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Japan and the Environment
Industrial Pollution, Biodiversity Loss, and Climate Change

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Japan's Basic Environmental Characteristics

With a land area of 378,000km^2 spread over 6,852 volcanic islands, Japan is the sixty-first largest country in the world, but has the eleventh largest population of 126.2 million people (MIC 2019). Due to the wide geographical dispersal of its islands, however, Japan claims the world's sixth largest marine Exclusive Economic Zone (EEZ), of 4.04 million km^2 (MLIT 2015: 2). Consequently a significant proportion of Earth's natural environment is under Japanese stewardship, with an estimated 14.6 per cent of marine species finding habitat there (Fujikura *et al* 2010).

Nearly three quarters of Japan's terrestrial environment is mountainous, coniferous forest and thus thinly populated. Settlements are mainly located along the coast, on alluvial plains, or nestled in steep sided valleys. Japan's cities are therefore some of the largest and most densely populated on Earth; indeed, the Kanto region is the world's largest urban conurbation at around 37 million people, with a population density of 6,200/km^2 in the Tokyo Metropolitan core. By contrast, London, western Europe's largest city, has 13.9 million people in its greater urban area, and a density of 5,500 persons per km^2 at its core (MIC 2019; ONS 2016).

Japan's climate is very varied, due to being situated in the north-western Pacific Ocean and south-east of the Eurasian land mass, and its long latitudinal range, stretching approximately 3,000km from sub-tropical Okinawa (24ºN) to the sub-arctic Sea of Okhotsk coast of Hokkaido (46ºN). In winter, Japan is dominated by the Siberian continental high pressure system, which tends to deliver heavy snowfalls to the north-western and central mountainous regions, and crisp sunny weather to Pacific coastal areas. By late summer, Japan enjoys a Pacific maritime climate, which brings hot sultry weather and occasional typhoons. In between these, the country experiences unstable weather, as warm air advances northwards in Spring behind the *baiu* rain front, or is pushed southwards in Autumn by the expanding Siberian High. While mean temperatures in winter are below zero in Hokkaido, in summer mean daytime highs exceed 30 degrees in southwestern regions (JMA 2019).

A large population and a high per capita income mean that, cumulatively, Japan consumes a higher proportion of the world's natural resources, while accumulating a growing quantity of waste. Japan is ranked 44th internationally for its per capita Ecological Footprint, but sixth for its total Ecological Footprint; together, this translates into the world's 23rd largest bio-capacity deficit, of 672 per cent (GFN 2019).[1] Hence, Japan is one of the world's biggest net importers of environmental services, the most significant being fossil fuels.

Indeed, Japan's long history of human development contributes substantial evidence towards arguments that the Earth has passed into the Anthropocene epoch, whereby human impacts on the planet's environment and geology represent a significant rupture from the Holocene (Crutzen & Stoermer 2000; Thomas 2016: 4). Japan's topography and geomorphology have been drastically reshaped; its heavy dependence on fossil fuels and process industries has changed the chemistry of the biosphere and its organisms, including humans (Walker 2010); and Japan has contributed to the catastrophic depletion of Earth's biological diversity. In short, the Japanese people are active participants in all of the world's most pressing environmental problems.

This chapter outlines Japan's experience with three environmental challenges: industrial pollution, biodiversity loss, and climate change. All three intersect with Japan's passage through development and post-development, and its economic and political globalization. Hence, the chapter shows how Japan's economic and population transitions have produced environmental change, and outlines the state's responses. In conclusion, the chapter will briefly introduce the potential for a depopulating Japan in the 21st century to contribute to global efforts in mitigating environmental damage, and the chapter will ask how Japan might lead Asia in establishing an environmentally sustainable pathway into the future.

Industrial Pollution

Widespread public concern for environmental issues emerged in Japan in the postwar era, prompted by a series of industrial pollution incidents dating back to the Meiji period. These exposed both the ineffectiveness of official mechanisms for dealing with environmental disasters and the reluctance of governments to intervene against vested interests. This section

[1] GFN (2019), using 2016 data.

surveys the historical development of environmental concern in Japan, via analysis of the six most significant pollution incidents to have occurred in the country's modern development. Each is significant due to the public response, which was sufficient to persuade the government to acknowledge the seriousness of these incidents, punish perpetrators, and enact reforms.

The Ashio Copper Mine Disaster

The first major pollution incident to occur in modern Japan began in the 1880s at the Ashio Copper Mine, located 120km north of Tokyo in the mountains of Tochigi Prefecture. It was the circumstances surrounding, and reactions to, this disaster that established a structured pattern of political-economic development and environmental response that, in many respects, continues to this day.

Bought by industrialist Furukawa Ichibei in 1877, the Ashio mine had been in operation since the 17th century. It was characteristic of early Meiji enterprises in that modern industrial technologies were adapted within a pre-existing business to accelerate output to generate enormous profits for their owners and contribute to national industrial and military strengthening (Notehelfer 1975; Sippel 2005). It also represents an early example of Meiji entrepreneurs leveraging Japan's new openness to international trade for further upscaling. In 1888, Furukawa negotiated a supply contract with The French Copper Syndicate through British-Hong Kong traders Jardine-Matheson & Company. This enabled investment in power and production technology, including Japan's first hydro-electric project, and thereafter the mine expanded rapidly to become the financial cornerstone of the emerging Furukawa *zaibatsu*, one of the largest of Japan's pre-war industrial conglomerates (Notehelfer 1975; Shoji & Sugai 1992).

The disaster began with mine tailings leaching into the Watarase and Tone rivers, causing fish and bird deaths, and illness among villagers downstream. In 1890 flooding caused by deforestation to supply timber to the mine drew further pollutants into the watercourse and deposited them onto 1,600 hectares of farmland, damaging 28 settlements in Tochigi and Gunma prefectures. Subsequent floods in 1896 were more devastating, polluting up to 100,000 hectares of land (Shoji & Sugai 1992). Estimates at the time indicated that up to

100,000 people had consumed contaminated food and water, and local death and illness rates rose significantly (Stone 1975).

The government belatedly confronted the problem when a vigorous citizens movement developed, led by local businessman-turned-Diet member and activist, Tanaka Shōzō (Stolz 2014; Stone 1975; Strong 1977). Initially, Tanaka brought the issue to the National Diet, but he was ignored by a government determined to pursue national strengthening through modernization. Tanaka resigned from the Diet and instead appealed to the Emperor Meiji directly in public with a letter, avoiding being killed by guards when a horse reared and knocked him to the ground (Shoji & Sugai 1992). The government was shocked at this turn of events and began to intervene, forcing Furukawa to install concrete river banks and a dam to control flooding, which the government then expanded into a huge re-engineering of the entire Kanto plain watershed (Stolz 2006). By 1911, sufficient political momentum had been achieved by Tanaka and other activists that the government passed the Factory Act, modern Japan's first law to include environmental legislation (Shoji & Sugai 1992).

The Birth of Japan's Modern Environmental Movement

The protest that developed out of the Ashio disaster gave birth to Japan's modern 20th century environmental movement, which drew on Tanaka's environmental philosophy. Tanaka was concerned with changes in the relationships between nature and the human community emerging from Japan's accelerated modernization, focussing on what he termed *doku* (poison) and its manifestations (Tanaka 2004 & 2005). He understood *doku* as more than chemical poison, but saw societal and political manifestations too (Stolz, 2006). And this broader meaning was given public impetus by pollution incidents succeeding the Ashio disaster, particularly the Minamata mercury poisoning. As Japan's environmental movement developed through the 20th century, it was mainly concerned with the impacts of industrial toxins on public health and wellbeing at the community level, and the institutional structures that enabled repetition. Consequently, it was later criticised for not developing a powerful national and international voice, for not being effective in overcoming structural barriers and vested interests, and for allowing the state and industry to fragment, disrupt, and co-opt emerging environmental coalitions (Waley 2005). This weakness was to become evident during the protests against the siting of nuclear power stations from the 1970s, and with the

anti-nuclear movement that briefly emerged after the Fukushima disaster of 2011 (Aldrich 2008; Kingston 2016; Samuels 2013).

Tanaka's criticism of the government's response to the Ashio disaster also exposed contradictions underlying the ideology of Japan's modern growth regime. For Tanaka, the construction of concrete flood controls, combined with the submerging of Yanaka village and forced resettlement of villagers were the repressive acts of an industrial state asserting the superiority of modernity and technology over a purportedly defective nature and inferior traditional community. Tanaka argued that it was modernity that was defective and that humans should adjust themselves to the 'flow' (*nagare*) of nature, rather than attempt to correct it and experience the destructive consequences of its 'backflow' (*gyakuryū*) (Stolz 2006). For the state, however, the 'successful' resolution of the Ashio disaster legitimised the habitual deployment of concrete infrastructure to solve the environmental challenges that Japan's geography poses for a modern society and economy to operate efficiently – that which was later termed the 'Construction State' (*doken kokka*) (McCormack 2001). Hence, despite Tanaka's critique and the movement that he inspired, the government implemented its plans for the Kanto watershed and entrenched the institutional arrangements of Japan's emerging modern political economy; the 'iron triangle' of the government, bureaucracy and big business which together formed and operated Japan's postwar 'Developmental State' (Johnson 1982; Feldhoff 2007). The implementation of this growth-at-all-costs political economic regime was to come back and haunt the government in the form of repeated public health crises.

The 'Big Four' Pollution Diseases

In the twentieth century, what became known as Japan's 'four pollution diseases' (*yondai kōgaibyō*) – Itai-Itai Disease in Toyama Prefecture (1912), the methyl mercury poisoning disasters at Minamata Bay (1956) and the Agano River (1964) in Kumamoto and Niigata Prefectures respectively, and Yokkaichi Asthma in Mie Prefecture (1960) – brought the issue of pollution in a rapidly industrializing society into mainstream public discourse and, by the late-1960s, the government was forced to acknowledge a national public health crisis.

Of the four disasters, Minamata had the most profound consequences, because of the number of victims and the symptoms that they endured, and the behaviour of both the perpetrator,

Chisso Corporation, and the government. The pattern of responses to Minamata mirrored those at Ashio, and it was the indifference to public health of an institutionalised government-bureaucracy-industry nexus in the pursuit of economic expansion that emboldened activists and galvanised victims to litigate, which achieved its first success in 1973, seventeen years after the first human victims had been identified. Nevertheless, were it not for a second methyl mercury discharge being identified along the Agano River in Niigata Prefecture in 1965/66, the disaster at Minamata might never have gained the prominence that it eventually attained (Saito 2009).

The Minamata poisoning changed Japan's postwar democracy by awakening the public to the human costs of the country's economic expansion and the preparedness of the government in Tokyo to collude with vested interests to ignore distant local communities (George 2002). In response to citizens' movements that emerged from these disasters, the Japanese government acknowledged its responsibility for asserting a vigorous regulatory regime and implementing anti-pollution measures, including clean-up operations, victim compensation, monitoring and regulation of industrial activity, passing the Water Control Law in 1970, and establishment of the Environment Agency in 1971.[2]

Minamata also achieved international resonance, partly because pollution was the concern of environmental movements in other developed countries at that time. Rachel Carson's *Silent Spring* (2000 [1962]) had alerted the United States public to government collusion in the spreading of disinformation to protect industry and inspired a nationwide environmental protest movement that resulted in the banning of DDT and establishment of the US Environmental Protection Agency (Lytle 2007). It was also Eugene Smith and his wife Aileen's decision to live in Minamata to document photographically the victims' suffering (Smith & Smith 1975) that brought international opprobrium on the Japanese government. Most recently, the United Nations Environment Programme has memorialized the poisoning in the 19 January 2013 signing of the Minamata Convention on Mercury (UNEP 2013).

Fukushima

[2] The Environment Agency was upgraded to Ministry status in 2001.

The tension between the protection of public well-being and the promotion of industrial interests resurfaced on 11 March 2011, with the overcoming of the Fukushima Daiichi nuclear power plant's cooling systems by the Great East Japan Earthquake and Tsunami. Although to date there have been no deaths directly attributed to radiation poisoning, this disaster revealed the persistence of inadequate regulation and government-industry collusion (Matanle 2011). Consequently, there was a serious loss of public trust in the government's ability to maintain public safety and provide accurate scientific knowledge in a timely manner (de Saille & Matanle 2016; Kingston (ed.) 2012).

In the wake of the tsunami, the majority of Japan's nuclear power plants remain idle, national energy policy has been revised to reduce the nuclear share of energy generation and increase the role of renewables, and the nuclear regulatory regime was reformed. The Fukushima disaster also had international ramifications, not least as a catalyst for Germany's phase-out of its nuclear industry by 2022 as part of the country's *energiewende* (Morris & Jungjohann 2016).

Biodiversity

Japan has nine terrestrial, three freshwater, and at least seven marine ecological regions – defined as 'areas within which there is spatial coincidence in characteristics of geographical phenomena' (Omernik 2004: 34). These range from the sub-tropical Nansei and Ogasawara island chains, through the temperate regions of Kyushu, Shikoku and Honshu, to the cooler alpine areas of central and northern Japan. Japan is consequently rich in fauna and flora, with more than 90,000 species of terrestrial and marine wildlife described, a large proportion of which are endemic, and therefore vulnerable, due to the historic isolation of their small island habitats (MoE 2015a).

Terrestrial Biodiversity

Among the more than 150 mammalian species identified as inhabiting Japan, endemic species include the Japanese macaque (*Nihonzaru - Macaca fuscata*), the most northerly of all non-human primates, the Japanese raccoon dog (*Tanuki - Nyctereutes procyonoides viverrinus*), celebrated in Japanese folklore, and the Iriomote mountain cat (*Iriomote yamaneko - Prionailurus bengalensis iriomotensis*), found only on Iriomote Island in Okinawa Prefecture. Approximately 600 species of bird have been recorded in Japan, of

which 250 breed there. In addition, there are 73 reptile, 40 amphibian, and 3,000 fish species (MoE, 2015a). Among non-mammalian endemic species are the Japanese woodpecker (*Picus awokera*), the green pheasant (*Phasianus versicolor*), the Japanese rat snake (*Elaphe climacophora*), and the Japanese giant salamander (*Ōsanshōuo* - *Andrias japonicas* – at 1.5m in length the world's second largest amphibian).

Biodiversity underpins all life on Earth. As elsewhere, however, Japan is experiencing considerable biodiversity losses. Population growth, expansion of human settlement, and economic development have all contributed to what is being described as the world's 'Sixth Great Extinction' (Zalasiewicz *et al* 2010: Leakey & Lewin 1995). These phenomena have produced habitat destruction, degradation, and fragmentation – the main causes of biodiversity loss – with species over-exploitation, pollution, invasive species and disease, and climate change as additional factors. Between 1970 and 2012 an overall 58 per cent decline in vertebrate abundance has been observed worldwide, and there has been a decline of 81 and 36 per cent respectively in freshwater and marine population (WWF 2016: 18-38). The rate of biodiversity loss due to human activity is consequently at catastrophic levels, hence the increasing use of the descriptors 'Holocene' or 'Anthropocene' Extinction (Kolbert 2014).

Conservation International has designated Japan as one of the world's 35 'Biodiversity Hotspots' (Mittermeier *et al* 2005), in recognition of the diversity of endemic terrestrial life there, but also of the fragility of the country's ecosystems and their continued destruction. The International Union for Conservation of Nature and Natural Resources lists 13 animal species extinct in Japan, including both the Honshu and Hokkaido wolves (*Canis lupus hodophilax* and *Canis lupus hattai*), and 459 species threatened with extinction (29 mammals, 49 birds, 25 reptiles, 20 amphibians and 100 fishes). Among Japan's endemic species 17 out of 43 mammals, 8 out of 24 birds, and 18 out of 46 amphibians are threatened with extinction (IUCN 2019).

The Japanese government has shown greater commitment in recent decades to the conservation of areas of natural importance or beauty. There is also recognition among rural residents of the damage that both human depopulation and the elimination of wolves from the forest ecosystem has done in allowing deer, boar and monkeys to multiply and damage the forest ecology (Knight 2003). Nevertheless, there are as yet no reintroduction plans for

wolves, due to public anxiety, the lack of wilderness areas with sufficient range and the perception of the primary purpose of the national parks system as being to allow human enjoyment of nature.

The Natural Parks Law was passed in 1957, and by 2019 there were 34 National Parks, 56 Quasi-National Parks, and 311 Prefectural Natural Parks covering nearly 15 per cent of Japan's total land area (MoE 2019). There are also five designated Wilderness Areas, where restrictions on public access are in place to protect original growth habitats. Japan joined the Ramsar Convention on Wetlands of International Importance in 1980 and there are 52 Ramsar Sites in Japan, with 13 in Hokkaido, 28 in Honshu, 6 in Kyushu and 5 in Okinawa (Ramsar, 2019). An important site is Yakushima Island in Kagoshima Prefecture. Within the Kirishima-Yaku National Park, Yakushima is a Ramsar site, a Wilderness Area, a UNESCO Man and the Biosphere Reserve, and has been a UNESCO Natural World Heritage Site since 1990, due to the number of endemic and endangered species present in the island and its surrounding waters. Among these are the loggerhead turtle (*Caretta caretta*), and an area of primary forest within which a small number of ancient Japanese cedar trees (*Cryptomeria japonica*) of some 2-3,000 years of age continue to grow (UNESCO 2016).

Marine Biodiversity

Japan's commitment to marine biodiversity is less developed, given the area of ocean under its jurisdiction, the Japanese people's historic use of marine resources, and the variety of marine habitats – from sub-arctic coastal shallows to deep ocean trenches and hydrothermal vents. Although the government has published a Marine Biodiversity Strategy (MoE 2011), its efforts are mainly directed at preventing marine pollution, researching marine environments, and developing a biodiversity plan for future implementation. Japan has yet, for example, to establish Marine Protection Areas or marine reserves beyond those – e.g. the Seto Inland Sea – that fall within existing protected terrestrial zones such as National Parks or Wildlife Protection Areas. Japan also does not participate actively in negotiations to establish international marine reserves. Furthermore, Japan still conducts pelagic whaling under the International Whaling Convention's (IWC) scientific exemption, despite the International Court of Justice's ruling in 2014 that the practice is 'not for the purposes of scientific research' (Hodgson-Johnston & Jabour 2014).

Although Japanese marine fish catch has decreased by 27 per cent respectively since 2005 (MIC 2019), fish consumption in Japan remains high at around 52kg per person per annum[3] (FAO 2016: 177). Fujikura *et al* (2010) calculate that the number of described marine species in Japanese waters currently stands at 33,629 (out of a global total of 230,000 described species), while the number of species identified but undescribed is 121,913. Undoubtedly a large number remain undiscovered.

Nevertheless, global fish stocks are being depleted at an unsustainable rate and the world's oceans are undergoing a profound ecological crisis as a result of over-exploitation by humans (Clover 2004; Worm & Branch 2012), potentially as 'a prelude to a major extinction pulse' and requiring intervention to avert a marine biodiversity disaster 'of the magnitude observed on land' (McCauley *et al* 2015). Japanese fish consumption is implicated in pushing various marine species towards extinction, including Atlantic Bluefin Tuna (*Thunnus thynnus*) and Japanese eel (*Unagi – Anguilla japonica*), which are listed as endangered (Clover 2004; IUCN 2019). Consequently, vigorous action in marine conservation is needed by encouraging aquaculture, developing public awareness, and in international monitoring and regulation of marine exploitation. Most importantly, international cooperation is required for the designation of marine biodiversity hotspots and the establishment of Marine Protected Areas (Clover 2004; McCauley *et al* 2015).

Climate Change

Not only is climate change the most pressing issue facing humanity in the 21st century, it acts as a 'threat multiplier' by accelerating the progression of other human-environmental crises, and carries heavy economic costs (Hansen 2011; King & Goodman 2011: 803; Obama 2017). Marine biodiversity loss, for example, is accelerated by climate-driven ocean warming and acidification (Doney *et al* 2012; Kroeker *et al* 2013). Climate driven poverty, disease, displacement, and property destruction can weaken already fragile governments (USDOD 2010: 84-88). Among the environmental crises currently being faced, climate change is also the least susceptible to independent action targeted at within-country outcomes. Mitigation and adaptation therefore require the greatest degree of international cooperation.

[3] EU=22kg.

Japan's cumulative greenhouse gas (GHG) emissions since 1850 are ranked fifth globally, at 4 per cent of the world's total to 2011 (Ge, Friedrich, & Damassa 2014).[4] In 2012 Japan's annual per capita emissions were ranked 37th out of 184 countries reporting, at 10.54 $MtCO_2e$ [5], though its aggregate GHG emissions were fifth highest at 1344.6 $MtCO_2e$[6] (UNFCCC 2015; WRI 2016), reflecting Japan's large population and high level of economic development in contributing to environmental problems.[7] Since 1990, Japan's GHG emissions have increased by 11.8 per cent (1234.4 $MtCO_2e$)[8], with the energy sector accounting for 91.6 per cent of emissions in 2012 (1990=87.45%) (UNFCCC 2015). Japan's GHG emissions intensity has, in addition, been falling more slowly than most developed countries (WRI 2016) and, since the 2011/12 nuclear shutdown, the fossil fuel component of the national energy mix has risen. Nevertheless, due to intense post-Fukushima energy conservation measures, Japan's GHG emissions are probably little higher than had the disaster not taken place (Cho *et al* 2016).

Impacts of Climate Change in Japan

The impacts of climate change are observable worldwide, and consistent with scientific theory and paleo-climatic observations (Hansen 2011). On 11 May 2019 the symbolically important 415 ppm global concentration of CO_2 in the atmosphere was passed (NOAA 2019; Goodell, 2019), despite 350ppm[9] being defined as the threshold beyond which warming 'will increase the risk of irreversible climate change, such as the loss of major ice sheets, accelerated sea-level rise and abrupt shifts in forest and agricultural systems' (Hansen 2011; Rockström *et al* 2009: 473).

Average temperatures in Japan are rising at a rate of 1.15ºC per hundred years, nearly double the global rate of 0.68ºC. The number of very hot days (≥35ºC) and hot nights (≥25ºC) is also

[4] USA=27%; EU28=25%; China=11%; Russia=8%.

[5] Kuwait (1st) = 62.3tCO_2e; USA (16th) = 19.9tCO_2e; UK (49th) = 8.69tCO_2e; China (55th) = 8.13tCO_2e.

[6] China (1st) = 10,975.5$MtCO_2e$; USA (2nd) = 6,235.1$MtCO_2e$; UK (14th) = 553.4 $MtCO_2e$).

[7] Principal GHGs are, in order of abundance: Water vapour (H_2O), Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Ozone (O_3), Chlorofluorocarbons (CFCs).

[8] France = -11.4%; UK = -25.2%; USA = 4.3%.

[9] Pre-industrial value=280ppm (Rockström *et al*, 2009: 473).

increasing (MoE 2012). On 23 July 2018 Kumagaya City, Saitama Prefecture, broke the official record for the highest daytime temperature nationwide with 41.1ºC (JMATCC, 2018: 6). The previous daytime record of 41.0ºC had been recorded on 12 August 2013 in Shimanto City, Kochi Prefecture, along with 106 weather stations across Japan recording their record highest temperatures. The previous day Tokyo's record daily minimum of 30.4ºC had been recorded – the first time the temperature had remained above 30ºC throughout an entire 24 hour period (JMA 2013). There has also been a decrease in the number of rainy days, an increase in the number of heavy precipitation events, and winter snow depth is decreasing (JMA 2018).

Although climate change impacts are disproportionately felt in developing countries, Japan is also experiencing its effects. Observed ecosystem impacts in Japan include: beech forest decline, pine-tree decay, and decrease in Alpine flora; eutrophication of freshwater systems and reduction of fish distribution; coral bleaching and northward migration of marine species; and earlier leafing and later autumn foliage in deciduous trees. Reported impacts on human-environmental systems include reduced rice yield and quality; reduced fruit quality (all 47 prefectures); drinking water restrictions, increased groundwater usage, and land subsidence; coastal damage, and inland flood and crop damage; increased mortality (heat-stress and -stroke); increased distribution of disease transmitting mosquitos and bacteria; impacts on economic and cultural life, etc. (MoE 2008; MoE 2015b).

Japan's Climate Change Diplomacy

Indispensable to mitigating climate change is international cooperation to reduce atmospheric GHG concentrations, especially among the world's top ten emitters, who account for more than two thirds of emissions globally (WRI 2016). Cooperation is achieved primarily through the annual Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC), beginning with Berlin in 1995 (COP1), and which uses as its evidence base the UN Intergovernmental Panel on Climate Change's (IPCC) Assessment Reports (AR), the most recent of which is AR5 (IPCC 2014).

Japan's notable contribution to climate change negotiations was in hosting COP3, from which emerged the Kyoto Protocol. Adopted on 11 December 1997 and entering into force on 16 February 2005, the Protocol agreed: a heavier burden on developed nations under the

principle of ‘common but differentiated responsibilities’; binding reductions to at least 5 per cent below 1990 levels in six GHG categories; and emissions trading, clean development, and joint implementation as achievement mechanisms. The Protocol also outlined resilience building measures and established an Adaptation Fund (UNFCCC 1997).

Between 1997 and the signing of the COP21 Paris Agreement in December 2015, international efforts were focused on implementing the Kyoto Protocol, including the Doha Amendment (COP18 in 2012), and on ratification – particularly the United States, which remains the only signatory not to ratify, and Canada, which withdrew during COP17 in Durban in 2011. International agreement on strengthening Kyoto with new binding emissions targets has been difficult, notably at the failed COP15 meeting in Copenhagen in 2009. Since then, Japan’s commitment to reducing fossil fuel consumption and GHG output has been setback by the Fukushima disaster, and Asian leadership in environmental negotiations is passing to China – the world’s largest emitter. Indeed, the Paris Agreement emerged from US-China bilateral negotiations and EU arguments for the potential economic opportunities from mitigation (Dimitrov 2016).

Conclusion

Japan’s spearhead contribution in leading Asia’s modern economic development has been a seminal moment in human history, and was achieved in-part as a result of the region’s 20th century population expansion – its ‘demographic dividend’ (Bloom, Canning & Sevilla 2003). The environmental outcome, however, has laid bare the myth that modernity can be experienced by all while, simultaneously, humans continue to live sustainably on Earth. Resource depletion, pollution and waste accumulation, species extinctions, and climate change are all associated with population expansion and economic development, and Asia is where the problem of population is most acute.

Unlike the West, which asserted dominion over nature, Japan achieved its modernization by the absorption of both the fact and idea of nature into its rendition of modernity (Thomas, 2001). Paradoxically, as increasing numbers of Asian people anticipate achieving the living standards of Europeans and Americans, the consequences of that eventuality for life on Earth are understood ever more clearly as ultimately catastrophic (Ghosh 2016: 92). More than any

other region, therefore, Asia is where human-environmental contradictions need to be resolved.

In 2008 Japan began to shrink. Under present trends its population will decline by one third to around 87 million people by 2060 (NIPSSR 2012), due to sustained falls in human fertility in the postwar era. South Korea, China, and other countries in the Asia-Pacific will probably begin shrinking soon. The rate of global population expansion, which for decades was driven by Asia, is slowing down, again because of Asia; and Japan is in the vanguard. Although the processes and outcomes of population decline cannot be assumed as the reverse mirror of expansion, there is potential for Japan to use its experience of depopulation to overcome the Asian modernization trap and achieve a 21st century 'depopulation dividend' (Matanle 2017), whereby population shrinkage would contribute to establishing globally sustainable human-environmental systems.

With a per capita bio-capacity deficit of 600 per cent, a population of more than 125 million people, and as Asia's richest and most technologically advanced country, Japan bears not only a heavy responsibility to urgently resolve its own environmental sustainability deficit, but also to contribute to leading the rest of Asia into a post-developmental future. There is tremendous scope for optimism, however, that the Japanese people can rise to this challenge. In doing so, what assets or advantages might Japan deploy to achieve an environmentally sustainable way of life for its own people? How might Japan use or change its international position to lead in transforming Asia's developmental pathways? What obstacles are there currently in the way of Japan achieving these objectives? Indeed, what evidence is there to suggest that Japan as a country wishes to lead Asia in charting a new path into a sustainable future? And, should this not occur, what would be the alternative?

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