
Sustainable Rain?

Rain sustains the land and people of Japan. In ancient Japan, rain in its myriad forms veiled the pure air—drizzles fell from the “plum rains” of early summer, tropical-like high humidities stifled midsummer afternoons, thunder and lightening storms hit on rare occasions in late summer, typhoons drenched the countryside in autumn, snow storms buried the Sea of Japan coast in winter, coastal and mountain fogs shrouded harbors and villages, hail and sleet shocked unwary travelers, sea sprays from the surrounding ocean whisked past children at play on the beaches, mists hovered above innumerable rice paddies, and blue-tinted vapors evapo-transpired from luxuriant coast-to-coast forests. Rain, or precipitation in its multiple forms, dominated the ancient island landscape of Japan.

Rain produced an equally moisture-laden culture. Japan is a culture of rain like the Native American Hopi culture is a culture of sun or the Arctic Inuit culture is a culture of snow. There are hundreds of words for rain in the Japanese language.¹ Japan’s wet rice agriculture is fundamentally dependent on abundant rainfall. Elements of clothing (e.g., *geta* sandals), housing (e.g., tile roofs), and gardens (e.g., the ubiquitous pond) reflect the prevalence of rain. In Japan the umbrella was elevated to a work of art. Japanese poetry and literature breathe rain, and Japanese art forms exude mist. A wandering poet-monk, Santōka, in a Zen-inspired *haiku* poem stated of himself what could be said of the people: *karada nagedashite shigururu yama* (flinging body, into drenched mountains). Black ink *sumi-e* paintings capture glimpses of distant figures in misty valleys. In *sumi-e*, as in many traditional art forms, colors are applied as if seen through a light rain. When used at all, they are

muted, pastels being the pinnacle of brilliance. During the tea ceremony gazing quietly upon boiling water and its wafts of steam as it changes media—tea kettle to bamboo ladle to tea bowl—is to shed the cares of the outside world. In the tea ceremony, as in many traditional art forms, an ambience of intermittent rainfall seems to suffuse ritual. Japan's ancient culture can be likened to a watercolor painting whose wash was laid on with a broad brush dipped in sky-blue air and whose endless detail was stroked in with smaller, finer brushes dipped in the boundless forms of moisture (typhoon downpours, rainy season drizzles, hot spring steams, summer humidity, winter wet “peony” snowflakes).

Japanese culture was born in a land of pure air and clean rain, but the price the people have paid for a modern, industrialized, urbanized world is to lose their pristine air and natural rain. The air and rain are now polluted. In this book we will witness the historical alteration and degradation of Japan's air and rain as wrought by one class of pollutants—acidic pollutants. We will study the history and present state of modern Japan's “acid rain” problems. (Even though “acid rain” is the popular designation for the problem, the term “acid deposition” is most often used in this book. The reasons will be made clear in chapter 3.) Specifically, we will investigate the science and politics of acid rain problems from the Meiji Restoration of 1868 to the present, ending around the year 2000.

Why devote a whole book to analyzing the seemingly arcane history of acid deposition problems in Japan? There are a host of reasons.

- Japan has long experienced acid deposition problems, longer than any other country in East Asia. Acid deposition is, first of all, a millennial old natural “problem” in Japan. The existence of numerous active volcanoes since the birth of the islands creates a slight but perennial acid deposition problem. No other East Asian country, and few nations in the world, possess a greater density of active volcanoes or a greater number of acidic environmental niches due to plate tectonic activity than Japan.
- Acid deposition as a human-induced problem is over 100 years old in Japan. The first instances of the problem resulted from copper smelting around the turn of the century. At this time the first efforts at acid deposition-related scientific research and policy measures occurred. No

other East Asian country earlier attempted research or policymaking on the issue.

- Acid deposition as a postwar environmental problem was first seriously studied in Japan in the mid-1970s. No other East Asian country tackled the postwar acid deposition problem earlier than Japan.
- Japan discovered the existence of long-range transport of air pollutants in East Asia in the mid-1980s, and in the process revealed acid deposition to be a transboundary problem in the region. Japan also discovered it was a “victim” of this transboundary air pollution (i.e., it imported more acidic pollutants than it exported to surrounding countries).
- East Asia now has the dubious honor of being the world’s third regional-scale acid deposition hot spot after Europe and North America. Transboundary air pollution (of which cross-boundary movement of acidic pollutants is the most prominent aspect at present) is a potentially explosive international environmental issue in East Asia. Japan is leading diplomatic efforts to defuse the issue. In the process, Japan is breaking new ground and setting scientific and political precedents in regional environmental cooperation.
- Japan is a world leader in environmental science and policymaking. It is the first Asian nation to achieve such status. What it learns in East Asia on the acid deposition issue will be translated to the world stage.

As the most scientifically advanced, economically powerful, and democratically sophisticated nation in East Asia, Japan is in a natural position of scientific, technological, economic, and political leadership on environmental issues. This guarantees that Japan’s science and policymaking will have a major impact, and in many ways define, the approach to acid deposition and other environmental problems in East Asia. Understanding Japan’s influence on environmental problem-solving in East Asia, and the world, provides sufficient incentive to investigate the historical roots of an environmental problem like acid deposition.

Acid deposition has a long history as an international environmental issue—over thirty-five years in Europe, over thirty years in North America, and now over fifteen years in East Asia. It was the first transboundary air pollution problem not related to nuclear weapons testing around which an international convention was signed (in 1979).²

Acid deposition has an even longer history as a local and national problem—over 100 years in Europe, North America, and East Asia. The long and multidimensional history of the problem makes it ripe for comparative analysis and for inquiry into long-term patterns related to environmental science and politics. Although the study contained in this book does not pursue comparative analysis (it is a single-site “archeology of knowledge”), it does seek to understand general patterns related to environmental science and politics that are not necessarily country specific.

Despite the focus on a single nation, the study is actually *international* in scope. One of the surprises revealed by analyzing Japan’s acid deposition history is the strength of international influences from the very first manifestation of the problem around the turn of the century. International forces have been highly instrumental in creating, understanding, and solving the various historical manifestations of Japan’s acid deposition problems. In particular, ideas drawn from Europe and North America have been especially prominent. Even though I do not attempt a comparative analysis of Japan’s acid deposition history with those of Europe and North America, I do situate Japan’s history within the context of larger international developments on the issue.³ In particular, I highlight the role of Europe and North America as source regions for ideas imported by Japan, and ask questions such as: How and why were acid deposition ideas imported from Europe and North America to Japan? How were they transformed (or “localized” to Japan) upon arrival? And how have they shaped Japan’s acid deposition science and policy?

Besides the fact that Japan has a long and fascinating acid deposition history that informs its present environmental science and policy, a second reason for analyzing the history is to illuminate patterns of interaction between environmental science and politics in general. Science dominates Japan’s acid deposition story from beginning to present. Until the 1970s it was essentially one of scientists straining to define an object of policymaking, and since the 1970s it has been primarily one of scientists and bureaucrats shaping “science policy” (e.g., decisions to fund research). This relative simplicity makes it a perfect candidate for analyzing the science component of the policymaking process. I extracted

from Japan's acid deposition history a generic set of concepts and relationships, spelled out in chapter 2, that I believe are broadly applicable to theoretical understanding of the interaction between science and politics on environmental issues wherever it occurs.

To my knowledge this book is the first to trace in detail both the science and politics of an environmental problem in Japan from its origin in the country's opening to the West in the late 1800s to the present. It is certainly the first related to the acid deposition problem. There is a vast literature on the science and politics of the acid deposition problem in the West. Very little has been written on its history in Asia. Thus, this work will contribute to the emerging field of Asian environmental history. I did not set out to write a book on environmental history, though. Indeed, I am not a historian. Although I have long had an interest in history, I am trained in environmental science and international environmental policy analysis. I began studying the science and politics of the transboundary air pollution issue in East Asia in the early 1990s, and what started out as simple curiosity as to the roots of Japan's present-day international environmental policymaking on the issue, turned, much to my amazement, into a prolonged investigation that revealed a history far longer, deeper, and richer than I ever imagined. I find it an intriguing history. A sense of dedicated puzzle-solving, humble integrity, energetic persistence, and missed opportunities pervades the story. I have tried to convey to the reader some of the human drama behind the facts, figures, and events.

"Simple curiosity" is perhaps too mild an expression for what motivated my plunge into Japan's acid deposition history. I was studying the role of science in Japan's leadership position on the transboundary air pollution issue in East Asia (initially framed as a regional "acid rain" problem), and I kept running up against a feeling that the sum total of *contemporary* factors used to explain its leadership position (such as Japan's victim status, its economic wealth, its desire to sell its environmental technology, its desire to enhance its environmental reputation, etc.) was not sufficient to comprehend its dogged and proactive pursuit of international acid deposition diplomacy. This led me to the history of the issue. What I discovered was that there are also significant *historical* factors that help explain Japan's activism. In particular, a strong

“historical scientific momentum” related to the problem fortuitously placed Japan in a position to scientifically recognize and politically act upon its international dimension in the region. I do not posit that such historical scientific momentum is a prerequisite for active international environmental diplomacy, but I do argue that in Japan’s case this, combined with its “culture of rain,” imparts a special aura and depth of commitment to the issue that is not necessarily encountered in its other environmental problem-areas.

This book is primarily directed at scholars in the fields of environmental science (especially scientists studying acid deposition) and political science (especially researchers analyzing the role of science in environmental policymaking). However, it also targets specialists in history (especially historians of Asian science) and Japanese culture (especially students of Japan’s relationship to nature). My hope is that all these academic communities will find something of value to inform their respective disciplines. The reader should be aware, though, that the book has an unavoidable bias toward the sciences. As mentioned before, analysis of Japan’s acid deposition history is highly conducive to investigating the workings of science at the science-policy interface. Thus, I have chosen to lean heavily on the science side of the equation. I dig deep into the science to be able to illuminate questions of how, when, where, and why environmental scientific knowledge worked its way into the policymaking world. Digging deep means I provide a high level of detail about Japanese acid deposition science. The result may be that those not well versed in environmental science will find some portions of the book difficult reading. If so, I encourage you to persevere or to skim. I have tried to structure the text so that it is easy to navigate around highly technical sections.

Despite the specialized nature of the book, there is a larger, nonspecialist audience to whom the book is also addressed—those who desire greater insight into the modern struggle to attain *sustainability* (a definition of sustainability is provided in the next chapter). In the course of my inquiry, besides unearthing a wealth of information related to Japan’s acid deposition problems, certain underlying patterns emerged that, I believe, are relevant to grappling with one of the paramount problems of modern civilization; namely, how to create ecologically and socially

“sustainable societies.” Thus, besides the more limited purposes already stated, this history serves another, grander purpose—to chronologically document in one corner of the world in one issue-area the human struggle to walk the path of sustainability, and to seek in this effort lessons that might be applied to the global challenge of creating a “sustainable world.”

During the Edo period (1600–1868), Japan was for all practical purposes a sustainable society.⁴ It was sustainable in the sense that it was self-sufficient in human and natural resources. Also, its population had leveled off by the middle of the period. There was only a trickle of people, goods, and ideas into the country, especially after a policy of national isolation (*sakoku*) was invoked in 1639. The Meiji Restoration of 1868 marked not only the end of the Edo period itself, but also the end of Japan as a self-sufficient and sustainable society. In sharp contrast to the Edo period, the ensuing Meiji period (1868–1912) witnessed a flood of foreign people, goods, and ideas. One small stream of foreign people (e.g., mining engineers), goods (e.g., mining technologies), and ideas (e.g., principles of capitalism) contributed to “acid deposition unsustainability.” In other words, they contributed to the emission into the atmosphere of large quantities of acidic substances that in certain locales created socially and ecologically unacceptable and unsustainable conditions. However, another small stream of foreign people, goods, and ideas (e.g., German chemists, precipitation chemistry monitoring equipment, and precipitation chemistry techniques) created the foundation for systematic understanding of and political action on problems such as acid deposition. Since 1868 Japan has experienced ups and downs on its path toward sustainability. Certain by-products of industrialization periodically knocked it off a sustainable course and countervailing elements in environmental science and politics often tried to get it back on course. We will follow this dynamic relative to acidic pollutants in the atmosphere.

Japan has experienced three pollution-related sustainability crises since the end of the Edo period.⁵ The first occurred around the turn of the century and was related to copper mining. The second occurred after World War II and was related to massive industrial pollution. And the third is the present-day, global crisis being experienced by Japan and the

rest of the world in which pollutants are exchanged between all nations and transported to the furthest reaches of the Earth. Since acid deposition played or plays a role in each of these pollution-related sustainability crises, investigation of acid deposition science and politics provides a window onto Japan's struggle toward ecological and social sustainability and clues to the attainment of sustainability in Japan and the rest of the world.

Japan's acid deposition history can be used to help answer questions about the origins of scientific knowledge, the influence of scientific knowledge on politics, and (un)sustainability related to environmental problems because our starting condition is a country in a sustainable state without an acid deposition problem and without a scientific tradition. Thus, Japan began more or less as a "blank slate" in relation to acid deposition science, politics, and sustainability in 1868. I use Japan's long acid deposition history to identify some of the essential aspects of science and the science-policy interface whose presence or absence helps explain political action and inaction in relation to sustainability. The historical portrait of the science-policy-sustainability triad that emerges is one of great organic complexity.

The book is composed of the following chapters.

Chapter 2 introduces the general set of concepts used to analyze the science-politics nexus. These concepts are employed in the remainder of the book to track and explain the relationship between science and policy related to the acid deposition problem in Japan.

Chapter 3 discusses nature, culture, and the acid deposition problem in Japan. It begins with a brief introduction to the acid deposition problem in general. It continues with an overview of elements of Japan's natural environment and culture that are relevant to its acid deposition problems. This is followed by a quick sketch of the history of science in Japan, which in turn serves as a preamble for describing in the final section the environmental and acid deposition chronologies used to organize analysis of Japan's acid deposition history. The swath of history between 1868 and the present (circa 2000) is divided into five environmental eras and six acid deposition periods.

Chapters 4–9 discuss in detail each of the six acid deposition periods.

Chapter 10 synthesizes and summarizes what was learned in the process of analyzing Japan's acid deposition history, and draws lessons that might be applied to the challenge of creating sustainable societies in Japan, Asia, and the rest of the world.

An appendix describes the present state of acid deposition science in Japan.