8 Environmental Destruction, Disaster and Climate Change

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Global environmental change and Earth's future

How many years have passed since we reached the point of shouting out that the environmental crisis is on a global scale?

Environmental issues came under serious discussion in the Cold War era, and with the arrival of nuclear warfare, the hypothesized 'nuclear winter' featured. The result of mass destruction by nuclear weapons is the stagnation of aerosols in the atmosphere, decreasing the global temperature by several degrees. The continuation of this process would result in what is called 'nuclear winter', an event that scientists throughout the world have been seriously discussing.

With the collapse of the Soviet Union in 1990, the west experienced a momentary victory. Two years later in 1992, the first and largest UN meeting, the United Nations Conference on Environment & Development (UNCED), was held in Rio de Janeiro, Brazil, concerning the global environment. This international conference was later referred to as the Earth Summit. At this conference, each nation's leaders earnestly discussed global scale environmental problems such as the threat of global warming, the decline of water resources and the decrease in biodiversity. The Earth Summit established two major international frameworks: the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). In 1997, five years later, a meeting of the Conference of Parties was held in Kyoto that established the Kyoto Protocol. The Kyoto Protocol mandated that Japan, among other nations, reduce CO_2 emissions. Initially, a few problems were identified: the US did not ratify the treaty, there was nothing in place to handle emissions from developing countries and countries as large as China were designated as developing countries. Ten years later, a meeting was held

in Johannesburg, South Africa, regarding the possibility of continuing the World Summit on Sustainable Development (WSSD), in which the UN Secretary General Kofi Annan stated, 'After the Earth Summit, progress was slower than expected, therefore, the most important thing is speed. If we miss this chance due to stagnation, there will be nothing but disaster'.

Annan's words lamented the fact that, from 1992, although there was a framework and various discussions around the world, the speed of environmental destruction had increased, while agreements on resolutions advanced slowly.

Another ten years later, in 2012, the United Nations Commission on Sustainable Development (UNCSD) held Rio+20. After the Earth Summit, in order to resolve each country's lack of progress on environmental problems, the discussion focused on economic mechanisms and the introduction of Green economics for global environmental conservation.

However, the G8 summit showed that developed nations are not cooperating in regard to Green economics, and was evaluated as the least successful environmental summit to date. In the meantime, global environmental changes are becoming more and more serious. Especially in recent years, abnormal weather has increased. There is no telling what will happen to the Earth.

According to a recent IPCC report (2014: 6), greenhouse gas emissions have had the largest increase over the last ten years, and forty years ago, the accumulation of CO_2 emissions were about half of today's levels (in other words, CO_2 in the atmosphere has doubled in the past forty years). Also, the written report shows that if the present conditions exceed our efforts, the temperature in 2100 will have risen 3.7~4.8°C (IPCC 2014: 9).

Although the increase over the last ten years is remarkable, the surface temperature of the oceans has largely remained unchanged. This is because the makeup of the surface layer of the ocean is different to what lies beneath it, and the heat is believed to only be stored in the topmost surface layer. This has caused the number of violent typhoons and flooding events to increase. From this point on, despite it being discussed all over the world, humans will experience climate change.

However, aside from the above issues, some scientists say that global cooling poses the greatest danger. They claim the last cold climate on Earth was caused by the Maunder Minimum, a period

when solar activity was at its lowest. Today, the Earth may also experience global cooling in a similar way.

Through Miyahara's research that measures the carbon isotopes of tree rings of trees on Yakushima Island (Miyahara 2008: 1380–1382), it has become clear that the occurrence of the lower period of solar activity from 1645–1715 (Maunder Minimum) was part of an eleven year cycle that has since changed to a fourteen year cycle.

Recently, regarding the increasing solar activity cycle, some scientists have argued that this is symptomatic of moving into a new cycle, but at present there doesn't seem to be any sign of it. Simultaneously, in accordance with global warming outbreak expectations, that influence, especially on the ice sheets in Greenland, will cause the north Atlantic to disperse a large amount of cold fresh water, thus the warm climate of Europe would become much colder on the whole (University of Illinois At Urbana-Champaign 2004). Although the salt concentration in the north Atlantic poles is high, the melting of ice sheets will result in the dispersal of a large amount of fresh water, reducing the salt concentration, which will stop thermohaline circulation.

Research on the shutdown of thermohaline circulation and its influence on the twenty-first century was discussed in a recent publication (Vellinga and Wood 2008). According to Vellinga and Wood at the Hadley Centre in England, in the case of the shutdown of thermohaline circulation, the northern hemisphere's average temperature lowers by about 1.7 degrees; especially northern Europe would become very cold[1].

In this way, scientists are maintaining that while global warming is a critical problem, preparation for global cooling must also be carried out. How can we characterize these distinct future predictions?

First of all, it must be recognized that the IPCC AR5 has pointed out that rising greenhouse gases and the global warming mechanism have completely different causes than the above-mentioned cooling mechanism. Global warming is mainly caused by human-made greenhouse gases that shield radiative cooling. Hypothesizing that global cooling is due to solar activity, it may be caused by the declining intensity of solar radiation. However, in previous times of low solar activity, like the Maunder Minimum, the exact mechanism at play and the temperature decline have not been fully understood. Also, since research into the solar activity decline is in its initial phases, a clear scientific mechanism has not yet been established.

Of course, regarding the possibility of thermohaline shutdown due to the melting of Greenland ice sheets, there is a link to the global warming scenario. The IPCC AR4 and AR5 have predicted the strong effects of thermohaline shutdown and more on global warming. However, it is difficult to tell whether a change in the prediction of this effect and fresh water influence estimations are realistic. In Vellinga's research mentioned above, if the estimations are correct, the Earth's equatorial region and polar temperatures will change drastically. Naturally, cooling will occur even if there are other ways for this to happen. One is a volcanic eruption larger than VEI-7. If the ash as volcanic ejecta remained in the stratosphere, the solar intensity on the Earth's surface would decrease. If this continued for a long period of time, cooling becomes a possibility. However, in the first several years, aerosol and sulphuric mist would cause global-scale cooling, but the eruption would also emit a large amount of CO_2, causing global-scale warming for a longer period.

In the absence of these extreme natural phenomena, the IPCC AR5 demonstrates that it will be difficult to escape the effects of global warming caused by human-made greenhouse gases. Therefore, what do humans need to do to 'adapt' to that kind of future?

In this vital matter, humankind has been taking adaptation into account over the past ten years. However, realistically, one could say we are not coping at all.

With the above-mentioned rapid changing of the climate, the global environment will alter considerably. Will humans have the chance to face the challenges this presents?

When it comes to nature, or events arising from the universe, human civilization unfortunately does not have the capacity to manage. That is to say, if there were a temporary change in solar activity, we would have no clue what to do. In contrast, when it comes to anthropogenic environmental changes, will humankind be able to cope?

Humans are known as rational, cognitive creatures, so it is natural for us to think that 'we can restore the changes we make'. However, in reality, with the passing of two world wars, humans with nuclear weapons began to doubt themselves, thinking 'it is impossible to restore the changes caused by our effects'. In the history of the twentieth century, surely the history of 'irreversibility' has been proven. In the IPCC's AR5 (Fifth Assessment Report), various relief scenarios have been proposed to protect against global warming. But

surprisingly, these large-scale ideas, more so than in AR3 and AR4, are thought to be mostly impossible to achieve.

Decreasing biodiversity also poses a critical situation. According to the World Wildlife Fund (WWF), since the year 1600, more than 700 species have become extinct. Although the exact number of extinct species is unknown, it is thought that 45~50% of extinct mammals have died out in the twentieth century alone. Also, of all the extinct bird species, 35~40% became extinct in the twentieth century. Though the main cause is overfishing, from now on, these kinds of global changes will increase exponentially. Human beings have already caused significant damage to other living things by destroying the environment.

Regarding the difficulties involved in managing climate change, it is clear that the problem stems from humankind's reliance on burning fossil fuels. Additionally, humans have relied on nuclear power to account for the decreasing dependence on fossil fuels. With the occurrence of two significant nuclear accidents (Chernobyl and Fukushima) and associated radioactive contamination, society is starting to once again doubt whether nuclear energy can provide an alternative to fossil fuels to overcome global environmental degradation.

If humans fail to consider the harm caused by the discharge of CO_2 into the Earth's atmosphere, they will not be able to control climate change. Further, the ability to control radioactive material is not thought possible, and is becoming a significant source of pollution.

We cannot shy away from the environmental disasters and climate change we are facing. We need to try to think about natural disasters and climate change, as well as the effects of environmental destruction and the increased vulnerability of our civilizations.

Examples of catastrophe: Water disasters

Based on the above circumstances, especially using the climate and water disasters of 2010 and beyond as an example, each country is experiencing unexpected torrential rain, and mudslides are occurring more frequently. These disasters are not only occurring in Japan, but have also hit the Philippines and Vietnam, and have caused serious damage especially along the coastlines. In the US, Hurricane Katrina caused New Orleans to crumble in 2004, and the same happened to Galveston in 2008 from Hurricane Ike. In

this way, global-scale disasters are increasing, and although they are now labeled 'disasters caused by climate change', other causes were initially identified. Let's look at water disasters as an example.

Japan has a history of floods with a devastating impact on human lives and property. To mitigate these events, Structural Measures have taken place consistently since the end of World War II. Structural Measures are based on the River Law (07/10/1964 #167)[2], and regarding nationally controlled Class A river basins, they protect citizens from floods by managing the responsibility of flood control and building dams and banks where flood risks exist.

Currently, in the River Law: (1) the national government manages the responsibility of flood protection of Class A Rivers, and (2) the national government needs to establish a fixed plan for the purpose of maintaining safety in regards to floods, of implementing Structural Measures and building flood defense systems.

In 1959 there were 5,908 victims (4,697 deceased, 401 missing) of Typhoon Vera (Iwase Typhoon) (Fire Defence White Book 2008). After that, the Ministry of Construction played a central role by investing capital into various technologies on Class A river basins across the country.

As for flood control infrastructure, dams were built upstream that decreased the flow rate, banks were constructed along rivers and estuaries, levee protection works were carried out, estuary dams were built and flood drainage ability was increased by floodway widening and riverbed excavation, in addition to the promotion of cement canal construction, a shortcut for river repair.

New rivers were changed, such as Yodo River in Osaka and Kusatsu River in Shiga. The Kusatsu River was famous for its natural beauty as a Tenjou river (river flowing above the railway and roads); however, the river was replaced by a new channel. Also, reservoirs were established in the circumference of large rivers prone to severe flooding. With this public infrastructure, it is possible to say that Japan's flood risk in terms of Class A Rivers has markedly decreased.

What is the process of establishing flood control infrastructure? Six operational goals are endowed in the comprehensive river plan in Japan: the Flood Protection Plan, Low Water Plan, Environmental Conservation Plan, Erosion Control Plan, Landslide Prevention Plan and Steep Slope Collapse Countermeasure Plan. Based on the most important item, a Designed Flood[3] will be determined based on the

Flood Protection Plan, protecting Japan's Class A river basins with safety measures so they only have to cope with excessive rain once per 100–200 years.

Further, the Forest Act and the Erosion Control Act were developed to defend against landslides in mountain regions. The Department of Agriculture and Forestry played a central role in promoting forest conservation and erosion control, and decreased the dangerous mountain regions in the country.

From this, Japan can meet a period of rapid population and economic growth, and has the basic ability to protect against flood damage in the greater part of the country.

These are the results of thinking about flood disaster mitigation; however, it has reached the point where problems are also being pointed out. First of all, a significant social problem has emerged. Because of dams and dikes, river ecosystems are being destroyed. On the public level, there has been much social opposition to these works starting in the 1990s, and many citizens are opposed to large flood protection infrastructure such as dams and dikes. Conversely, it should be added that there has been a large decrease in Japan's vulnerability to floods.

Also, through flood protection establishment preparedness and the decrease of flood risks, the value of downstream floodplains will increase, and conversely, the cause of large populations gathering in high-risk areas will be identified.

In these circumstances, according to the recent trend in climate change, along with severe weather, the risk of flood events will increase. The future difficulty will be generating acceptable limits. For example, a river dike that would usually experience one torrential rain event per 100 years that causes flooding will, due to global warming, experience this once every twenty years. If this is the case, the river dike's risk of flooding will substantially increase. Furthermore, the flood defense system that accounts for flooding every fifty years needs to plan and mitigate for floods every ten or even five years.

Presently, based on the trend of increasing flood frequency, this kind of example will become more common. In that case, what mitigation measures will we be able come up with? The first thing that can be done is raising the level of cement in man-made river basins. The construction of super levees and reservoirs, as well as the building of multipurpose upper stream dams, are being taken into consideration.

Even though according to citizens, maintaining safety is the thought process behind these initiatives, in reality, there are a number of hurdles to overcome to implement these new measures.

The reasons are as follows: (1) the extreme cost, and opposition regarding funding; (2) environmental restrictions – there are soil limitations in the city, making it less feasible to construct cement-sided rivers with such low amounts of soil; and (3) the fact that citizens find it difficult to understand the lack of certainty surrounding possible future disasters. As a recent development, unstructured measures (soft measures) have become a high priority.

These are: hazard map formulation, disaster education in the form of citizen disaster prevention training and using IT to establish a refugee network. Rivers with topsoil banks, however, do not have the power to protect residential areas from actual flooding. Given this fact, how will people escape? This prevention plan doesn't change the fact that flood damage will increase in the future.

In 2014, torrential rain occurred in Hiroshima, causing a landslide and debris flows that resulted in many deaths. This became a problem because a hazard map was not prepared in advance. At the same time, the torrential rainfall occurred at night, the cumulative rainfall was record-breaking, and due to the rainfall build-up, it could not be prepared for completely. Also, torrential rain had never resulted in landslide to that extent before.

Rainfall phenomena are increasing due to global environmental changes, and the Ministry of Land, Infrastructure, Transport and Tourism of Japan is compiling the degree to which this is happening in our country. Firstly, according to statistics from all 1,300 AMeDAS[4] collection points in Japan, there were an average of 209 cases where rainfall events exceeded fifty mm from 1976 to 1985, and an average of 288 cases from 1996 to 2005. This represents an increase of 1.4 times. The average number of cases where the events exceeded 100 mm from 1976 to 1985 was 2.2, and from 1996 to 2005 there were an average of 4.7 cases, a difference of roughly 2.1 times.

Although it's not clear whether the trend would continue if the statistics were available from 2006 to 2015, if one were able to particularly focus on cases of torrential rain in 2013 and 2014, it would appear that the trend is not decreasing.

In the same vein, in São Paulo, Brazil, the number of days in which rainfall exceeded fifty mm in the 1930s was approximately ten, whereas in the 2000s, it was about forty. There were no days in

which rainfall exceeded 100 mm in the 1930s, but that has increased to about seven days in the 2000s. The discussion needs to be had regarding whether this is an effect of climate change or the large city 'heat island effect'.

In Japan, in the past fifty years the atmospheric temperature in cities has risen five times more than areas outside the city, and although the heat island effect is a characteristic of big cities, in recent years torrential rain disasters have increased dramatically. The first direct cause is that the Sea Surface Temperature (SST) is increasing in the outskirts. In our country, large typhoons and torrential rain events are caused by rising sea temperatures, and this is related to a La Niña effect. Similar relationships are being discussed as the same type of La Niña and El Niño that occurred in Brazil in 2010 and 2011 that caused catastrophic floods and landslides in Rio de Janeiro's mountain zones.

Recently, it has been reported that, depending on the change in structure of the ocean's water, the El Niño effect (Weng et al. 2007; Ashok et al. 2007; Weng, Behera and Yamagata 2009; Ashok and Yamagita 2009; Weng et al. 2009; Ratnam et al. 2010; Yuan and Yamagata 2014) will create a new form, like the California Niño, which significantly changes the ocean.

Extinctions and disasters

What should we do in Japan to mitigate flood disasters and other risks?

Most people would say that earthquakes and tsunamis come to mind first when they think about disasters. However, compared to earthquakes and tsunamis, floods occur more often, and although periodic, they pose an unpredictable risk.

The question is are enough inspections being carried out? With earthquakes there is risk assessment, and the administration is required to prepare for potential damage caused by floods.

As for Japan, earthquake disasters are recognized as posing a significant risk because (1) they offer meager advance warnings and prediction is difficult, and (2) they cause widespread damage.

On the other hand, earthquakes almost never occur in Brazil, and flood disasters are thought to pose a greater risk. In Japan, you come across weekly articles titled 'The next earthquake will occur in XX', but in Brazil, you more likely to read 'The next flood will occur in XX'.

Risk awareness is seared into the minds of citizens due to incidents such as that of January 2010 where the São Paulo River flooded, completely submerging the small city of São Luis de Paraitinga, whose streets crumbled.

There are three potential causes of the extinction of life on Earth: (A) asteroid attack, (B) gigantic volcanic eruption and (C) climate change. (A) is considered to be the primary cause of the huge extinction event sixty-five million years ago at the end of the Cretaceous period. Other extinction events are thought to be related to this.

It is conceivable that (B) was the principal cause of the Siberian flood basalt at the end of the Permian period. That leaves the last cause of an extinction event, (C). This is thought to be the cause of the 'Snowball Earth', the Cambrian period in which the Earth experienced global cooling. Particularly in modern history, 20,000 years since the last ice age, the Earth's cooling would be a serious natural disaster.

As for gigantic volcanic eruption (B), it had an effect on mankind 74,000 years ago with the eruption of the Toba Caldera in Indonesia. At that time, the volcanic ejecta exceeded 2,800 km^3; in Japan the largest eruption was the Aso Caldera, which only produced 600 km^3.

In modern history, VEI-8 volcanoes have not erupted; however, various greater volcanic eruptions occurred during the nineteenth century, for example, the 1815 Mount Tambora eruption in Indonesia. It is reported that this eruption even led to crop failures in the US, and is acknowledged as a global disaster. In 1902, Mount Pelee on Martinique of the West Indies erupted, totally destroying the capital San Pierre and killing about 30,000 people. Also, in 1985 the Nevado del Ruiz eruption that occurred in Colombia featured pyroclastic flows that caused mudslides, leading to the almost complete destruction of Almelo at the foot of the mountain, killing 21,000 people.

Although Almelo had prepared a hazard map, this was unsuccessful. The Mayor spread erroneous information about the eruption, resulting in disaster. This highlights the serious nature of the government's judgment during crisis.

In the small country of Montserrat in the Caribbean Sea (British Territory), the capital city Plymouth was abandoned in the mid-1990s after the eruption of Soufrière Hills Volcano because of volcanic ash and pyroclastic flow, and is now in ruins. Volcanic eruptions are rare, but they cause major damage, and should never be taken lightly.

In Japan in 2014, Mount Ontake suddenly erupted, killing sixty mountain climbers. Although there were advance warnings of

this eruption, no ban was placed on mountain climbing. Thus, the difficulty of accurately predicting volcanic eruption was again proved.

As for (A), an enormous meteorite collision occurred on June 30, 1908, crashing into the Podkamennaya Tunguska River (Krasnoyarsk Krai, Russia). The meteorite was presumed to be 100 m in diameter. On February 15, 2013, one crashed into the Chelyabinsk River in Satka, with a presumed diameter of seventeen meters. The explosion site was fifteen km away from the city of Chelyabinsk (Popoval and Jenniskens et al. 2013), and caused 5,000 windows to break within the city, injuring 1,500 people.

Although those listed above are the only actual collisions, on June 14, 2002, a seventy-three meter diameter meteorite, 2002MN, came one-third the closeness of the moon to Earth, creating the possibility of a Tunguska-scale explosion. For that reason, Near Earth Object (NEO) monitoring measures were taken at NASA and the International Spaceguard centre, where monitoring for meteors that would affect the Earth continues. In this way, although the possibility of a catastrophic disaster that has the ability to wipe out humankind is low, we cannot forget the risks involved in living on Earth.

Global environmental problems and disasters

Modern civilization directive

In this chapter we accord with the following argument: 'the creation of substances thought to be harmless for the purpose of improving human civilization (CO_2, fluorocarbons, etc.) caused the balance of the Earth to be disrupted, and the possibility of marked environmental changes on the Earth'.

Mass production and mass consumption are the driving force of modern civilization, and in support of the same global values, assets, conveniences and happiness that civilization requires for secure living, stable energy and food security, a large scale natural change is necessary.

In order to create safe living spaces, various river infrastructure and embankments are constructed, and in order to produce stable energy, power plants are built. Over many years, humankind has thought of the Earth as a conquerable object. In modern civilization, the Earth itself is 'dead' and is only an 'environment'. The humans

who must live in this world use what is 'usable', 'eliminating' things that are not essential. To these humans who are 'living', they have come to create a 'pleasant environment'.

According to humans, things that we need are pleasant cities and infrastructure, and because of this we also create things we don't need, undesirable things for the Earth, and waste.

This waste includes nutrient salts, organic matter, heavy metals and small amounts of organic pollutants. The atmosphere experiences the greenhouse effect and air pollution; and the soil receives the nutrient salts in manure (N, P), organic solvents, gasoline, small amounts of organic pollutants and heavy metals.

Also of extreme concern is radioactive waste. Although the full meaning of the Fukushima Daiichi nuclear power plant accident is only understood through others' explanations, it is thought that due to forty years of power generation, high level nuclear waste was produced. The meltdown thus resulted in environmental catastrophe.

Of course, although the meltdown and the leak of radioactive waste during the accident in 2011 was unimaginably huge, the Fukushima nuclear disaster can be considered as a consequence of long-term accumulated radioactive waste over forty years' operation.

The Gaia hypothesis on human induced climate change

Climate change problems and other pollution/contamination primarily affect the Earth's ecosystem in a negative way, and greenhouse gases destroy Earth's entire temperature balance. Using human beings as an example, our appropriate body temperature is thirty-seven degrees Celsius, anything above or below that can hinder our organ functions. For that reason, body temperature works as a self-regulating mechanism; in hot weather we can reduce out temperature by sweating, and if it becomes cold we can work to increase it. Assuming this is the case for the Earth, in order to preserve the fixed temperature of the Earth's surface, the ocean current moves the heat to the polar regions, and through evaporation, heat can be released.

In the greenhouse effect, because the Earth's balance is disrupted, warming can't be stopped, leading to various problems.

As a result of the Earth's body temperature increasing (atmospheric temperature), various parts (areas) and internal organs (forests/polar ice caps/ocean currents) are liable to be destroyed. In other words,

we should treat global warming not as simply an increase in body temperature, but as if the Earth's body temperature has risen to the extent that its internal organs are collapsing (Earth as a life form is dying), and the environment is changing completely.

Although humans think of the Earth as a fixed ground upon which to amass their civilization, devouring it greedily, humankind is one part of this life form called Earth. This part is abnormally multiplying, causing Earth to be in a critical condition. In other words, so long as we continue in this way, humans are like cancerous cells on Earth's surface. According to James Lovelock, Earth is assumed to be one life form (Gaia). By nature, life possesses a 'self defense mechanism' to avoid extreme conditions. In the current state of affairs, what is this life form's biggest danger? The answer would unmistakably be the existence of humanity.

Because humankind lacks the ability to control the measure of 'civilization', from every single angle, humanity poses a threat to Earth as a life form. Furthermore, humans have rapidly expanded the scope of their lives, causing serious damage. So, what would be the disease control prevention measures Earth would take? Make no mistake, if this was the case 'the eradication of humans' would be the course of action. Thus, if civilization remains as it is now, the Earth as a life form will either be destroyed, or, the human civilization on it will be destroyed.

The contradiction of engineering and Gaia thought

On the contrary, assuming for a moment that we can understand ideas like the above, if we try to think in terms of engineering concepts, the first thing should be 'human prosperity' instead of 'human life'. Even though in order for Gaia to live, a large number of humans would have to die, human engineers are thinking every day about how humans can survive.

In the disaster prevention field, in order to save even one person (the smallest possible goal) you must remodel nature, by for example constructing river dikes. However, the only way humans can survive is through 'nature restructuring', and in this sense we can understand that it is impossible for 'Gaia' to survive as well. This problem has serious inconsistencies that we must cope with. Because of this type of infrastructure, flood defenses like embankments and dams will unmistakably cause injury

to Gaia. The same goes for building embankments to protect against tsunamis.

Of course, we may avoid building disaster mitigation infrastructure because of its serious impact on the natural environment, on Gaia itself, or as a result of high estimated cost. However, realistically, without this infrastructure, humans would suffer. When protecting against disasters, we should think about ways we can be less dependent on infrastructure and instead use new technologies, like hazard maps, as 'evacuation models'. We need to keep in mind that the hazard map does not protect us directly, but only shows us how to escape from disaster.

Considering for a moment the prioritization of Gaia's life, this would entail giving up most of the 'blessings of modern civilization'. Would it be possible to do so? How do we think about and take action towards the contradiction between 'prioritizing Gaia's life' and 'our dependency on modern civilization'? Although the solution does not yet exist, we should be searching in this direction.

The survival of humankind

From this point forward humans need to think deeply about considering and respecting 'Gaia, the Earth as a life form'. Especially, before we categorize our survivability problems as environmental problems, energy problems and food problems, we should examine how we can preserve Gaia's stability over the long-term. Since the Earth Summit, there have been other summits and international conferences involving heads of state from each country. However, the concept of 'Gaia Earth as a life form' has not gained much support.

It was made clear at the 2012 UNCSD Rio+20 that implementation of green economics has not occurred due to the economic problems of each country. In other words, more effort was made toward dealing with the problems of modern civilization than examining or enforcing the green economy.

Within the laws and organizations that are human institutions, the concept of 'Earth as a life form' or 'Earth as an individual life' has not been fully clarified. Accordingly, a statesman representing 'Earth as an individual life' to protect her interests does not exist.

The 'Earth as a life form' principle is not yet sufficiently understood, the criticality of the situation has not been recognized

and there is no consensus on how to obtain compassion for 'Earth's survival' from all creatures living and depending on her. Accordingly, the 'Earth' continues under the 'conditions of a disease', which will become worse unless drastic action is taken.

For this purpose, we need to construct an academic framework that earnestly thinks about and acts on how humans live on Gaia, and seriously consider Gaia's future as our shared destiny. The new academic framework called Human Survivability Studies can be summarized as the study of 'how we can cohabit with Gaia'.

Notes

Chapter 8

1 While shutdown due to global warming would not cause an ice age, as was depicted in recent blockbuster *The Day After Tomorrow*, eastern North America and Western Europe would nevertheless experience a climatic shift.
2 The River Law of October 7, 1964 (#167), last modified November 22, 2013 (#76).
3 Flood event of a given annual flood probability, which is generally taken as: fluvial (river) flooding likely to occur with a 1% annual probability (a one in 100 chance each year), tidal flooding with a 0.5% annual probability (a one in 200 chance each year) or estimated flood using a hydrological model assuming that the projective rainfall (with a Return Period of 100–200 years) occurred in the catchment without considering flood controlling structures.
4 The Automated Meteorological Data Acquisition System operated by the Japan Meteorological Agency.