Chapter 2
The Concept of Environmental Leader

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Abstract Leadership has shifted focus from the individual to the group or institute. Efforts to link leadership and the natural environment have already begun and the necessity for environmental leadership has never been higher than ever in the era of complex and evident environmental and social problems, such as climate change, global conflict, limited resources, an overwhelming amount information, etc. There is no single solution for environmental problems that can solve the conflicts of diversified community relations. Therefore, environmental leadership development is a priority element for improving the deteriorating environment. However, the current education system, especially in Asia, lacking in providing a holistic view of environmental issues, as well as inter- or trans-disciplinary and cross-cultural approaches, or a balance between the environmental, economic and social dimensions, using hands-on experience.

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In response, APIEL strives to fill this gap by improving education for environmental leadership with sustainability issues in mind. This chapter will review the concept of the environmental leader through a discourse on leadership. As well, it will introduce the authors' experiences in fostering environmental leader by establishing and implementing environmental leadership education over the past four years. The discourse on environmental leadership illustrates how environmental leaders have been educated to cope with emerging environmental issues. The concepts of transformational/transformative-, eco-, collective, green, and communicative leadership provide a map to understand the evolution of the theory and practice of environmental leadership education.

Keywords Discourse on leadership • Environmental issues • Environmental leadership • Leadership experience

2.1 Discourse on Environmental Leadership[1]

What is so different about environmental leadership from leadership in other areas? To answer this question, this chapter begins with the fact that very little research has been done on the issue of environmental leadership, although a comprehensive review of the literature on leadership itself uncovers focuses on business, political, and public leadership. Books on business leadership typically contain neither a substantive analysis of the psychology of future orientation nor a sense of the larger systemic constraints on future activities that must be taken into account by leaders [1]. For instance, the idea of a leader for the future contains little reflection on the larger systemic constraint on future activity, including climate change, as Heifetz [2] put it, "our focus on the production of wealth rather than coexistence with nature has led us to neglect fragile factors in our ecosystem." However, recently, scholarly textbooks on leadership have addressed the importance of the natural environment as a significant context for leadership, or as an "emerging issue" of interest [3], and Heifetz [2]'s theory of adaptive leadership provides an important starting point for thinking about environmental leadership.

2.1.1 History of Environmental Education and the Need for Environmental Leaders

Environmental education has traditionally focused on how to foster changes in individuals that are associated with pro-environmental actions and behaviors [4]. As Table 2.1 shows, environmental education has developed over the past 50 years from the perspectives of natural resource management or the management of environmental organizations. Few researchers have placed the relationship between leadership and the natural environment at center stage and examined it from diverse viewpoints [5].

[1]This section is written by one of the authors, Kyoungjin J. An from Department of Urban Engineering, Graduate School of Engineering, The University of Tokyo, Japan.

Table 2.1 History and trend of environmental education (adapted from Palmer [6])

	Environmental education: key events on a development timeline	Key trends in environmental education and leadership development
	1948 The International Union for Conservation of Nature (IUCN) conference; first use of the term environmental education **1949** Founding of IUCN	
1960s ↓	**1968** The United Nations Educational, Scientific and Cultural Organization (UNESCO) Biosphere Conference, Paris	**Nature study** Learning about plants, animals and physical systems **Fieldwork** Led by an "expert" with a particular academic focus: biology, geography, etc.
1970s ↓	**1972** UN Conference on the Human Environment, Stockholm **1975** Founding of the United Nations Environment Programme (UNEP) and Institute for European Environmental Policy (IEEP) UNESCO/UNEP International Workshop on Environmental Education, Belgrade **1977** UNESCO First Inter-Governmental Conference on Environmental Education, Tbilisi	**Outdoor/adventure education** Increasing use of the natural environment for first-hand experience **Field studies centers** Growth of field and environmental/outdoor education for developing awareness through practical activity and investigation **Conservation education** Teaching about conservation issues **Urban studies** Study of the built environment, street work
1980s ↓	**1980** World Conservation Strategy (IUCN, UNEP, World Wildlife Fund (WWF)) **1987** UNESCO/UNEP Educational Congress on Environmental Education and Training, Moscow World Commission on Environment and Development—Our Common Future—The Brundtland Report	**Global education** A wider vision of environmental issues **Development education** Environmental education has a political dimension **Value education** Clarifying values through personal experience **Action research** Community problem solving, student-led problem solving involving fieldwork
1990s ↓	**1990** Publication of *Caring for the Earth: A Strategy for Sustainable Living* (IUCN et al.) **1992** UN Conference on Environment and Development –"The Earth Summit"	**Empowerment** Communication, capacity building, problem solving and action, aimed at the resolution of socio-environmental problems **Education for a sustainable future** Participatory action, relevant approaches to changing behaviors and resolving ecological problems
2000s		**Community** Students, teachers, NGOs, and politicians working together to identify and resolve socio-ecological problems

A comprehensive list of readings and reports on environmental education touches on every aspect of sustainability as we learned from Table 2.1, but the link with leadership angle is left unexplored till the early 1990s. Gunderson et al. [7] provide insights into leaders and managers trying to solve natural resource and other environmental problems. Without mentioning leadership, Moser and Dilling [8] provide a comprehensive look at the communication challenges presented by climate change. In the twenty-first century, environmental education is turning toward a community of partners so that students, teachers, NGOs, and politicians can work together to identify and resolve socio-ecological problems. In order to make these fundamental changes, leadership is pivotal for driving the change. As well, leadership capacity is needed across a broad range of stakeholder groups, including politicians, city officials, and emergent leaders in the public and private sector, also researchers, educators, communities, and individual citizens [9].

Today, the challenge for fostering leaders is how higher education policy and provisions can be reoriented or retrofitted in a way that is organizationally practicable, academically acceptable, and educationally sound. Higher educational institutions have a crucial role to play. Therefore, when we say *reorienting higher education*, the tasks we have to observe are how the existing knowledge on environmental education and sustainability can be extended as well as establishing the role that the higher educational institutions can play. There must be a balance in society between investing for sharing existing scientific knowledge and further extension of that knowledge. Our strong emphasis on leadership pedagogy reflects our belief that under the present circumstances it is more important to extend basic knowledge of how the world works for the common good than for a few specialists to master further details of their special disciplines. As described in Chap. 1, APIEL was born through such reoriented environmental education at The University of Tokyo. However, Asian universities have been relatively slow or distant from the global movements of networking in environmental education and leadership development. In addition, participatory leadership programs in higher education in Asia have been weak so far while various international environmental leadership programs have been launched by the United Nations Environment Programme and/or universities in Europe and North America.

2.1.2 Evolution of Environmental Leadership Over Time and Space

Leadership in this chapter entails environmental concerns and takes place in two dimensions: space and time. The type of leadership—transactional leadership shown by the Western industrial paradigm of the past few 100 years—premised on using resources regardless of social and environmental concerns is no longer desirable in a world that recognizes universal human rights and sustainable development. The contemporary view of leadership can be defined as a process of influence that occurs within the context of relationships between leaders and followers, and involves establishing vision, aligning resources, and providing inspiration to achieve

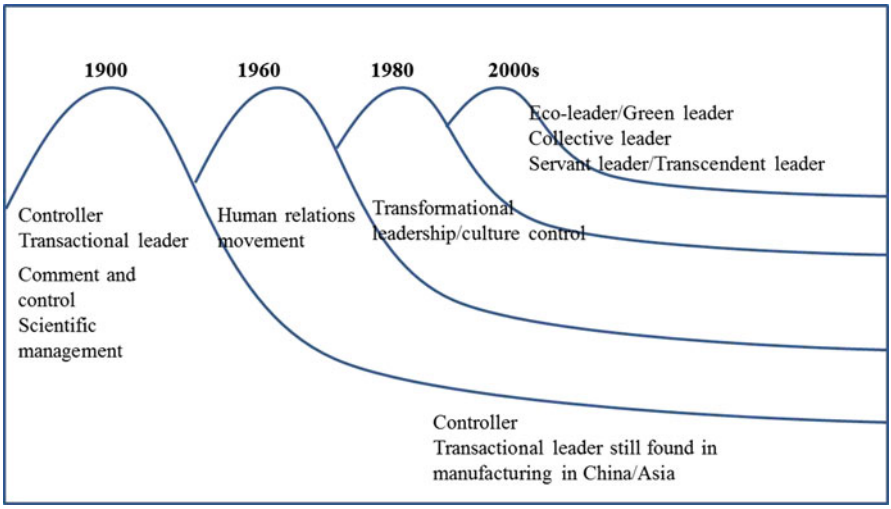

Fig. 2.1 Discourse on leadership. Adopted from Western [13]

mutual interest. Although, there are many leadership theories, none are universally accepted in environmental leadership. However, transformational leadership has often been featured strongly in studies of environmental leaders [10] and this theory is helpful in understanding and explaining the behaviors of environmental leaders. For instance, Burns [11] defines leadership as transformational leaders inducing followers to act for certain goals that represent the values and the motivations of both leaders and followers. Greenleaf [12]'s servant leader is more explicitly visionary than the transforming leader, in that leaders must also have a prophetic vision of the future state into which followers are being led. Collective leadership that includes cultural and social perspectives to deal with complex environmental issues is addressed in following Sect. 2.2. We depend on leaders to respond to time and place in a situation of diminishing natural resources and growing environmental degradation. Figure 2.1 illustrates the discourse on leadership and how environmental leadership has evolved spatially and over time in response to needs [13].

2.1.3 Becoming an Environmental Leader

Norman L. Christensen Jr. has written his perspective on environmental leadership in the foreword to the book *Environmental Leadership Equals Essential Leadership* [14]. He states that there are four ingredients for environmental leadership: boundaries, priorities, uncertainties, and action [14]. Among the most interesting and daunting characteristics of environmental issues is addressed: the extent to which they permeate virtually all *boundaries*. For instance, decisions to cut or not cut a forest in one region have an effect on the nature of forest management in other regions, and the solutions to such environmental problems demands

communication, understanding, and collaboration among diverse disciplines and traditions. Berry and Gordon [5] argue convincingly that the antidote to the boundary problem is problem-oriented, systems-based thinking. Effective environmental leaders assess the extent of a challenge by the spatial and temporal scale of a physical or biological process, as well as its cultural, social, and institutional elements, rather than trying to destroy or redefine boundaries. Environmental challenges appear to be limitless, while the resources used to meet these challenges are limited. Therefore, leaders must be able to set clear *priorities* among the needs and demands. *Uncertainty* is a major challenge for leaders in many circumstances, but most especially in those related to an environment of ignorance, variability and complexity. If leaders are certain beforehand, they can lead more effectively, but the truth is that environmental leaders must constantly act in the context of uncertainty and change. The connection between leadership and *action* is described as change. Successful leadership depends on a clearly stated vision and goals as well as models that connect the action that drives change.

Berry and Gordon [5] stated that leadership, at least in terms of environmental leadership, is not yet sufficiently congruent with any theory for it to provide a reliable basis for thought and action. In this view, experience, observation, and individual thinking must substitute for a theory as the basis for teaching. For classroom education, they included four elements: (1) a vision on the characteristics of leaders, which is produced from the practice of thinking ahead using all available data, and testing predictions and insights, and thus it becomes learnable and teachable; (2) leadership skills, such as ethics and personal values, communication, management, conflict assessment and resolution, influencing legislation and policy, and fundraising; (3) an observation of leaders themselves, knowing that effective environmental leadership very much depends on the context, e.g., organizational culture, geographic location, variability in the natural environment, etc.; and (4) the construction of leadership prescriptions for real organizations and real situations, which includes the current status, challenges and problems, as well as options for the solutions, and indicators to monitor and assess the solutions. The traditional model of a hierarchical leader with strong authority was replaced by the leader who worked in a participatory team environment where goals were created in a collaborative and shared decision-making process.

Environmental leaders who promote environmental sustainability infuse their desire to protect the natural environment into their decision-making and action processes [15]. Although the traditional focus of environmental leaders has been on individual development, today it involves two levels of influence: individual and institutional. So, in this regard, leadership can be found as both individual and group-based change. This leadership skill is more likely to be successful if leaders understand how to influence interrelated processes at all levels. However, the process of converting one individual at a time is slow and is unlikely to accomplish major change quickly, unless there are highly visible indicators of progress in the form of policies, programs, and budgets. Therefore, leadership development is a process of creating change agents in society, which is a complex psychological and social process. Describing the change process for individuals participating in environmental leadership development

programs may be as complex and challenging as describing the change process in future transformational leaders. Leadership development programs that aim to build this transformational leadership capacity are rare in an Asian context. This chapter then argues that building leadership capacity within higher academia is a way educators can work to affect desirable behavioral change and advance sustainable environmental management practices. The following sections (2.2–2.4) will introduce other author's concepts of environmental leaders from their experience applied to APIEL as educators in higher academia. As such, collective leadership, institutional leadership and strong leadership under disaster management are introduced.

2.2 Exercising Collective Leadership to Find Solutions for Global Environmental Issues[2]

This section outlines the author's experience of conducting research in the Heihe River basin in northwestern China. From this and other experiences, it is apparent that the complexity of environmental problems requires collective leadership that includes cultural and social perspectives. One possible definition for collective leadership, following Akiyama et al. [16], is also included.

2.2.1 Introduction

It is widely acknowledged that environmental problems are the problems of complexity. One of the dimensions of complexity arises from conflicts of the vested interests of the various stakeholders. However, how do you balance the interests of stakeholders with sustainable development that includes environmental concerns? Following the author's own experiences in the Heihe River basin in northwestern China, he feels that collective leadership might be a key in reaching a consensus among stakeholders that ultimately leads to the shared visions/goals for solving global environmental problems. The author will outline some of his experiences through participating in an interdisciplinary research project called Historical Evolution of the Adaptability in an Oasis Region to Water Resource Changes, carried out from academic year 2001 to 2006.[3]

This section is based on the integral framework for environmental leadership education proposed in Akiyama et al. [16]. Figure 2.2 shows the framework that was

[2]This section is based on the personal experiences of one of the authors, Tomohiro Akiyama from Graduate Program in Sustainability Science, Graduate School of Frontier Sciences, The University of Tokyo, Japan.

[3]Further information about the project can be found at their website (http://www.chikyu.ac.jp/rihn_e/project/H-01.html).

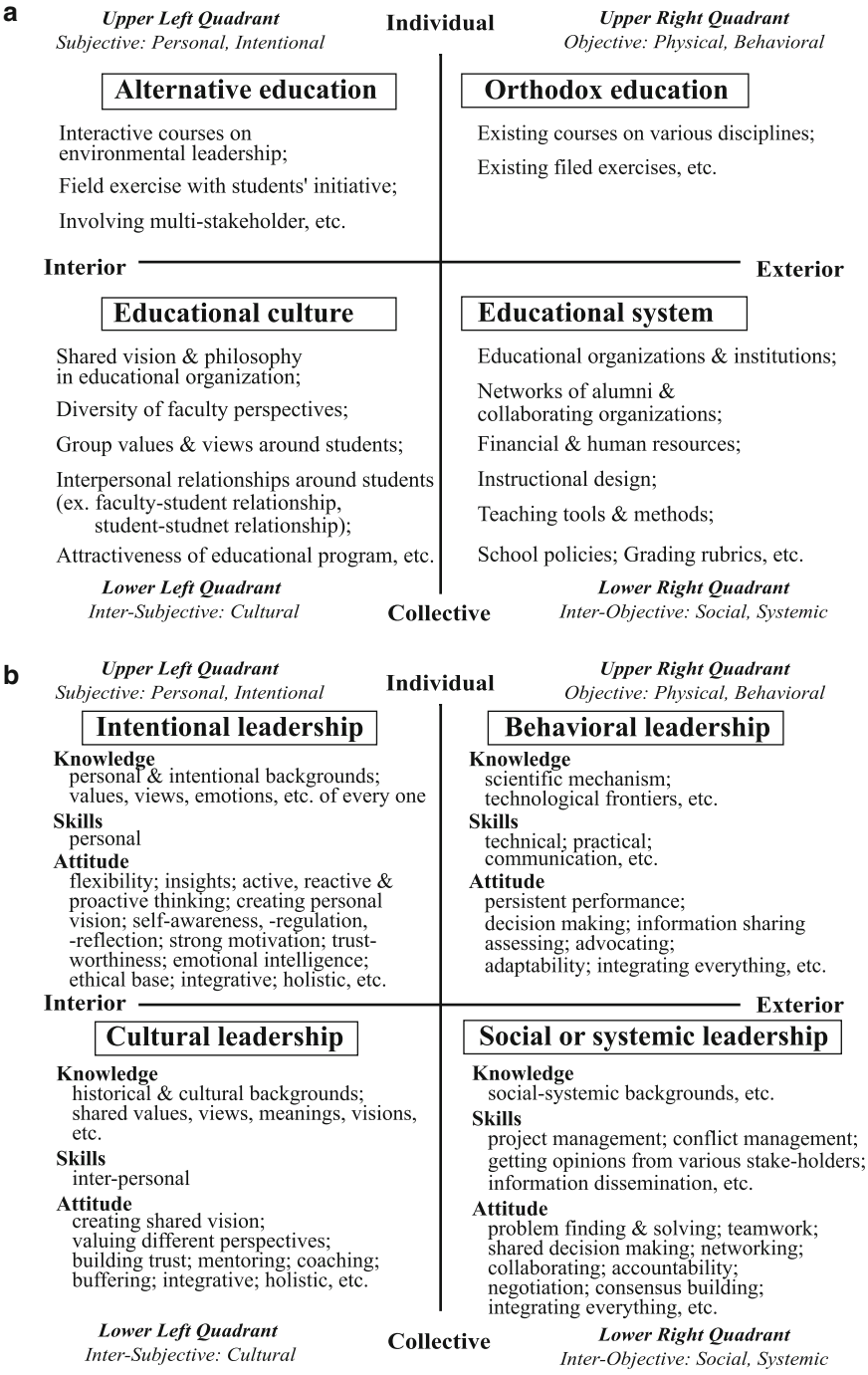

Fig. 2.2 Four-quadrant model of integral leadership education for sustainable development [16]

developed by modifying Integral Approach of Wilber [17, 18].[4] The upper quadrant in Fig. 2.2a shows the components of education programs, while Fig. 2.2b presents components of environmental leadership inherent in students. In this framework, collective leadership is considered to incorporate both cultural leadership and social leadership within leadership theory.[5] This section considers that collective leadership is the key to building general environmental leadership skills.

2.2.2 Experiences in the Heihe River Basin

Water is essential for life. However, water environmental problems, including the drying up of rivers/lakes, declining groundwater tables, vegetation degradation, and desertification, are intensifying in many regions. The Heihe River basin in northwestern China is a good illustration of these problems on the scale of a river basin. The Heihe River is the second largest inland river in China. Its basin area covers about 130,000 km^2, and it is 821 km long. Roughly speaking, this river flows through three administrative provinces in China: the upper reaches are in Qinghai Province, the middle reaches are in Gansu Province, and the lower reaches are in the Inner Mongolia Autonomous Region. In the river basin, people rely on glacier meltwater and precipitation from the mountainous areas in the upper reaches. Over the past 2,000 years, the Han and Mongolian people have lived in the middle reaches (oasis region) and lower reaches (desert region), respectively [20–22].[6] Due to these geographical differences, the Han mostly practiced settled farming, while the Mongolians were nomadic pastoralists (herdsmen). Throughout their history, the people living in the middle reaches and the people living in the lower reaches had continual conflicts over water. The conflict has dramatically worsened since the 1950s. The people living in the middle reaches, benefiting from technological improvements to dig deep wells with electric pumps, have been able to reclaim and irrigate large areas of farmland on the fringes of the oasis. Those lands do not have direct access to river water, so in the past, people were not able to grow crops there. However, given access to groundwater, the people have been expanding the area of irrigated farmland; their use of water intake for irrigation, as a consequence, has

[4] Wilber [17, 18] proposed an integrated method called the all-quadrants, all-levels (AQAL) model, which is gaining attention in the education field as an effective way of teaching and designing curricula [19]. Wilber [17, 18]'s integrated methodology features a four-quadrant framework which contends that reality is composed of holons. All holons have both an objective exterior expression and a subjective interior experience. At the same time, all holons are both individuals and members of a collective. These two distinctions between the exterior and interior, and the individual and collective, give rise to four aspects of reality, or four ways of knowing, represented by the quadrants. Although the four quadrants are ontologically distinct, Wilber [17, 18] suggests that there is an interwoven, intimate correspondence between all four quadrants.

[5] In the literature, there are many definitions of collective leadership.

[6] More ethnic groups live in the river basin. Han and Mongolian people are simply the majority groups in the middle and lower reaches, respectively.

Fig. 2.3 A river disappearing into the desert, lower reaches of the Heihe River basin (January 2002)

Fig. 2.4 Wells buried by sand (June 2002)

increased. As a result, the water intake in the middle reaches has increased substantially, while the river discharge to the lower reaches has declined (Figs. 2.3 and 2.4).

The author visited the Heihe River basin for the first time in 2001. That summer, as a graduate student majoring in hydrology, he joined a research project that was investigating the water balance of the river basin. He was in charge of the study of the lower reaches. For the research, the author travelled the desert to find Mongolian nomadic households and to investigate their wells. Though a total stranger, he was welcomed warmly with tea and wine. He sometimes spent nights in their yurts, and was served fresh goat meat, which was the best treat in the region. The hospitality was impressive. Every time he returns to the region, the author tries to visit the same

Fig. 2.5 Mongolian teaching Mandarin to his granddaughter (May 2004)

families. However, reunions with old friends have become difficult in recent years. Many families are not living on their pasture land anymore. This is not because they are moving seasonally, instead it is more related to the implementation of a government policy for environmental conservation (Fig. 2.5).

Environmental degradation in the Heihe River basin, mostly in the lower reaches, has attracted a lot of attention in China since the late 1990s. The two terminal lakes of the Heihe River have dried up, in 1961 and 1992, respectively. Due to mass media reports, the area around the dry lakes is believed to be the origin of sandstorms in northern China. As a result, the Chinese government promulgated the Integrated Water Resources Management Plan of the Heihe River basin in 2001. In the lower reaches, the detailed plan was implemented in 2002 to help in the recovery of the environment. The detailed plan includes putting fences around 20,000 ha of riparian forest, establishing 2,700 ha of farmland for growing fodder, digging 110 wells with electric pumps, and relocating 1,500 nomads from grasslands. The logic behind the policy for the lower reaches was that the nomadic style of raising livestock was the fundamental reason for the environmental degradation. Therefore, to promote "economically efficient" livestock raising, the government created incentives for nomads to raise animals in shelters. The government built houses with livestock shelters close to the center of the town, and provided subsidies to the nomads who moved into them. The wells and reclaimed farmland were dedicated to raising livestock in fixed locations.

Were these policies effective for environmental conservation? Mongolian nomads in the lower reaches generally do not think so. They said that although the government required the middle reaches to release a certain amount of water to the lower reaches every year, they only released water *after* irrigation period in the middle reaches. The nomads also said that now the grasslands cannot recover, and the water release simply brings a flood over a short period. In addition, the water was diverted to the terminal

lakes through man-made concrete channels, so riparian vegetation cannot get enough water. Meanwhile, grassland without livestock is facing other problems, such as an overpopulation of mice.

These policies, which ignored the indigenous Mongolian culture and their expertise in raising livestock, in turn upset the balance of ecological systems in the lower reaches. On the other hand, in the middle reaches, the government restricted the intake of river water. However, no-one paid much attention to groundwater management. Han farmers, living in the middle reaches, simply changed from river water irrigation to groundwater irrigation. As a consequence, declining groundwater discharge into the river resulted in less river discharge in winter (non-irrigation period) in the lower reaches because of the complex interaction of the systems [23]. In short, the results from our research project clearly showed that the environmental degradation was caused by farmland expansion in the middle reaches, instead of the overpopulation of livestock in the lower reaches [24–28].

The key environmental problems in the Heihe River basin are how to effectively distribute water between the middle and lower reaches and how to support the different styles of subsistence as well as the natural environment. As we have learned, nomadic pastoralism, as an adaption to the spatial distribution and the temporal variability of arid regions, exists across the Mongolian steppes and Eurasia. It disperses the burden on the environment through movement across the grasslands. On the contrary, settled farming requires more water. The fodder growing promoted by the government actually created a new need for water, or in other words, a burden on the environment.

2.2.3 Collective Leadership for Finding Solutions for Environmental Problems: A Personal View

In recent years, environmental issues are attracting substantial attention from academics, policymakers, businesspeople, and the general public. However, policymakers and their think tanks and academic institutions are often outsiders who do not have an adequate understanding of indigenous cultures and other information about the target regions. Thus, the ideal image drawn by policymakers and researchers may not reflect the needs of local people. Advanced technologies may not be a good match for the real circumstances in target regions. Good intentions to solve environmental issues, as a result, can cause disagreement, or even conflicts.

In the Heihe River basin, the author strongly feels the need to build effective communications between the middle and the lower reaches—the Han farmers and the Mongolian nomads—as well as communications between policymakers and local people. Consensus building through discussions and mutual understanding might be the first step in solving this problem. In Fig. 2.6, the author's Mongolian friend, born in the lower reaches, and a Han friend, born in the upper reaches, are shown enjoying a party together after a day of hard work. The Han friend, due to his diligence and kindness, was called *Jaahandai* by the local Mongolian people, a word often used to describe something small but lovely. This nickname shows their hospitality and

Fig. 2.6 Party after a workday (September 2004)

friendship towards the young man. Going back to the start of this section, the author believes that collective leadership incorporating cultural and social perspectives is one of the keys to solving current global environmental problems.

2.3 Required and Expected Abilities and Skills for Environmental Leaders in Asia[7]

2.3.1 Environmental Problems and the Need for Environmental Leaders in Asia

With an increasing population and rapid economic growth in Asia, the demand for food and water resources has expanded. In addition, environmental pollution and health hazards are also becoming more pronounced. Therefore, there is an urgent need to deal with these problems. Without solutions to environmental problems in Asia, we might face a serious situation for sustainability on a global scale, as shown in Fig. 2.7.

However, human resources are required to resolve the issues of poverty, urbanization and industrialization, as well as environment problems. Therefore, the development of people who can contribute to the solution of emerging environmental problems is urgently needed in Asia. As well as responding to these problems, it is

[7]This section is based on the personal experiences of one of the authors, Hiroaki Furumai from Graduate School of Engineering, The University of Tokyo, Japan.

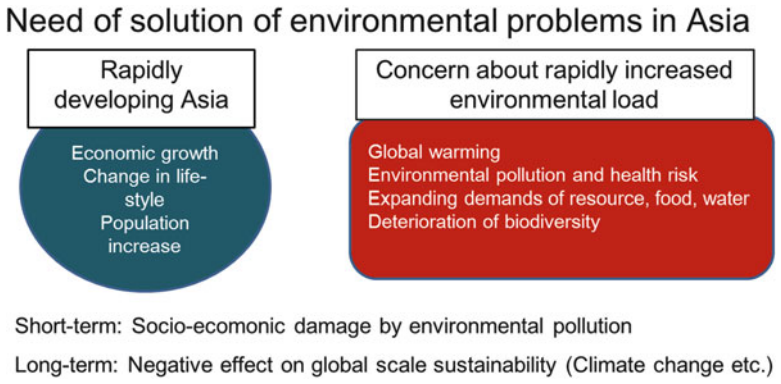

Fig. 2.7 Need of environmental leaders in Asia (http://www.env.go.jp/press/press.php?serial=9516)

necessary to realize a low-carbon, recycling-based society, one in harmony with nature from a long-term perspective. Toward the creation of a sustainable society, it is essential to have people who can internalize environmental protection and conservation into today's society.

It has been recognized that people are a part of nature in Asia. In addition, environmental ethics and wisdom from traditional philosophies of "Enough is as good as a feast" have been handed down over the generations. Recently, we have tended to forget the historical accumulated wisdom, while we put more weight on economic growth and efficiency. We have to re-recognize the importance of environmental ethics and wisdom. In addition, leaders with a long-term perspective are required to achieve a sustainable development in Asia.

2.3.2 Essential Elements of Environmental Leaders

Committee on the Vision for Developing Environmental Leaders in Higher Education towards Achieving a Sustainable Asia, the Ministry of Environment, Japan, reported/discussed the key concept/component/element of environmental leaders. They proposed that environmental leaders are required to have "strong motivation," "expertise" and "leadership," as shown in Fig. 2.8.

Strong motivation should be based on a clear understanding of the urgency of the current state of sustainability and action. Willingness to act for environmental protection is expected of environmental leaders. Environmental ethics and the ability to assess long-term and short-term needs are closely related to the strong motivation of environmental leaders. At the same time, motivation and willingness should be supported by the ability to understand the relationships among the environmental, economic and social dimensions. The value of the environment has not been well recognized in the current socio-economic system. Therefore, it is necessary to deal with trade-offs among these three dimensions.

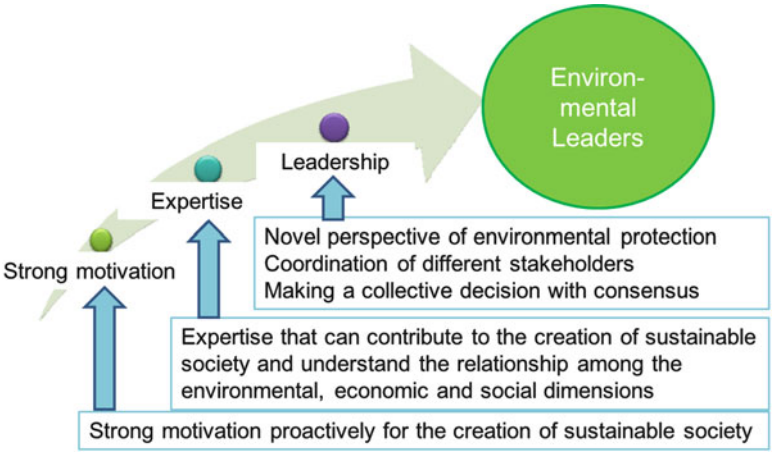

Fig. 2.8 Three key elements of environmental leaders (http://www.env.go.jp/press/press.php?serial=9516)

Expertise is also required for environmental leaders. It is useful to summarize the abilities and knowledge that are required to deal with environmental issues as an expert. The author had an experience to discuss the required knowledge and abilities of environmental engineers as a committee member for Japan Accreditation Board for Engineering Education (JABEE). Table 2.2 lists the key criteria for expertise to be acquired by university graduates. These abilities and knowledge are essential for dealing with environmental issues and to identify problems so that possible solutions can be proposed. The integration of knowledge and technologies especially is one of the most key components to reach proposals for solutions and for effective decision making.

Leadership is a special key element for leaders having expertise. Environmental leaders are expected to transfer their knowledge, information and technology for solving environmental problems. They need several leadership abilities, including the ability to:

- Capture the multi-faceted holistic environment, economic, social aspects
- Organize a novel perspective on environmental protection
- Collaborate with stakeholders by listening to their opinions and helping to address their interests
- Reach a collective decision using consensus building.

2.3.3 Education Experience During APIEL Thailand Unit 2012

In August 2012, APIEL organized a field exercise unit with the theme on "Sustainable Urban Water Management: special focus on flood management in Bangkok (Thailand Unit 2012)". During the unit, teaching staff tried to provide a

Table 2.2 JABEE criteria for expertise in the field of environmental engineering

1. Ability to understand and appropriately address the fundamental principles of environmental management, conservation, improvement, remediation and reduction of environmental load
2. Ability to observe, acknowledge and analyze phenomena relating to the environment
3. Knowledge and abilities of applied mathematics and at least two subjects from natural sciences, mainly focusing on physics, chemistry, biology and geology
4. Ability to plan and execute surveys or experiments, to accurately analyze and examine the acquired data, and to explain the results
5. Ability to identify environmental issues, to set agendas, and to propose possible solutions by integrating knowledge and technologies

holistic view of environmental issues, inter- or trans-disciplinary and cross-cultural approaches, as well as a balance between the environmental, economic and social dimensions needed to deal with complex water management issues under flood conditions. Water management is one of the most critical environmental issues, globally and locally. Tropical regions especially often have vulnerable water resources, floods, and limited access to safe water. Thus, the unit focused on the flooding in Thailand, especially in Bangkok, in 2011.

Participants looked into the flood risk not only through the "lens" of climate change but also socio-economic change. Discussion extended to water quality and quantity with respect to water security and health risk management during floods. Lectures were given to students (on flood scenarios, impact, and control) to provide them with basic knowledge and information on flood issues and their management. Technical visits were arranged to learn from different stakeholders, including Rojana Industrial Park which was damaged by the flood, Royal Irrigation Department, Bangkok Metropolitan Administration, and the World Bank. Students learned about flooding and management policies from different stakeholders, deepening their understanding through roundtable discussions. In addition, interviews with citizens covering water access and management during floods were also arranged through assistance from governmental officials.

To achieve the goals of the course, group working time was reserved for students to have in-depth discussions and to making proposals. Three working groups were organized with different themes selected by the students: flood management and land use (Group 1), access to basic human needs in case of flood (Group 2), and disease prevention after floods (Group 3). During the group work, students were expected to make proposals for dealing with their theme.

For example, Group 3 focused on the challenging issues of providing basic public health needs for disease prevention. They learned to (1) identify the problems of accessing basic human needs immediately after the 2011 Thailand flood, (2) analyze how early flood warnings and flood awareness influenced access and (3) propose possible measures to minimize problems of accessing basic human requirements in future emergencies. They conducted an in-home questionnaire survey and street intercept in Ayutthaya Province, which had been severely affected by the flooding. The questionnaire had two main parts: accessibility of targeted public health needs including early warning and flood awareness.

The Thailand Unit was successfully conducted in collaboration with the Asian Institute of Technology (AIT). Students from UT and AIT were mixed to form groups to tackle their own tasks in the field. The outcomes of the three groups were presented as posters in the 10th International Symposium on Southeast Asian Water Environment held in Vietnam in November 2012.

This type of APIEL field exercise should be designed to provide structured knowledge, as well as the practical skills and experiences that are needed for fostering young professionals with strong motivations to meet environmental challenges. Through the education experience of the Thailand Unit 2012, faculty members also learned how to better organize the course program and how to stimulate student discussions during group work. For example, faculty members in many cases, made appropriate comments and suggestions on students work according to their background and knowledge; on the other hand, faculty members observed the obstacles and struggling among students group work from time to time.

During the group work and presentation meetings, some students showed a marked improvement in integrating information and knowledge and coordinating different opinions through good communications with other students. They had acquired the high level of skills needed to explain their ideas clearly and logically while using good examples. This demonstrates to us that collaborative work with sufficient discussion time in a working group environment provides the essential opportunity to strengthen and expand the abilities that are required for environmental leaders.

2.4 Strong Leadership in a Task Force After the Tsunami[8]

2.4.1 Background

A massive tsunami hit the coast of northeastern Japan following the Great East Japan Earthquake on March 11, 2011. This was a tragic disaster for Japan, and many Japanese volunteered to help people in the devastated area. As a professional in environmental engineering, the author had serious concerns over the water environment in the area a few weeks after this tragic event. Although critical problems such as food, medical care etc. were being dealt with by various organizations including volunteer groups, water environment issues remained unsettled and drew less attention as they seemed to be less urgent.

The earthquake had a profound impact on the Japanese people, and the scientific community was no exception. *The first emergency recommendation regarding the response to the Great East Japan Earthquake* was published by the Science Council of Japan on March 25, 2011. The Japan Society on Water Environment

[8]This section is based on the personal experiences of one of the authors, Hiroyuki Katayama from Department of Urban Engineering, Graduate School of Engineering, The University of Tokyo, Japan.

Fig. 2.9 Wall at wastewater treatment plant collapsed by tsunami

Fig. 2.10 Sample collection at wastewater treatment plant hit by tsunami

(JSWE) also responded and formed a task team. The task team, together with the Tohoku (northeastern Japan) area branch of JSWE, proposed two fields for study groups to work on. These are called the Study Group on Health-Related Water Microbiology (HRWM) and the Study Group on Wetlands and Coastal Areas.

The author is a secretary of the HRWM study group, and was appointed as a core researcher to lead the Study group. This is a rare situation for a researcher, since this activity is not only related to research but is also closely associated with social problems.

2.4.2 Key to Success: Integration of Multi-Stakeholders

Our research team from the Department of Urban Engineering, UT had been conducting onsite field surveys in foreign countries, including collecting samples and analyzing microbial water quality, as well as simple water quality parameters. This experience was a great help for organizing field surveys in Tohoku, where no adequate experimental facility was available at the time. For the field surveys, a virus concentration method was developed and applied to a large volume of water and then modified for application outside the laboratory. Many things had to be done quickly for the field survey, and teamwork was especially important. However, students on a research team should have independent research themes, and most of them had independent scopes of research.

The culture in our research team includes the practice of "on-the-sampling training." For a water quality survey, new graduate students help with surveillance, while senior laboratory staffs instruct and advise them. Unlike lectures at the university, this advice contains unwritten knowledge about the area of the surveillance. Experience outside the laboratory also allows the students' eyes to be wide open to the real situation and gives them the opportunity to view their own research from a wider perspective. The senior members experienced this training before, and they are transferring their experience to the new students. Through day-by-day work in this laboratory culture, mutual trust was developed among the team members; the team is now always ready to receive a request of surveillance.

Communication is also an important factor. Advice from a wide range of people was gathered by senior professors from different universities in the JSWE headquarters, helping to further improve communications with stakeholders. Stakeholder groups included the local wastewater departments, and the local fisheries departments and fishermen's cooperatives in Miyagi Prefecture who all responded positively to our involvement. With strong support from these stakeholders, our proposal was submitted to the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and to the Ministry of Environment. The two ministries agreed to give us funds for research and surveillance of the wastewater system and the coastal area that receives discharge from the sewer systems.

2.4.3 Key to Success: Application of Scientific Knowledge

The first step was to select a target site for the field survey. Ishinomaki City was selected for the following three reasons: a lot of people remained producing wastewater, commercial fishing had restarted, and the wastewater treatment plant was not

yet functioning. The task team set our target as affordable treatment, which can be applied in the rehabilitation stage before the full recovery of the treatment plants.

The MLIT, in charge of sewer systems, insisted on adding chlorine to the untreated wastewater to meet the coliform standard for effluent. However, this policy does not work for microbial water safety because chlorine is not effective against all pathogens, including viruses and protozoa. The task team pointed out the weak point in that policy, and tried to find alternate ways to achieve a relatively safe water environment.

Our concept was that given the urgent situation the treatment would not be perfect, but should be affordable. Usually wastewater is treated biologically over a relatively long retention time, but in this unusual case physicochemical treatment might be better able to achieve microbially safe water in a short time. Instead, the target among the water quality parameters should be narrowed down only to pathogen control, which is more urgent and important under the circumstances in a disaster area (Actually, on some occasions, nutrient or organic loading is not always harmful to the environment, but pathogens have to be removed in any case).

Our experience was useful in searching for an appropriate treatment for storm water combined with untreated wastewater, which is discharged into open bodies of water when the sewer overflows due to an overabundance of rainwater. A combination of coagulation-sedimentation and ultraviolet disinfection was tested and found to be the most effective method for producing relatively safe water.

Polysulfuric ferrite, a waste byproduct from the iron and steel industry, was selected as the coagulant. It was also used as an anti-odor agent for municipal wastewater. Polysulfuric ferrite is used for organic wastewater treatment in the food industry, among others. The proposed method successfully removed suspended solids and turbidity from the influent, and achieved a good amount of bacterial and viral removal when used together with ultraviolet light disinfection. This result was presented at a wastewater works conference.

Our method was not applied in reality in Ishinomaki City because it requires waste sludge management after the coagulation and sedimentation. The sludge management system was restored almost at the same time as the other water treatment facilities, and the wastewater treatment plants selected a biological treatment. The method the task team developed will be used in the future or in other recovery areas in the Tohoku region. The sampling campaign for water quality in the coastal area is still contributing to future water quality management plans from the viewpoint of microbial water safety. During the course of the project, much support was given to us by senior professors, stakeholders, and laboratory staff. Overall the author experienced a strong leadership applied under such a tragic disaster by integration of multi-stakeholders and application of scientific Knowledge.

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