17 Coexistence with Nature

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Protection and development

Ever since the human race came into being, humanity has coexisted with nature and all its many blessings. For example, we breathe air and use it to replenish water in order to live. Since we cannot convert inorganic to organic matter through photosynthesis, as plants do, we use other animals and plants as sources of nutrition. We have always coexisted with nature, and we have been blessed with life amid nature's material cycles and biological food chains. The general theory is that human history started in Africa and spread from there to other continents. This history can be described as one of opening up new frontiers and adapting to new local climates (Diamond 2000).

Today, however, hardly any primeval or 'unspoilt' nature remains in any terrestrial place capable of human habitation. Humans have modified nature to their own ends, produced food and created various artifacts. Humans have produced food via agriculture and livestock farming, mined for ores and quarried and processed various metals and fossil resources from nature. In the process, the relationship between humans and nature has not been one of coexistence, but rather one of antagonism. Specifically, agricultural and industrial revolutions have provided catalysts for the human race to flourish, but could also be said to have caused a widening rift between humans and nature. For example, the development of farmland through crop farming (cultivation of plants) and nomadism (domestication of animals) in the agricultural revolution destroyed or diminished forests and drove many locally unique species to extinction. The large-scale plundering of fossil resources since the industrial revolution has caused air pollution and climate change, while mining for ores and other underground resources has polluted our soil and water. The explosive growth of the human population in

recent years has elevated the challenge of securing food, resources and energy to the greatest problem facing human survival. These concerns are in fact exacerbating our antagonistic relationship with nature.

Nineteen sixty-one is etched in history as the year when a human being embarked on the first manned flight in space. On that occasion, Yuri Gagarin of the then Soviet Union boarded Vostok 1 and orbited Earth. When he saw Earth covered by its beautiful blend of oceans, land and atmosphere (cloud), Gagarin uttered the now famous words 'The Earth is blue'. It was the moment when, for the first time in human history, humanity had left the Earth and looked down on it from above. At the same time, this event prompted the realization only too clearly that the Earth looks like a living entity, that the Earth is limited, or in other words, that it is 'Spaceship Earth' (see Chapter Two).

The crisis of human survival outlined in *The Limits to Growth* (1972), a report commissioned by the Club of Rome, was explored in greater detail and examined both comprehensively and analytically in the US government report *The Global 2000 Report* (1980). This trend was then continued in a series of UN conferences and others on the environment and development. In this way, concern over problems caused by the global environment grew significantly in the developed world from the second half of the twentieth century onwards. In the developing world, however, home to the majority of the world's population, the desire for economic growth in pursuit of lifestyles on par with those in developed nations makes it extremely difficult, in reality, to maintain a balance between 'protection and development'.

While it is self-evident that coexistence with nature is the key to human survival, the existence of the human race itself is turning into a kind of endlessly multiplying 'cancer' within the Earth's ecosystems. What we need at both an individual and social level are measures to control self-propagation, foster a spiritual culture and lifestyle that focuses on 'satisfaction with one's lot' and manage the desire for material possessions. We need to rethink how we can achieve sustainable use and balanced distribution of the Earth's limited resources, particularly bioresources and other renewables of a cyclical nature.

The challenge for Human Survivability Studies taken up in this chapter is that of coexistence between humans and nature. To sum this up in one phrase, we could frame it as 'retrieving nature'. While this entails extricating ourselves from antagonism and competition

with nature and restoring a relationship of coexistence, specific measures to achieve this are difficult to formulate. Here, I consider how to ensure the sustainability of nature and ecosystems, which will be essential for human survival into the future, and discuss measures to bring this about. In particular, I introduce cases involving forests, as hubs of material cycles and ecosystems in the terrestrial region, and consider how to harmonize 'protection and development' through management aimed at securing resources while actively taking steps to regenerate degraded nature.

What is nature?

Of the *objects* in the external world surrounding ourselves as *subjects*, we use the term 'nature' to define a primeval world barely touched by human activity. The concept of 'nature' essentially refers to 'that which exists by itself' without human intervention – mountains, rivers, seas and the myriad things that live on and in them, as well as trees, plants and flowers, collectively known by some as 'the whole of creation'.

Domains of physical space involved in human survival and activity are described in their totality as the 'humanosphere'. Elements that comprise this humanosphere are broadly divided into three: the geosphere, the biosphere and the anthroposphere. The geosphere consists of the air surrounding the Earth (the atmosphere and outer space), the water and soil near its surface (hydrosphere and soilsphere) and the lithosphere beneath it, among others. This is the domain of the natural environment, comprising the world of material cycle networks. The biosphere, meanwhile, houses the loci of the life activity of living things, including plants and animals, but also fungi, bacteria and other microorganisms. This is seen as the world of ecosystem networks, or in other words, the eco-environment. Human beings are one of the species that exist in the biosphere. However, activity associated with subjective production and consumption by humans is now having a major impact on the geosphere and biosphere, and this interaction can no longer be ignored. For that reason, it would be more appropriate to treat the anthroposphere (specifically the sphere of human habitation) as a separate sphere. The anthroposphere is a domain of physical space consisting of human-made structures such as cities, houses, factories, roads and crop fields that lie at the heart of human activity. Based

on the spheres described above and the interactive relationships between them, the concept of 'nature' could be understood as belonging to the biosphere and geosphere, the latter two of the environmental elements surrounding human beings. Sometimes these three spheres merge together to form and share spaces through mutual interaction.

Perceptions of the nature/human relationship

Primitive humans had an animistic view of natural phenomena, communing with nature as an object of awe, as something to be feared and worshipped. Nevertheless, in the epic poem *Gilgamesh* written in the ancient civilization of Sumer in Mesopotamian antiquity, nature is already perceived as something hostile to man; the dominant view is a dichotomy between man and nature which must be overcome and subjugated (see Chapter Four). Forests were a typical example of the latter, leading to a repeated process of tree felling and deforestation. In ancient cities, forests were destroyed to make way for the expansion of cities and farmland to cope with population growth. Large quantities of timber are also known to have been used in civil engineering works and buildings. This attitude to nature was maintained in ancient Greece, where nature was regarded as an opposing concept to human activity under the term *physis* (nature). Unlike these views that prevailed in Western Asia and Europe, in East Asia a binomially coexistential view of nature, in which humanity is harmoniously regarded as part of nature, has been widely accepted. Thus, the human attitude towards nature strongly reflects the climate, culture, history and religion of the region in question. If we take a general view of human and civilizational history, human beings could be said to have consistently destroyed nature and plundered food, timber, coal, oil and other resources and sources of energy from it. Land use has been utterly transformed; the expansion of agricultural practices converted forests into farmland and pastures, and these in turn into cities, factories and other domains alongside the growth of industry.

It is only in relatively recent times that terms like 'coexistence with nature' or 'symbiosis' have become commonplace. Until the modern era, nature was regarded as unfathomable, sometimes hostile, causing earthquakes, typhoons, floods, volcanic eruptions,

forest fires and other natural disasters, as fearsome events that could not be managed or predicted by humans. Today, data from Earth observation satellites and others that offer a bird's eye view of Earth's systems are progressively being accumulated and analyzed. For example, the mechanism whereby solar energy concentrated in the tropics creates circulation in the atmosphere and oceans and is then transported to temperate regions where it takes the form of localized climate change and extreme weather, is gradually being unraveled. Similarly, the process whereby typhoons, cyclones and hurricanes spawned in the tropics absorb thermal energy and water vapor from the oceans and develop while moving toward temperate regions can also be predicted with considerable accuracy. These developments are gradually shaping our understanding of the effects caused by water, energy and other global material cycles on our weather via the atmosphere and oceans (see Chapter Eight). Meanwhile, the world of living organisms is adapting to localized weather and climate to build diverse ecosystems. The food chain is a causal relationship between organisms that is relatively easy to understand. In this way, nature depends on interactions between physical matter and living things.

Ways of achieving conservation, i.e. maintaining a relationship of symbiotic coexistence in which we sustain human life while preserving nature, have been the subject of much discussion in recent years. International conferences on 'environment and development' have been hosted about once every ten years by the UN and other peak bodies. The first 'United Nations Conference on the Human Environment' (Stockholm Conference) held in 1972 was followed by the Nairobi Conference in 1982, the Rio de Janeiro Conference in 1992, the Johannesburg Summit in 2002 and most recently Rio+20 (2012). At the Stockholm Conference, a broad-ranging discussion was held from the viewpoint of the anthroposphere, covering subjects such as human habitation, development and the environment, the holistic management of natural resources, humanity and the biosphere and environment-related information, culture and education. At the Rio Conference, agreement was reached in the form of the 'Rio Declaration on Environment and Development' as well as action plans for the Declaration such as 'Agenda 21' and the 'Statement of Forest Principles'. Also at Rio, frameworks for today's protection of the global environment and sustainable development were formed in the

'Framework Convention on Climate Change' and the 'Convention on Biological Diversity', among others.

Over these past twenty years, the limited nature of energy and resources as well as other 'limits of the Earth' have become increasingly clear, while the BRIC nations and other emerging economies have achieved standout economic growth. Experiences of disasters including the Sumatra earthquake and Indian Ocean tsunami and the Great East Japan Earthquake have led to a deeper awareness of risk management related to development and disasters. In the international community, there have been calls for a shift to a 'Green Economy', which seeks a balance between environmental conservation and economic growth (see Chapter Nineteen).

Why are forests important?

The most significant characteristic of living organisms is that they are 'reproductive' and that they maintain continuous cycles. On land inhabited by humans, forests are the most important components of the ecosystem. Although the Earth's forested area has decreased from six billion to four billion ha since the beginning of arable farming, it still covers one third of the world's total land area. Forests also retain an overwhelmingly large volume of reproducible biomass. The total volume of the Earth's biomass has been estimated at 1.8 trillion tons, of which accumulated forest biomass amounts to 1.65 trillion tons, thus accounting for more than 90% of the total (Sasaki 2007). On top of that, forests also play an important role as sites of interaction between ecosystems, material cycles, resource production and other components of the humanosphere.

Plants link inorganic with organic matter through water, air (oxygen) and carbon, and form the basis of natural and ecological networks that support a wide range of other organisms through primary production based on photosynthesis. As the amalgamation of woody plants, forests are hubs of terrestrial ecosystems and food chains, and together with the oceans, they are also hubs of material cycles for water, air, carbon and other elements in the geosphere. Forests are the most important places for the protection of terrestrial and brackish water ecosystems in the biosphere and provide a foundation for maintaining biodiversity and photochemical energy through photosynthesis. In terms of the anthroposphere, meanwhile, forests provide timber, food,

medicines, fuel and other materials or energy sources. They are also sources of the water and oxygen essential for our survival. In this way, forests have various beneficial functions. The Science Council of Japan has estimated that the value of public benefit functions of Japan's forests amounts to around seventy trillion yen per year.

According to the most recent data by the United Nations Food and Agriculture Organization (FAO), the world's forests are shrinking by five million hectares per year (2000–2010; FAO 2011). This shrinkage is particularly conspicuous in South America, Africa, Southeast Asia and other regions where originally there were large accumulations of biomass and where there are tropical rainforests with the richest biodiversity. Of all Southeast Asian countries, the decline is particularly acute in Indonesia. According to the FAO, forested areas currently occupy 47% of the tropical zone sandwiched between the Tropics of Cancer and Capricorn on either side of the equator, while temperate forests account for 11% and boreal forests in high latitude regions account for 33%. The average biomass accumulations of these forests, i.e. the average existing volumes (volumes by dry weight), are said to be around 350–400, 300–350 and 200 t/ha (Sasaki 2007; Hara 2010), respectively. The annual biomass production of tropical forests, temperate forests and boreal forests (net ecosystem production) is around sixteen to twenty-two, twelve to thirteen and eight t/ha/y, respectively, showing that tropical forests are exceptionally voluminous in both forest accumulation and biomass production. These values are far larger than the average values for accumulation and biomass production of cropland (eleven t/ha and 6.5 t/ha/y, respectively), and are of course larger than the biomass accumulation (four to twenty-seven t/ha) and production (2.8 t/ha/y) of grassland and open woodland (Sasaki 2007).

Thus, tropical and subtropical natural forests, which account for the majority of the world's total forested area, are the largest existing sources of biomass accumulation and production. As stated above, the critical situation concerning the depletion of forests has sparked a thriving international debate on environment and development since the second half of the twentieth century. However, the discussion on 'sustainable development' tends to place more weight on the second of these elements, i.e. 'development'. As development in the sense of human beings modifying nature to suit their own

objectives is essentially devoid of affinity with sustainability and maintenance, we must be careful of the environment being used as a cover for development.

Japan's forests and wood culture

The state of forests in Japan is very different from the global situation described above. Lying on the eastern edge of the Asia monsoon region, Japan's land mass stretches across a considerable expanse from north to south, is located in a warm and wet climate zone and has an environment eminently suited to plant growth. Japan is therefore blessed with rich forests and vegetation, mainly featuring temperate forests but also ranging from boreal to subtropical forests. The 'Age of the Gods' section of the ancient *Nihon Shoki* (Chronicles of Japan) reveals that the characteristics of representative trees like Japanese cedar, Japanese cypress and camphor were already well known in the ancient era, and that they were skillfully used for different purposes. In Japan, some 4,178 architectural structures are currently designated as national treasures or important cultural properties, and some of them have been registered as UNESCO World Cultural Heritage due to their significant historical and cultural value. More than 90% of these structures designated as cultural heritage are made of wood. A prime example is Hōryū-ji Temple in Nara, which has a history stretching back 1,300 years. This 'wood culture' is one outstanding characteristic of Japan's culture compared to that of western countries and even countries in East Asia and Southeast Asia, to say nothing of Western Asia.

In fact, Japan's forests suffered a period of depletion throughout the medieval Sengoku and Momoyama periods, when large quantities of timber were used for mass construction of shrines and temples, castles and other buildings. The forests recovered, however, thanks to plantation and strict regulatory policies by the feudal domains from the beginning of the Edo period in 1603 (Totman 1998). Compared to other parts of the world, where virgin forests were felled and then left to regenerate naturally, the Japanese developed intensive forest management technology including planting, weeding, pruning and thinning from extremely early on (second half of the sixteenth century), thus achieving a conversion from exploitative to sustainable forestry. A forest of Japanese cedar planted at the beginning of the Edo period can still be seen in Yoshino, Nara Prefecture (Tani

2008). These trees have grown to a breast-height diameter of about 1.5 m and a height of more than fifty m, creating the atmosphere of a virgin forest. In Germany and other parts of Europe, by contrast, forests were significantly devastated in the sixteenth and seventeenth centuries, when they were opened up for major expansion and conversion to farmland. Extensive (quasi-natural) forestry based on the principle of natural regeneration was promoted from the second half of the eighteenth century in order to recover and revive woodland, and steps were taken toward (environmental) protection and sustainable use of resources.

Once again greatly depleted by indiscriminate felling during World War II, Japan's forests recovered to a current area of 67% thanks to organized tree planting after the war, making Japan one of the most forest-rich countries in the developed world, along with Finland (74%). These human-made forests of Japanese cedar and cypress have grown to the point where timber can be harvested, but there has been little progress in thinning or logging, and Japan's self-sufficiency in timber remains low at 28%. As a result, domestic forestry has stagnated, the failure to make adequate use of trees has conversely led to a progressive disintegration of forests and there are fears over a decline in their environmental functions. For this reason, structural reforms of forestry and the development of infrastructure that can address changes in demand are pressing issues at the moment. The Forestry Agency has drawn up a Forests and Forestry Revitalization Plan (2009), and, reflecting this, a Forests and Forestry Basic Act (2011). These propose a number of systematic measures, starting with (1) achieving stable timber production by developing road networks, intensifying forest management and training foresters and management bodies, etc., and including (2) reforming the structure of domestic wood processing and distribution and (3) expanding the use of timber but also building networks directly linked to citizens and consumers, such as by using NPO activities and citizens' movements, and creating new types of forest industry and forest business (Forestry Agency 2001).

Attempts to regenerate forests

Regenerating forests by preventing deforestation and promoting afforestation of denuded land have become matters of pressing urgency in recent years. Although the world's human-made forested

area is now gradually increasing at a rate of about 2.8 million ha per year (2000–2005), this still only accounts for 3.8% of the Earth's forests (140 million ha). The key to forest regeneration lies in aggressive afforestation, particularly on an industrial scale. This is because increasing manageable economic forests will provide direct incentives for forest regeneration, making it possible to furnish the increased demand for timber resources and energy accompanying population growth. This also constitutes a practical step toward maintaining existing virgin (reserved) and conservation forests.

Trees grow slowly when very young, then more vigorously, until growth slows again when they are mature. This results in a sigmoidal growth curve. However, the time span of the growth curve differs greatly depending on the region, species and management method, among other factors. For example, the endemic species known as Japanese cedar (*Cryptomeria japonica*) can maintain growth for 100 years or more with appropriate silvicultural management, while fast-growing tropical trees like the acacia (*Acacia spp.*) generally grow rapidly, but mature in ten to twenty years and then often stop growing (Kamis and Taylor 1993).

Whether in natural or man-made forests, biomass accumulation in stands is greatest at the mature stage. In mature forests, however, carbon absorption due to growth is balanced out by carbon emissions due to withering and decomposition, and the increase in biomass accumulation is thus zero. In the case of reserved forests, where the priority is on biodiversity maintenance functions, biomass accumulation is important as an evaluation index. In economic forests (production forests) that prioritize timber production functions, on the other hand, increasing stock is important. In production forests, trees are felled to match the increase in stands, then processed and used to the maximum possible effect, thus ensuring continuity of production and use. To this end, it is vital that annual biomass accumulation (stock), the increase in stock and logging (flow) are analyzed and understood dynamically.

Unregulated development and excessive felling have decimated forests and turned them into grassland in southern Sumatra, Indonesia. Figure 17.1 compares the biomass stock and flow in natural forests, grassland and acacia forests in that region (as of 2006) based on a case of large-scale industrial afforestation that started in 1990 (Kawai 2016; Kobayashi et al. 2015). In the figure, the biomass accumulation of tropical rainforests is largest with a maximum 400

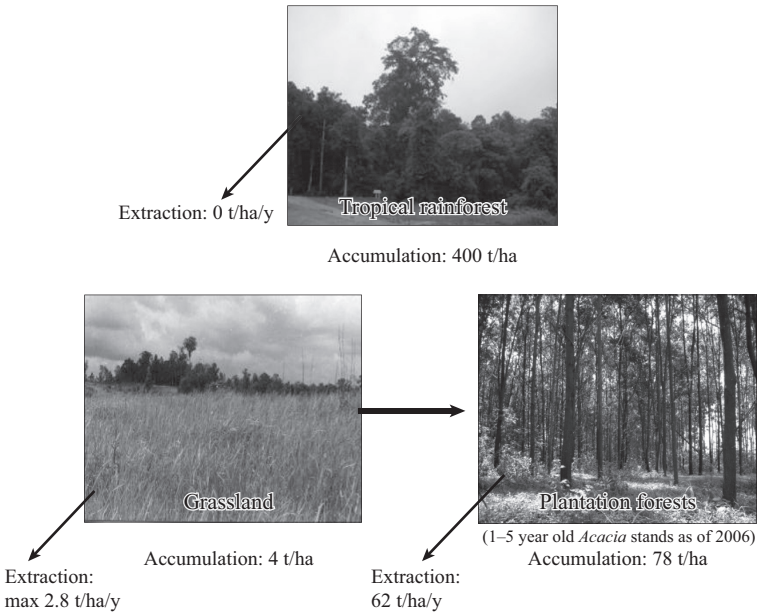

Figure 17.1: Biomass accumulation (stock) and logging (flow) in natural forests, plantations and grassland

Source: Kawai (2016).

t/ha, but these are mature forests, where carbon absorption due to growth is balanced out by carbon emissions due to withering and decomposition. As a result, the increase in carbon accumulation is evaluated as zero. Moreover, if there were no removal of wood from the forest due to illegal logging or similar, the flow would again be zero. In other words, biomass in tropical natural forests shows a state of apparent stability. In the same way, biomass accumulation on grassland dominated by cogon grass (*Imperata cylindrica*) is only around four t/ha. Furthermore, much of the biomass growth corresponding to the annual increase in stock inside the forest is lost to withering and decomposition, and the flow discharged outside the system due to energy, etc., is estimated to be at most around 70% of the total (2.8 t/ha/y). By contrast, in acacia plantation areas aged one to six years, a cycle of felling and plantation is repeated over a certain area every year. Thus, while there is variation in the accumulation, increase and logging volumes in individual stands, a

certain stable volume of accumulation and increase may be expected over the afforested area as a whole (120,000 ha), while logging is carried out every year. That is, the figure shows that as of 2006, the average accumulation volume of one to five year old acacia forests was seventy-eight t/ha, which is not necessarily large compared to that of tropical rainforests. However, when the logging flow of around sixty-two t/ha/y is added, the total of this stock and flow in 2006 is estimated to be 139 t/ha. This could be seen as significant in terms of forest conservation efforts.

Opening up the future: Coexistence with nature

What sort of landscape lies behind our visualization of coexistence with nature?

For example, the Japanese concept of *satoyama*, a scene of traditional farming and mountain villages, depicts a landscape created through interaction between humans and nature. Primeval nature comprising forests of evergreen, deciduous broad-leaved and other shade trees (tolerant trees) has been destroyed by anthropogenic disturbance, causing a gradual loss of fertility. In its place, forests of Japanese oak, Japanese red pine, chestnut and other sun trees (intolerant trees) grow and become intermixed, forming what is known as mixed woodland. Local people practice a repeated cycle of appropriate felling in mixed woodland around villages, gather fallen leaves and branches as fuel or fertilizer, and thereby maintain a stable ecosystem, not in a state of climax but in a state of transition from deciduous forests. This is what we call *satoyama*. 'Transition' is the process where living organisms modify the environment they have adapted to through their own presence and prosperity, where other species inhabiting that space also change. In other words, *satoyama* could be said to refer to secondary forests modified by human activity, or managed nature. The *satoyama* landscape, consisting of villages and the countryside (paddy fields) around them, along with the mixed woodland and plantation forests of Japanese cedar, cypress and others behind them, could be described as a classic Japanese *furusato* (homeland) scene. This *satoyama* landscape in which humans coexist with nature can similarly be observed in places all over the world.

Besides transitions in ecosystems caused by climate change, the interaction between living organisms and the environment, whereby humans and living organisms have an effect on the environment and

the environment changes correspondingly while living organisms also adapt to this, is widely known through research on transitions in vegetation based on pollen analysis, radiocarbon dating and others (see Chapter Four). The *satoyama* landscape has been created through a system designed to support paddy rice cultivation since the Yayoi period – in other words, a system of sustainable and stable food, energy and material production – and has played a major role in forming Japan's rural landscape and *satoyama* culture. *Satoyama* and *satoyama* culture used to support the lives of the Japanese, and moreover came with conditions that were maintained over the long-term. In other words, they were established as a model of coexistence between humans and nature. At the same time, they have played a major role in forming the Japanese view of nature, in which *sato* (human society), *satoyama* and remote mountains (nature) are viewed as a continuum.

Satoyama could also be seen as a buffer zone between nature and humans. In eras when anthropogenic disturbance is more pronounced, the *satoyama* environment is devastated and mixed woodland cannot be maintained, transitioning to grassland and pine forests. This tendency is particularly strong in suburban *satoyama*, where anthropogenic disturbance is more conspicuous. Archive records like *Miyako Meisho Zue* (Images of famous places in the capital, Kyoto) suggest that *satoyama* in the suburbs of Kyoto were severely disturbed by humans collecting timber, fertilizer and fuel (firewood) in the Edo period. The ecosystems fell into a state of undernourishment, or an extremely depleted state featuring many bare mountains with only a few pines dotted sporadically. However, when people stop collecting firewood and fertilizer from *satoyama*, as in recent years, those *satoyama* become rich in nutrition and transition to forests dominated by laurel. At the same time, deer, boars, monkeys and other wild animals have proliferated, and together with a shortage of nuts, mushrooms and other natural food sources, they appear in villages and towns and create problems there. In this way, *satoyama* are also places where humanity's relationship with nature appears most conspicuously. While they are symbolic of the sustainable use of nature, it is also evident that their maintenance and conservation depends on appropriate management.

As stated above, if we look back over the history of humanity's relationship with nature, it has become antagonistic where only the human side profits. This should be corrected to the original

symbiotic relationship where both sides benefit. Although it is of course important to preserve primeval nature as it is, it is regrettable that nature in a primeval state hardly exists anywhere today. Measures for conservation, whereby preservation and exploitation are balanced through appropriate management of nature, are important in practice (see Chapters Three and Four).

Forests may be increased through management, and in this respect they differ greatly from mineral and fossil resources. On the other hand, forests can rapidly decline and be destroyed or devastated by excessive felling and inadequate management. The recent decline of tropical rainforests in South America and Southeast Asia is often highlighted. In the tropics, once land becomes bare, runoff of soil nutrients is vigorous and vegetation is extremely slow to recover. To regenerate forests in tropical regions, therefore, renewing plantations will be more effective than regenerating natural forests, and regenerative forestry should be promoted for the conservation management of tropical forests. Besides technical issues that need to be resolved for industrial afforestation in the tropics, however, there are still many environmental and social issues. For example, the degree to which short rotation forestry causes loss of nutrients and soil deterioration is unknown. Besides a decline in biodiversity and increased vulnerability to disease and pests due to large-scale afforestation, other issues include friction with local inhabitants. Instead of the clear-felling method that has a significant impact on nature, attempts at forest management in which locally dominant species are planted in the spaces left after line thinning of natural secondary forests have been started on the Indonesian island of Kalimantan (Borneo) and elsewhere. In this way, there is an ongoing search for 'coexistence with nature' in which a compromise is sought between economic growth and environmental issues.

In Japan, the importance lies more in making positive use of timber resources and caring for human-made forests and mixed woodland in *satoyama* for the sake of environmental conservation. This is because conserving soil and water through afforestation helps us to make full use of the role of biodiverse forests as environmental resources. The nature of river basins, ranging from remote mountains to *satoyama*, *sato* (human habitation), *satogawa* (managed rivers) and on to *satoumi* (managed seas), in combination with human activity, is a classic example of a sustainable society that is rich in harmony. *Sato*, i.e. humans, link forests with seas and

enrich nature (Mukai 2012). Sustainable use of *satoyama* resources, as loci for local development, is expected to provide a foothold for community regeneration, rich lifestyles and the preservation of traditional culture. To forge a future life in which nature is used sustainably with coexistence between humans and nature, we need to learn from history and the wisdom of our forebears, reappraise multifaceted values and search for new lifestyles, values and social development. We need to shift from a doctrine of growth and expansion to one of coexistence and symbiosis that emphasizes sustainable cycles.

From our consideration of forests, we need to ensure the continuity of natural environments and ecosystems as well as the sustainability of timber production. To this end, regions will need to be zoned over wide areas in accordance with multifaceted functions. This will require landscape design that aims to harmonize the anthroposphere with the natural sphere. In terms of the biosphere, we need landscape design that appropriately allocates reserved forests that focus on ecosystem maintenance and conservation functions, secondary forests (conservation forests) as buffer zones and production forests that emphasize the function of supplying resources and energy in the anthroposphere. We will need to develop technology that seeks harmony with the environment as a foundation for human activity and survival, and to create doctrines and systems for a return to nature.

Research on the diversity of bird species in large-scale industrial afforestation in tropical regions, as seen above, shows that isolated and scattered small-scale secondary forests left in afforested areas provide important habitats for bird populations, and contribute to maintaining the diversity of species (Fujita et al. 2014). In acacia afforested areas with young trees (two years old), the diversity and habitat density of bird species are poor, with diversity close to that of bare land or grassland. But in acacia forests aged four or more years, diversity has recovered to a level approximating that of secondary forests. These research results suggest that afforested areas in which a certain level of bird species diversity can be secured are established by appropriately allocating secondary forests and appropriately designing forest stand demarcation, even in single-species large-scale industrial afforestation. For animals that move on the ground, however, it is unknown what role is played by isolated secondary forests. Our challenge will be to secure conservation forests that are

linked together providing animal corridors. Pressing tasks in this regard will include grasping the current state of land use transition and forest resources from a bird's-eye view and with high precision, developing systems for holistic management of bioresources and achieving future landscape design for coexistence with nature, by harnessing the satellite remote sensing technology that has seen such conspicuous growth in recent years (Kobayashi et al. 2015).

To summarize, issues related to humanity's coexistence with nature bring into question our human doctrines and lifestyles, as well as the nature of society. Conceptualizing the nature of a harmonious human society, such as looking at the best ways of using biomass, developing local communities and correcting disparity and poverty, will also be important in terms of ensuring the sustainability of nature.