of Edo lived a life using fire under black roof tiles in such a densely packed environment on hot summer days. Thus, imagining “Edo's heat island” may not be entirely fanciful.

How can we suppress global warming? Efforts are also being made to reduce greenhouse gases. Moreover, cities aiming for “carbon neutrality” are emerging around the world. Technologies for carbon dioxide capture and storage are being demonstrated on a large scale in Japan as well. The development of clean energy is also being promoted. For example, in wind power generation, which is expected to expand, the latest technology utilizing typhoons has also appeared. There are high expectations for such cutting-edge technologies.

However, we should also focus on what each of us can do immediately. This is precisely the wisdom and ingenuity of our ancestors from the Edo period.

## Results and Discussion

It is meaningful to take a closer look at their wisdom to get over the hot summer then. As previously mentioned, the $CO_2$ emissions during the Edo period were not high, and there was no phenomenon of global warming. Temperature rises due to natural periodic climate changes. So, how did the people of Edo overcome the hot summers? Actually, the houses in Edo were designed to efficiently utilize natural forces to provide cooling even in densely populated urban areas. One example is the machiya, where merchants lived and operated their businesses. Most machiya had backyards or courtyards (tsuboniwa), where the shade of plants and trees generated humidity, which cooled the air. The cold air circulated throughout the house with the wind, effectively lowering the temperature in all rooms. The homes of farming families were also built to promote airflow.

Rooms that are usually separated by sliding doors can be opened up in the summer, and in this way the breeze can be flown from the beaten floor through the house to the garden beyond. The humid space of the beaten floor cools the air, making it significantly cooler throughout the house even in midsummer. Additionally, the house promotes air circulation with what is commonly known as a 24-hour ventilation system. Modern homes are highly airtight, with individual rooms separated by doors. Since July 2003, the implementation of "24-hour ventilation systems" has been mandatory in housing, and the idea of ventilating the entire home rather than each room individually is similar to the design of Edo-period homes, for example, the Air Path construction method. What are the ways to cool a house that either does not have a 24-hour ventilation system installed or does but is still warm? Opening windows and allowing the wind to flow in is one method. In the evening, when temperatures drop or after returning home, opening the windows to let in the cool outside air is effective as it exchanges the air inside. When utilizing openings for ventilation, it is effective to open windows or doors that are diagonally opposite from each other and as far apart as possible. This was also effective in countering COVID-19. For places like walk-in closets that have no windows and tend to trap heat, fans or circulators can be placed to direct airflow towards rooms with windows or ventilation features to expel the heat outside.

The deep eaves at the front entrance of a traditional Edo townhouse resembled a modern arcade, protecting the house from strong sunlight and rain. Passersby could comfortably walk under the eaves of the storefronts during hot and rainy days while shopping. Similarly, the eaves of homes were also extended outward significantly, serving to block sunlight and rain from entering spaces like the porch or workspace outside the home. As an outdoor ingenuity, the waterways intertwined throughout the town served as a natural cooling system. In the densely populated Edo urban area, the water channels and rivers crisscrossed, creating a cool breeze.

Furthermore, during the peak summer season, people would sprinkle water on the streets, a practice known as "uchimizu," to lower the surrounding temperature. Uchimizu cools the air by utilizing the heat of vaporization when the water evaporates, absorbing heat from the vicinity. However, if done when the ground is hot during the day, the sudden evaporation can lead to a rise in temperature, making it feel even more humid. Therefore, sprinkling water in the relatively cooler mornings or evenings is more effective, and it is better to sprinkle it in the shade than in the sun. Last year, in 2024, Tokyo launched a webpage named "Uchimizu Biyori" with the slogan "This summer will be boiling in Tokyo."

Also, close the curtains during the day when going out and ventilate when returning home. To reduce the amount of heat and sunlight entering through the windows, use blackout curtains inside the house. Installing outdoor bamboo blinds can block sunlight while allowing air to pass through, which is excellent. Besides, some types of awnings that can be added later, as well as insulation sheets or films that can be applied to windows, are also helpful in reducing sunlight easily.

There is also a method of borrowing the power of plants. Climbing plants, or "green curtains," which are natural curtains that soften sunlight, can cover the windows and walls of buildings to make it more difficult for sunlight to enter the room. Even placing foliage plants outside the window can reduce the amount of direct sunlight hitting the window. Herbs and evergreen perennials can serve as green curtains, providing coolness with some ingenuity.

The townhouses of Edo are practical and efficient. They are the result of creativities applied to every aspect of the building's structure and mechanisms. Even in modern times, there are various approaches to feel cool outside of just house design. Without relying on high technology, we can feel cool with just some ingenuity, relying on our own senses. Using tatami mats and rush mats is one way to stay cool. The "igusa tatami" commonly used in Edo has properties that do not conduct heat through the sponge-like parts of the igusa and the straw parts of the tatami base, has high natural moisture absorption capability, and is suitable for hot and humid conditions, making it excellent for allergy prevention. Moreover, tatami mats are soft, so they do not cause fatigue even after sitting for long periods. If there is no tatami room in the house, there are tatami mats that can be used like rugs laid on flooring. If you have a tatami room, it's comfortable to spend hot days there. Tatami rooms have a low floor and high ceiling, allowing for good air circulation and coolness. Tatami rooms typically use many sliding doors and fusuma, which block sunlight and lower the temperature inside.

You can also cool the space with colors and scents. There is a difference in perceived temperature when seeing cool colors (blue tones) and warm colors (red tones). In fact, white, blue, and green colors also help prevent radiant heat. By creatively choosing the colors of curtains and decorative items, you can create an impression of coolness visually. When smelling mint, people's bodies feel cool, and their perceived temperature drops by 4°C. ( From the website of the Japan Aromatherapy Environment Association)

It is also possible to understand and utilize microclimates. The summer heat today is directly influenced by climate change, making fundamental

improvements to the overall heat in Japan difficult. Therefore, what we want to pay attention to is the concept of "microclimate." It means a climate in a narrow area.

Moreover, the "microclimate" mentioned earlier would like to be emphasized by the author. Microclimate refers to a climate in a narrow area. People in the Edo period were masters at understanding and utilizing microclimates, especially in agriculture and garden design. They intentionally made use of microclimates. Anyone in the Edo period knew that if there were trees or walls in a garden, that corner would have more shade and become cooler (and warmer in winter) than other areas for most of the year. That was why they used trees, walls, potted plants, or sunshades to create shade. They also utilized trellises or differences in elevation indoors to improve ventilation, creatively generating a microclimate. These are ideas we would like to incorporate even today. In the future, it would like to be recommended to students who want to live in a house with a garden by the author.

Furthermore, it is a helpful idea to pursue coolness through ears and eyes. For example, wind chimes, hung on the eaves and producing a refreshing tinkling sound, were regarded as a popular item to cope with the heat in the Edo period. While they didn't actually lower the temperature, the sound likely provided a sense of coolness. In the early Edo period, glass was quite precious, making wind chimes a luxury item inaccessible to the common people. However, as glass craftsmanship spread, the price of wind chimes decreased, and vendors began to sell them. Similarly, goldfish provided a visual sense of coolness. By the late Edo period, they became accessible to the common people as well. When purchasing goldfish from vendors, they were placed in small glass containers called "kingyo-tama," which people would hang from their eaves and admire at home.

Although refrigerators did not exist during the Edo period, there were specific foods and drinks that provided relief from the summer heat. Watermelon, juicy and still popular in summer today, was chilled using water from wells or tubs during that time.In summer, vendors selling cold water could be seen walking around calling out, "Hya-koi, hya-koi"! They sold cold spring water mixed with sugar and white rice dumplings for about 4 mon (approximately 100 yen today), making it an affordable way for common people to enjoy some coolness in summer. Additionally, drinks such as barley tea and loquat leaf tea were also sold. Another summer favorite was sweet sake (amazake). While today it is perceived as a winter drink, in the Edo period it was often consumed during summer to supplement nutrition and prevent summer fatigue, as indicated by its recognition as a summer term. Furthermore, there were merchants selling tokoroten, which was likely enjoyed as a snack.

The content mentioned above has been covered in the general subject called SDGs Exploration, a required subject course for 1st year students in the Advanced Courses, for the past four years in NITFC. In that subject, the students have been discussing how, in fact, until half a century ago, people were committed to discover their best way of living that could cope with modern climate change, especially the extreme heat of summer. On the other hand, when the circumstances 50 years ago were depicted by the author, they were sometimes relied on the author's own experiences as the junior high school student.

However, the stories, which may be quite distant in age from the students, seem hardly to resonated with them as much as these stories had been hoped by the author. Furthermore, it is believed that the fact that Iwaki City, where our school is located, does not have any scorching hot days may be another significant reason.

On the contrary, at the Human College hosted by Iwaki City, we have been discussing specific examples from the Edo period in the "SDGs Exploration Department" for the past five years. Many of the participants are senior citizens, so even when discussing stories from half a century ago, they can receive more empathy than the students.

Therefore, from this school year on, students started being assigned by the author to ask their grandparents about old methods to deal with heat management. They need to summarize what they learned and present it, and then have to put these old-fashioned initiatives into practice with some feasible ideas. By doing so, the author is convinced that they will understand how Japanese people in the past implemented practical solutions for warming countermeasures.

## Conclusions

As mentioned above, people in the Edo period dealt with hot summers using their life wisdom, even though they did not have access to modern technology. Such knowledge and ingenuity from our ancestors can be applied immediately, as seen in practices like sprinkle water, and this should be implemented alongside the latest technology without any doubt.

Although humans have acquired civilization and made full use of advanced science and technology, they have not been capable of preventing severe disasters or climate change as before. Therefore, it can be said that it is more significant to learn from the wisdom of the Edo period and apply it to the future along with taking largescale measures against climate change.

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