

# Chapter 1

## Global Environmental Issues and Human Wellbeing

Environment is the foundation and support of human existence and survival and the guarantee of sustainable human development; environmental protection has undoubtedly become a common understanding and development strategy of all countries of the world. Now humankind is striving into the historical process of postindustrial society and is trying to reach rebalance with environment in later stage of development. All countries need to perform respective duties and obligations in environment governance, in joint efforts to plan economic development, social progresses and environment protection to realize mutual wins and sustainable development of the world and to create an Earth homeland for harmonious co-existence of humankind and environment.

### 1.1 Key Global Environmental Problems

#### 1.1.1 Global Warming

Global warming refers to the phenomenon of gradual temperature rise of atmosphere, soil, water and vegetative cover on Earth's surface year by year, major cause of which is "greenhouse effect" due to emission of such greenhouse gases (GHG) as carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). On one hand, GHG absorbs the outward long-wave radiation emitted by Earth; it has no any resistance against the inward shortwave radiation from the sun on the other, which causes temperature rise in Earth surface and the lower atmosphere and results in global warming. Among the GHGs, carbon dioxide makes over 50 % of contribution to global warming. For a long period before the Industrial Revolution, the concentration of carbon dioxide in atmosphere stabilized at 270–290 ppm. With the accelerated industrialization and urbanization after the nineteenth century, CO<sub>2</sub> concentration started the process of escalation at faster and faster speed. In 2007, Intergovernmental Panel on Climate Change (IPCC) released the IPCC Fourth

**Table 1.1** Global greenhouse gas concentration 2010 and WHO-GAW global greenhouse gas trend

	CO <sub>2</sub> (ppm)	CH <sub>4</sub> (ppb)	N <sub>2</sub> O (ppb)
Global abundance in 2010	389.0	1,808	323.2
2010 abundance in relative to year 1750	139 %	258 %	120 %
2009–2010 absolute increase	2.3	5	0.7
2009–2010 relative increase	0.59 %	0.28 %	0.25 %
Mean annual absolute increase during last 10 years	2.00	2.7	0.77

Source: WMO greenhouse gas bulletin 2010

Note: The figures for pre-industrialization are: 280 ppm for CO<sub>2</sub>, 700 ppb for CH<sub>4</sub> and 270 ppb for N<sub>2</sub>O

Assessment Report (AR4); it is pointed out that the CO<sub>2</sub> volume fraction was 379 ppm in the year 2005, which has gone far beyond the scope of spontaneous change in the past 650,000 years. In 2011, the annual Greenhouse Gas Bulletin released by World Meteorological Organization indicates that the greenhouse gas abundance in global atmosphere in 2010 has made a new high in industrialized era. Table 1.1 reflects the general situation of global greenhouse gases concentration and the trends of change in the last decade. Since the Industrial Revolution, the average air temperature of the globe has increased by about 0.7 °C and is increasing at the speed of 0.2 °C every 10 years.<sup>1</sup> Global warming will have far-reaching influence on the world, such as polar glacier partial thawing, rise of sea level, submergence of some foreland regions, etc.; global warming will cause precipitation change and abnormal climate, damage to the ecosystem and droughts and floods, threaten both the production and daily life of humankind and trigger diseases related to heat wave.

### 1.1.2 Ozone Depletion and Destruction

Ozone depletion and destruction is caused by ozone-depleting substances, mainly chlorofluorocarbons (CFCs). Ozone layer can absorb over 99 % of the UV ray from solar radiation and thus protect the lives on Earth from UV injury as a natural “Umbrella” of Earth. Since 1950s, ozone layer has showed trend of concentration reduction found during observation and research. In 1974, Professor Rowland and Dr. Molina from the University of California in USA published their paper “Chlorofluorocarbons in Environment” and firstly put forward the causal relation between CFCs emission and ozone depletion. In the 1980s, UK scientist found the “ozone hole” over Antarctica, which was proved by the observation data from U.S. satellite Nimbus-7. After that, Germany scientist again found similar ozone hole over Arctic. With the full unfolding of ozone sounding and further findings in

<sup>1</sup>HU An-gang, China: Innovation of Green Development [M]. Beijing: China Renmin University Press, 2012. P82.

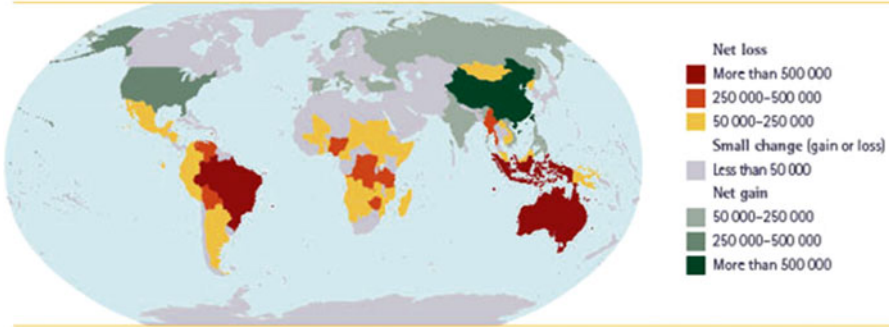
scientific research, phenomena of ozone layer depletion appear all over the globe. As forecasted by the USEPA, if no restrictions are set on CFCs emission, by 2075 stratospheric ozone will decrease by 40 % compared with 1985. In that case, there will be 150 million of skin cancer patients, 18 million of cataract patients, 7.5 % of crop harvest decrease, 25 % of aquatic product loss and decline of human immunologic function, which will bring about tremendous hazards. As ODS is very stabilized that can live as long as 50–100 years, even if the globe absolutely stopped any emission of ODS, it would take rather long time to see any restoration phenomena on ozone layer. The Scientific Assessment of Ozone Depletion 2010 released by the UN indicates that Earth's atmospheric ozone layer has stopped depletion and will gradually recover. In recent years, however, observational data showed that from the actual indicators like ozone hole area, depth and time lapse, the atmospheric ozone depletion over Antarctic is still severe. For instance, since 2000 the ozone hole over Antarctic has maintained at high level of depletion in large area and the ozone hole area has exceeded 25 million square kilometers in 2003, 2006 and 2008; especially in 2008, the area has reached 27.2 million square kilometers, even larger than the entire North America. In 2009, the size of ozone hole over Antarctic was still at the level of the last few years. Therefore, it's quite clear that the ozone depletion over Antarctic does not stop and there will be a long way to go for the recovery of atmospheric ozone layer.<sup>2</sup>

### ***1.1.3 Sharp Decrease of Forest Cover***

Forest is an important ecological resource having effects of air purification, adjusting climate, water conservation, resisting wind and stabilizing sand, biological diversity protection and promoting ecological stability. At the infancy of human civilization, the virgin forest on the globe covered two thirds of the continent, reaching 76 million km<sup>2</sup>; in the mid-nineteenth century, the covered area was 56 million km<sup>2</sup>; by the end of twentieth century, the area was reduced to 34.4 million km<sup>2</sup>, coverage falling to 27 %; and in 2003, the forest cover area was left as some 28 million km<sup>2</sup>. It is obvious that since the Industrial Revolution in the eighteenth century, the global forest cover has been seriously damaged. Figure 1.1 shows the forest changes in world countries during 2005–2010, which tells that forest loss is rather severe in regions like Oceania, South America and Africa. And, the latest report of Food and Agriculture Organization of the United Nations (FAO) indicates that there are 130,000 km<sup>2</sup> of forest lost or converted into land for other purposes every year during 2000–2010, while the decade before the period the magnitude has been 160,000 km<sup>2</sup>. Reduction of forest cover has brought about severe adverse impact on the global ecosystem, causing water loss and soil erosion and land desertification, damaging biological diversity, intensifying greenhouse effect and threatening the sustainable development of human society.

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<sup>2</sup>WANG Geng-chen, Good News for Ozone Layer Protection [N]. The People's Daily, 2010-10-26.



**Fig. 1.1** Net change in forest area by country, 2005–2010 (ha/year) (Picture via FAO)

### 1.1.4 Declining of Biological Diversity

Biodiversity includes genetic (biological genes) diversity, species diversity and ecosystem diversity; it is the core component of Earth's life-support system and the material basis of human survival and development. However, in the past hundreds of years, due to the adverse impact of human activity, species extinction rate has been 1,000 times that of natural species extinction rate in history.<sup>3</sup> Now there are about 12 % of birds, 23 % of mammals and 25 % of conifers faced with the risk of extinction.<sup>4</sup> As UNEP forecasts, there will be 1/4 of biologic species on the earth trapped in the danger of extinction for the forthcoming two or three decades; by 2050, about half of all animals and plants will disappear from the earth. In order to protect biodiversity, the globe has been devoted to finding a roadmap for protection of biodiversity since 2010 and the 10th Conference of Parties of the Convention on Biological Diversity held in October 2010 in Japan approved the Strategic Plan for Biodiversity 2011–2020, which established the goal of global biodiversity by 2020 and designed the roadmap and time schedule for global biodiversity protection.<sup>5</sup>

### 1.1.5 Acid Rain Pollution

The academic term of acid rain is acid deposition, mainly caused by emission of acidoids into the atmosphere due to human activity, such as sulfur dioxide, nitrogen oxides, etc. During the period from 1950 to 1990, global sulfur dioxide emissions

<sup>3</sup> Millennium Ecosystem Assessment. Ecosystems and Human Well-Being: Biodiversity Synthesis [M]. Washington DC: World Resources Institute, 2005:3.

<sup>4</sup> HU An-gang, China: Innovation of Green Development [M]. Beijing: China Renmin University Press, 2012. P85.

<sup>5</sup> XU Hai-gen, DING Hui, WU Jun, et al. Interpretation of the 2020 Global Biodiversity Targets and Its Assessment Indicators [J]. Journal of Ecology and Rural Environment, 2012(1).

increased by 100 %, exceeding 150 million tons per year now and nitrogen oxides emissions also arrived at about 100 million tons per year. The Scandinavian region in North Europe, the European Continent and North America are the top three central areas with severe acid rain pollution. Since the 1980s, acid rain pollution in some Asian developing countries like India and China have become increasingly severe too. In 1998, the area of acid rain region in China has covered over 30 % of its territory and the total annual loss due to acid rain reached USD 13 billion. In 2005, China's sulfur dioxide emissions reached as high as 25.49 million tons, ranking first in the world. The major hazard of acid rain is damage to forest ecosystem resulting in water and soil acidification, causing death of aquatic animals and plants, reduction of crop production and erosion on buildings.

### ***1.1.6 Land Desertification***

Land desertification is also known as “land degradation”, meaning the degradation of land in arid and semi-arid areas mainly due to climate change and irrational human economic activities. Up to 1996, global area of land desertification has reached 36 million km<sup>2</sup>, influencing 1/6 of world population from over 100 countries and regions. At present, there are still about 60,000 km<sup>2</sup> of land becoming desertification every year on the globe. Land desertification has caused severe hazards, threatening human living environment, speeding up deterioration of ecological environment and limiting socioeconomic development. The loss caused by desertification in agricultural productivity only would be roughly as high as USD 42 billion. With the increasingly severe global land desertification as target, the United Nations has launched the Decade for Deserts and the Fight against Desertification 2010–2020 on August 16, 2010, in the hope to further enhance global awareness of the hazard by desertification and land degradation and meanwhile urging all countries to take effective steps to prevent land desertification.

### ***1.1.7 Marine Pollution and Damage***

Marine pollution and damage primarily refers to the pollution to marine environment and the damage to marine ecosystem due to over development of marine resources. Major sources of marine pollution include sewage, pesticide, petroleum, household garbage, industrial solid waste and certain heavy metals. The most severely polluted sea areas are in Baltic Sea, Mediterranean Sea, Tokyo Bay, New York Bay and Gulf of Mexico. “The largest accidental marine oil spill” happened in 2010 – Gulf of Mexico oil spill has caused 11 deaths, 5 million gallons of oil spill and almost 1,500 km of ocean beach contaminated, resulting in thousands of billion dollars of economic loss. Over development of marine resource is also intensifying. Now there are globally 70 % of all oceanic life, including 77 % of

fishes, encountering extreme or over development, which has big impact on the fertility of the ocean and diversity of oceanic life. As indicated by the UNEP, with the increasingly severe threaten on ocean from environmental pollution, heavy fishing and climate change, global marine ecosystem will be facing the danger of collapse in the few coming decades.

### ***1.1.8 Water Pollution and Freshwater Resource Shortage***

Water is the source of life, and one of the indispensable physical resources for the survival and development of human society. Globally, the freshwater that can be utilized by humankind only accounts for 0.325 % of the total water volume on Earth. In company with the economic development and population growth, human demand for water resource is also increasing, followed by freshwater resource shortage because of water pollution problems. Discharge of household wastewater and industrial wastewater as well as surface runoff of agricultural pollutants like fertilizer and pesticide, is the leading cause for water pollution. According to the estimates of related international organizations, the population of countries with water resource shortage will increase from 132 million in 1990 to 653 million by 2025 (estimated as per low population growth) or 904 million (estimated as per high population growth); by 2050 the figure will further amount to something between 1.06 billion and 2.43 billion, accounting for about 13–20 % of the estimated world population.<sup>6</sup> Lack of safe drinking water and sanitary facilities has resulted in hundred million cases of disease related to water and at least 5,000,000 deaths every year.<sup>7</sup> WHO's investigation also indicates that 80 % of human diseases are related to water pollution. Therefore, rational development and utilization of water resources and strengthening water resource conservation has become a priority.

### ***1.1.9 Toxic Chemical Pollution and Cross-Border Transfer of Dangerous Waste***

There are about 35,000 types of chemicals on global market that are harmful to human health and ecological environment, in which more than 500 types causes cancer, teratogenesis and mutagenesis. Use of toxic chemical may lead to contamination to the atmosphere, water mass, soil or even life to varying degrees. Dangerous waste refers to those wastes carrying chemical activity or toxicity, explosiveness,

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<sup>6</sup>LIU Xiang-lian, PANG Zhen-je and ZHAO Rui-ping. Protection of Water Resources: Allowance of No Delay [J]. Journal of Environmental Management College of China, 2005(2).

<sup>7</sup>XU Zai-rong, Global Environmental Issues and International Response [M]. Beijing: China Environmental Science Press, 2007. P47.

corrosivity and other properties that are harmful to human living environment, not including radioactive waste. Currently the quantity of hazardous waste generated globally every year is about 330 million tons. Because hazardous waste means severe pollution and high disposal cost, developed countries are transferring hazardous wastes to developing countries at the rate of 50 million tons per year to shift the pollution.

## **1.2 Influencing Factors of Global Environmental Issues**

### ***1.2.1 Economic and System Influence***

First and foremost, the traditional economic development pattern focusing solely on economic growth is the immediate cause of environmental issues. History shows that after the Industrial Revolution, countries like UK, USA and Germany have created miracles of rapid economic development, but accompanied with the global environmental issues that threaten human development. This is because the traditional economic development pattern focused more on the achievements made in economic sphere with primary target at pursuit of growth in total output value and economic profit and increase of material wealth. Under such traditional pattern, people sacrificed resource consumption and environment damage in return for economic growth, regardless of resource utilization efficiency; ecosystem is exposed to destruction because of lack of rational resource development and utilization. On one hand, development and utilization of renewable resources went beyond the limit of regeneration rate of resources and even beyond the development level of their substitutes, with ever increasing consumption of non-renewable resources. On the other hand, owing to weak awareness of ecological environment protection and pursuit of economic interest maximization, low-cost production methods that are harmful were adopted, having no regard for pollution-free technologies and scientific environmental resource management. Such development pattern has directly led to increasingly severe environmental problems worldwide. Just as Engels pointed out in *Dialectics of Nature*, “Let us not, however, flatter ourselves overmuch on account of our human victories over nature. For each such conquest takes its revenge on us. Each of them, it is true, has in the first place the consequences on which we counted, but in the second and third places it has quite different, unforeseen effects which only too often cancel out the first.”<sup>8</sup>

Secondly, capitalist system in developed countries and the inequitable international order under that system are the root causes for global environmental problems. Under capitalism, environment does not exist as a natural domain where humankind must coexist with other species, but as a domain to be developed in the

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<sup>8</sup>Compilation and Translation Bureau of the CPC Central Committee. Marx and Engels Gesamtausgabe (Vol. 20) [M]. Beijing: People's Publishing House, 1973: P519.

ever expanding process of economy.<sup>9</sup> Ecological socialists argue that capitalism is the root cause for Western or even global ecological crisis and environmental problems. The expansion of capitalism goes without limitation; the trends of infinite accumulation of capital and the dominating logics of maximization of added value implies impulsive consumption of earth's resource and destruction of natural environment and has inherently decided the unsustainability of economic development and the inevitability of ecological colonialism.<sup>10</sup> With the formation and development of world economic system, developed capitalist countries tried to protect their vested interest through domination of the old international economic and political order. The old international political and economic order is typically reflected as environmental hegemonism and colonialism in environmental issues. The establishment and execution of rules regarding global environmental problems also focus on the interest of Western great powers with one standard for the developed countries and another standard for the developing countries, which excessively emphasizes that developing countries should undertake equal responsibilities as developed countries in environment protection. As a matter of fact, developed countries are the main responsible party of today's global environmental issues: first for the ecological cost of spoliation and expansion and diversion during the 300 years of industrial civilization and secondly for the ecological loss due to the global production and consumption in the past few decades. Developed countries have controlled over 85 % of global resources with 15 % of population, whereas more than 60 % of the consumer goods produced in developed countries especially in China are exported to developed countries. 95 % of world's toxic waste are generated in the 20 plus developed countries. Also, developed countries utilize their advantage in economic globalization to divert the ecological and resource crises to developing countries.<sup>11</sup> They have financial, technical and management advantages in global environment governance, but unwilling to undertake historical responsibility; instead, they try to maintain dominance of global interest and future resource through dominant position in establishment of international system and environmental negotiation, so as to increase the environmental capacity limit for developing countries. Moreover, the commitment of financial and technical support for developing countries is very often "shown more by words and less by actions". But developing countries are faced with dual role in both economic development and environmental protection; it is rather unpractical to solely emphasize their responsibility in environmental protection while sacrificing the right to development. The old international environmental order of the dominant leading powers not only can't solve the global environmental problems, but also will further intensify the contradictions, leading governance

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<sup>9</sup>Fred Magdoff. On Capitalism and the Environment [J]. WU Xuan and LIU Ren (Translate). Foreign Theoretical Trends, 2011(10).

<sup>10</sup>YU Jin-yao. Capitalism and the Global Ecological Environment since Modern Era [J]. Academic Research, 2009(6).

<sup>11</sup>CHEN Liang. Changing International Political and Economic Pattern and Establishing New Global Environmental Order [N]. China Environmental News, 2009-12-24.



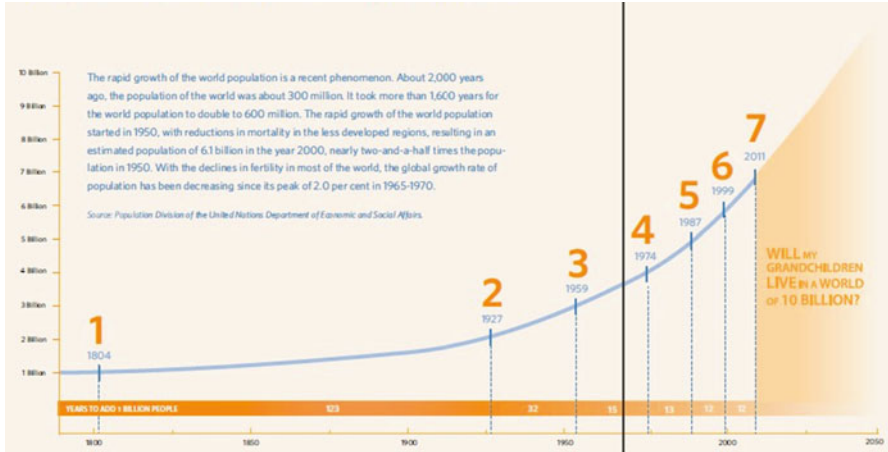


Fig. 1.2 Years when world population reached increments of one billion (Source: State of World Population 2011, UNPFA)

of global environmental issues into the predicament of benefit and policy coordination. Therefore, although both developed countries and developing countries are aware of the importance of these issues and have established a global environmental governance network with the UN as central and national governments and public society as participating, response to these issues is not yet really based on the benefit of the entire humankind and no substantial steps are made in global environmental governance. Only global environmental collaboration based on mutual confidence can make ideal achievements.

### 1.2.2 Influence from Population and Society

First, the growing population has been a great pressure for the resource environment. Excessive growth of population in spite of ecological environment load-bearing limitation is another important cause for global environmental problems. In history, many scholars have already been aware of the causal relation between the surplus of population and environmental crisis. A huge population size and higher natural growth rate of population have brought about great pressure for global resource environment. The demand and consumption of material goods by ever growing population increasingly grow too, which will eventually exceed the capacity of environment to supply resources and dispose wastes, leading to over taking from nature and thereby resulting in various resource and environmental problems. Since the nineteenth century, particularly after the twentieth century, the rapid growth of population has triggered series of environmental problems, such air pollution, scarcity of resource, piles of household garbage, etc. Figure 1.2 shows the trends of

world population change. In 2011, world population has reached seven billion, which posed a big challenge for global resource environment and should awake the awareness of the entire humankind of the crisis in their living environment.

Secondly, environmental issues are also influenced by people's awareness of the natural world and changes of practice in the different times of human society. In the primitive society when productivity is relatively low, population size was small and human activities were mainly collection of natural food and hunting, environment was less a problem. When human society entered agricultural civilization, productivity was improved, population size grew faster, people's ability to reform nature was strengthened, and development and utilization of resources like land, forest and water increased; during this stage, environmental issues began deteriorating. During the industrialized civilization period, science and technology made great strides, productivity increased by a wide margin, and population expanded rapidly; humankind tried to conquer nature and started accumulation of material and wealth at the cost of over development of resources and pollution of environment. These caused intensification of contradiction between population and resource & environment and deterioration of ecological environment threatens the existence and development of humankind. Under such context of crisis, people became aware of the severity of environmental issues and strived for harmonious development of both humankind and nature with emphasized consideration of population and resource and sustainable development of environment; thus human society may step into the era of ecological civilization and the environmental problems could be controlled and improved to certain degree.

### ***1.2.3 Influence from Cultural Tradition and Ethnic Consciousness***

Cultural tradition and ideological consciousness show important influence on economic development pattern and thus influence ecological environment. The cultural tradition dominant in UK and USA and taking "individualism" as core value has put individuals on the center society and history and emphasizes individual right to pursuit of economic benefits; especially after the 1980s when neo-liberalism advocated extreme individualism and highly liberalization became the main-stream ideology worldwide, such value orientation undoubtedly got adapted to the need of infinite extension of capital,<sup>12</sup> but it also brought in destruction to ecological environment. The US scholar Sprenak points out in his *The Resurgence of the Real: Body, Nature and Place in a Hypermodern World* that ecological environmental issues is a way to reflect the modern civilization crisis and argues that the modernistic egoism of economic man, the social order of industrialism, the hierarchal

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<sup>12</sup>HAN Yi. Cultural Tradition Influences Economic Development Pattern [N]. Chinese Social Sciences Today, 2011-7-15.

arrangement under patriarchy, the centralized pattern of thinking as well as the absolute anthropocentrism all together form a powerful anti-natural culture force that leads to severe environmental pollution and ecological damage. An Australian thinker Plumwood also believes the intrinsic logic relation between ecological crisis, environmental pollution and the malady of modern civilization.<sup>13</sup> The cultural ethics that spares no sacrifice of ecological environment for egocentric purpose makes global environmental protection consciousness generally weakened and causes many environmental issues.

### ***1.2.4 Influence from Alienation of Science and Technology***

Advance of science and technology is double-edged sword that can not only benefit humans and promote social development, but also be accompanied with environmental problems that endangers the entire globe. The US scholar Commoner and Capra argue that science and technology are the root cause of global environmental problems. After investigation into the impacts of nuclear pollution, fertilizer, plastic material, synthetic fiber and automobiles on environment, Commoner argues that the root cause of environmental problems is modern science and technology that not only brings about economic benefit but also destructs ecological environment. In *The Closing Circle: Nature, Man and Technology*, Commoner indicates that the facts seem apparent that the leading cause of crisis that swallowed the American Environment is the unprecedented production technology reformation since World War II. Capra indicates in *The Turning Point* that pollution of air, drinking water and food is only the distinct and direct manifestation of the effects of human science and technology on natural environment, and the less distinct but perhaps much more dangerous effects have not been fully understood by people so far. Science and technology has severely disturbed, or may be even destructing the ecosystem that human survival depends on.<sup>14,15</sup> Undoubtedly, alienation of science and technology is one of the important cause for global environmental issues, but not the root cause. However, we could see that some technological invention in the area of environmental protection could play a major role in solving global environmental problems. Therefore, such alienation should be avoided during the course of technological development, making science and technology to take positive effects and realizing unification of both technological development and the development of human society.

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<sup>13</sup>LIU Jian-tao and JIA Feng-zi, Overview of Studies on the Root of Environmental Problems. Frontier, 2012(1).

<sup>14</sup>Ji Zhen-hai, On Ecological Civilization [M]. Beijing: People's Publishing House, 2007: 81–82.

<sup>15</sup>LIU Jian-tao and JIA Feng-zi, Overview of Studies on the Root of Environmental Problems. Frontier, 2012(1).

### 1.3 Global Ecological Environment and Human Wellbeing

Ecological environment provides various services for humankind through the process of interaction and inter-constraint between economic and environmental system. Such services are the gains from the economic-environmental system, including supply service, regulation service, cultural service and support service (See Fig. 1.3). Supply service refers to the various product resources obtained from ecological environment, such as material resources like food, raw material, energy material, etc. and non-material resources like biological inheritance. Regulation service refers to the gains from regulating effect of ecological environment, such as maintenance of air quality, regulating climate and moisture, erosion control, water purification and waste disposal, human diseases regulation and control, biological control, pollination and protection from storm attacks. Cultural service means the non-material gains from ecological environment through intellectual life, development cognition, brain thinking, recreation & entertainment and aesthetic enjoyment; it includes multiplicity of culture, spiritual and religious value, knowledge system, educational value, source of inspiration, aesthetic value, social relation, sense of location, cultural heritage value, recreation, and

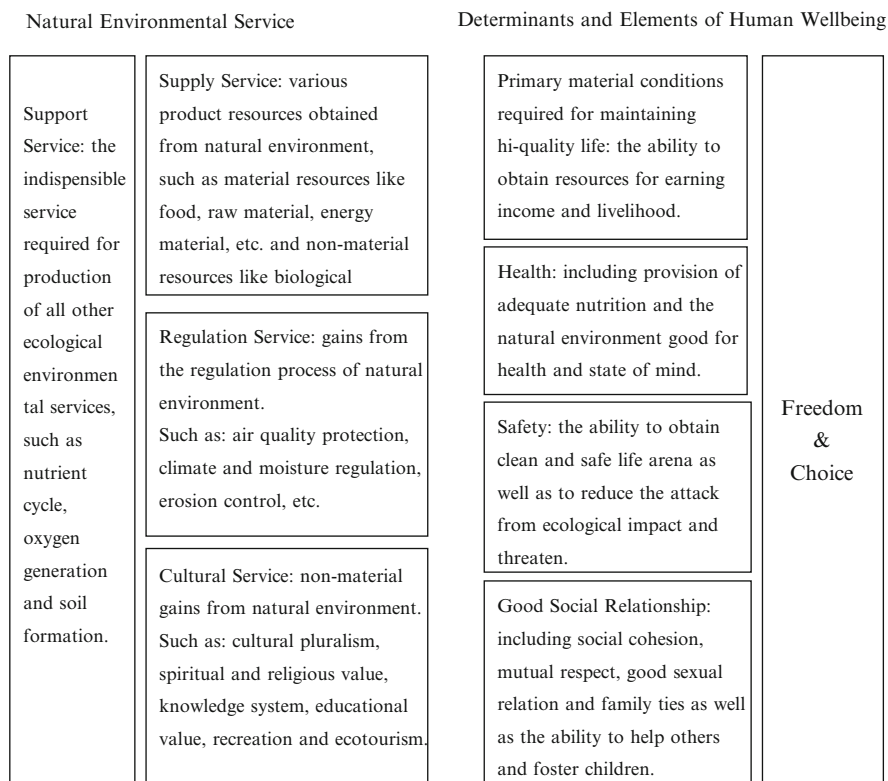


Fig. 1.3 Natural environmental service & its relationship with human wellbeing

ecotourism. Support service refers to the indispensable service required for production of all other ecological environmental services. Compared with the relatively direct short-term effect of other services of ecological environment, this service's effect on humankind is either indirect or occurs in a very long period, such as nutrient cycle, oxygen generation and soil formation.

Human wellbeing is a concept with complexity that is consisted of multiple elements and multiple ingredients, including the primary material conditions required for maintaining high-quality life, freedom and choice, health, good social relations as well as safety and security. The elements that constitute wellbeing are closely related with surrounding environment and can reflect the status of local geography, culture and ecology.<sup>16</sup> As a matter of fact, ecological environment increases human wellbeing through provision of supply, regulation, culture and support services, satisfying human needs for material, health and safety; in a sense, it is indispensable for human wellbeing (See Fig. 1.3). First of all, supply and regulation services have strong tie with the primary material conditions required for maintaining high-quality life by humans. For example, the food supplied by ecological environment is the material basis for human survival, raw material and energy material are the basic input for human production, while clean water resources are provided through like purification service. Secondly, human health also has strong tie with the supply, regulation and cultural services. For instance, the quality of food supplied by ecological environment directed decides human health status; regulation service can take effect on the dissemination of insect pests that transmit diseases and hence indirectly influence human health; while cultural service provides benefits in the recreation and spiritual life of humans and thus improves human health. Moreover, safety is also affected by supply service, regulation service and cultural service. Changes in supply service may affect provision of various materials, and, due to decrease of resources, may possibly lead to conflict; changes in regulation service will affect the laws, frequency and distribution of different types of natural disasters; differences of ecological environment itself may also cause differences in religious ritual or spiritual nature, which will influence the relationship among the different ethnic groups within the community. Thirdly, human social relationship is mainly affected by the changes in cultural service: it may affect the character related to human experience. Finally, freedom and choice are largely established on basis of the other elements of human wellbeing and therefore also affected by changes in ecological environment.

Ecological environment is nothing that never changes; there are many factors that may directly or indirectly cause changes in ecological environment, its systematic services and human wellbeing. Such natural or human factors which caused direct or indirect changes in the ecological environment system are referred to as driving force. Changes of ecological environment system services may be affected by multiple driving forces that have interactions in between; at the same time, the changes of ecological environment system services will show feedback effects on the driving forces.

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<sup>16</sup>Millennium Ecosystem Evaluation Project Team. *Ecosystem and Human Wellbeing: Evaluation Framework [M]*. Beijing: China Environmental Science Press, 2006: 11.

Driving forces can be classified into different types according to different criteria. According to the path by which various influencing factors take effect on ecological environment, they can be classified into direct driving force and indirect driving force. Direct driving force directly influence the course of ecological environment and is the physical, chemical and biological driving forces for changes in ecological environment and its services; we may identify and measure them by different accuracy. Direct driving forces include climate change, regional land utilization and land coverage change, species introduction or elimination, technological improvement and application, external input (such as fertilizer application, insect pest control, irrigation, etc.), various natural, physical and biological driving forces (such as volcanic mountain), harvest and resource consumption. Indirect driving forces have wider effects, often take effect by changing one or more direct driving forces; they are the different kinds of signals stimulating decision making process and thus their influence can be understood through how they affect the direct driving forces. Direct and indirect driving forces often produce synergistic effect. Indirect driving forces mainly include population driving force (such as population quantity, age and gender structure, educational level, spatial distribution), economic driving force (such as economic scale, structure of import and export), sociopolitical driving force (such as democratization, status of private social organization, mechanism for solving international frictions), cultural and religious driving force (such as choice of personal consumption concept), technological driving force (such as rate of investment in scientific research and development, rate of new technology adoption, status of development in biotechnology).

According to if the various factors could be under the direct control of decision makers, driving force can be classified into internal and external driving force. Decision makers may change internal driving forces, but they can't change external forces; therefore, internal driving forces are under the direct control of decision makers, but external driving forces are not under their control. Decision is generally made via three levels of organization: local level (such as certain farmland or standing forest), regional level (municipal, provincial and national) and global level. The same influencing factor may show changing controllability at different level and different timeframe.<sup>17</sup> Some of the influencing factors are exogenic and uncontrollable for decision makers at local level, but turn to be endogenic and controllable at regional level; for instance, national policies are uncontrollable for local government, but controllable for central government. Similarly, some other influencing factors are unchangeable and uncontrollable in short term, but changeable and controllable in the long term, such as technology, which can hardly achieve breakthroughs in short term but can be always changing from the long run. This book mainly addresses the driving forces at regional level. At this level, the internal driving forces of decision making generally include: various systems (such as property right system), service and commodities' price and market, technological innovation,

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<sup>17</sup> Millennium Ecosystem Evaluation Project Team. *Ecosystem and Human Wellbeing: Evaluation Framework* [M]. Beijing: China Environmental Science Press, 2006: 91.

different types of economic policies, etc. External driving forces include: changes in land utilization and land coverage pattern, climate change, fundamental science development, ecosystem features, etc.

There have been many causes for the declining of ecological environmental services, some of them are natural and others are human, with the latter as major cause, including economic growth, population change and excessive demand for services of ecological environment system due to personal choice. The limitation of technological level and various institutional flaws are the root cause of excessive demand for ecological environment system services. First, due to the limitation of technological level, people's understanding of natural laws is far from sufficient, which leads to formation of the outlook like unsustainable production and consumption; but technological limitation means, on one hand, low efficiency of resource utilization resulting in more resource service input to satisfy the same demand, and inadequate human ability to improve ecological environment system service, on the other. Secondly, system factor causes low efficiency of resource service allocation, which is another important reason for the declining of current ecological environment system services. Theoretically, perfect free market mechanism may guarantee the services for ecological environment system services. But the fact is not necessarily so. In fact, either there is no such market existing for certain ecological environment system services, or, although the market is there, allocation of the system services is biased due to market failure and policy failure.

Generally speaking, human intervention against natural system may enhance the gains from ecological environment by human society. With necessary supports like instrument, system, organization and technology and through sustainable good interaction with ecological environment, humans can improve the level of their own wellbeing. Among these, technological innovation and system insurance are the most rooted measures to build up the service ability of ecological environment. First, advancement in science and technology can make people better understand natural laws and better know the interaction between ecological environment and human economic society, and can help the formation of sustainable production and consumption concepts by humans. Secondly, technological innovation can increase the unit satisfaction efficiency of resource, minimize the resource consumption for each unit of human welfare and thus increase the supply ability of nature, which is favorable for sustainable utilization. Thirdly, technological innovation can improve the structure and functions of ecological environment, hence increase the supply ability of the system and promote sustainable development of both environment and economic harmony. System innovation is the ultimate guarantee for improving ecological environment for humans. Environmental service can improve human wellbeing and therefore environmental resources are valuable. Some of these services are traded in market and some are indirectly related to market, but many environmental resource services do not have a market due to their nature of externality and publicity or other causes, the so called market failure; together with the other two even more ultimate causes of incomplete property right system and government failure, environmental problems like environmental

resource abuse, exhaustion and pollution have thus occurred.<sup>18</sup> Therefore, to solve these problems requires government sector to correctly understand the publicity nature of environment, correctly assess the value of environmental resource, establish necessary system to promote internalization of external influence and implement correct policy to regulate people's behavior, so as to realize coordinated development of economy and environment.

#### 1.4 Hard Exploration in Global Environmental Protection

Since the advent of humankind, she has established an inalienable close tie with environment. As early as 5,000 years ago, especially after the start of human civilization, the area coverage by human colonization has been continually widened with the increase of population and progress of production technology, and environmental problems followed. Throughout the process of human development, the entire history is actually a process during which humankind kept fighting against and got adapted to environment. The Industrial Revolution of the UK occurred in the middle of eighteenth century indicates the coming of an industrial society era; when industrialization was providing the benefits of industrialized civilization and economic growth for humans, series of important environmental problems worsened in company with industrial globalization. From the Industrial Revolution in the eighteenth century to 1950, developed countries accounted for 95 % of CO<sub>2</sub> emission. During the 50 years from 1950 to 2000, emission by developed countries still took up 77 % of world total. Once indicated by the General Assembly of the United Nations, "The major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in industrialized countries." Especially after the 1940s when the unbalance between ecology and economy in fields like resource, energy and environment became increasingly out-standing, the issue of environmental protection began one of the biggest concerns of the public. Researches on environmental issues also broke the geographic restriction of nation or region, from catchwords to concrete course of action; certain organizations of developed countries even launched "strong initiatives" for global environmental protection. The representative ones include International Union for Conservation of Nature (IUCN) founded in Switzerland in 1948 devoted to influencing, encouraging and assisting social organizations of the world to protect the integrity and diversity of nature and to realize sustainable development of ecology; World Wildlife Fund (WWF) founded in 1961 that advocates protection of biodiversity, ensuring sustainable utilization of renewable natural resources and promoting reduction of pollution and waste-type consumption and that has now established connections in more than 100 countries and completed over 10,000 environmental protection projects; Club of Rome, the first social group established for the purpose of solving the ecological

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<sup>18</sup> XIAO Dai-ji, ZHENG Hui-yan, WU Pei-ying, QIAN Yu-lan, et al. A Cost-Benefit Analysis on Environmental Protection [M]. Taiwan: Junjie Publishing Co., Ltd., 2002: 13–15.



dilemma in April 1968, which, through release of series report like *The Limits to Growth* and *The Global 2000 Report* to the President, protested and criticized industrial revolution that had led to severe ecological consequences; Greenpeace International, established in 1971 in Canada with 43 branches in over 30 countries now, aiming at realization of a more green, peaceful and sustainable future and devoted to promoting government, corporation and the public to jointly seek solutions to environmental problems and protect earth environment and world peace through research, education and persuasion; and World Commission on Environment and Development (WCED), established by the UN in 1983 to counter the economic and social development consequences caused by deterioration of human environment and natural resources. In 1987, WCED submitted an initiative report *Our Common Future* to UN General Assembly and firstly put forward the concept of sustainable development. In addition to the above, there are Friends of the Earth founded in 1983, Global Environment Facility (GEF) launched in 1991 and International Environmental Protection Organization Association (IEPOA), all very influential advocator and implementer of environmental protection throughout the world and having made progressive contribution to the undertaking of global environmental protection.

We should also see, however, these organizations are mostly advocated or established by developed countries and initial participants are also developed countries; only at a later stage did developing countries and underdeveloped countries absorbed join in. But, standing on the moral highland of “Save the Homeland for Human Beings”, some developed countries attempted to become the leader of global environmental protection, control the “right to speak” and maintain the global supremacy of developed countries. In recent years, Western developed countries led by USA were unwilling to accept the bondage set by international climate “within the system” and tried again to control the voice in the issue of global environment change. With regard to issues concerning environmental protection rights and responsibilities, there are many divergences between developed countries and developing countries considering respective benefits. For instance, in all previous climate summits, developed countries and developing countries have always show divergence in key issues such as emission reduction goals, fund and technical support, and every round of negotiations has been very hard. Although the 17th contracting parties conference of the United Nations Framework Convention on Climate Change held in 2011 in Durban of South Africa reached an agreement on climate and emission reduction, details like its legal effect, quantization of emission reduction indicator and time span were not finally decided; there is still a long, long way to go to reach uniformly agreed global environmental protection action. Undoubtedly, such fighting about environmental issues is essentially fighting about benefits. In spite of the divergence and conflict within the group of developed countries, they have common benefits in how to maintain the wide gap between them and developing countries and how to restrict emerging great powers from rising. Therefore, only by mutual support and cooperation between all countries of the world with an eye to the tied common benefit in global environmental protection can the divergence be substantially removed and agreed actions be reached.

## **1.5 Enhancing Environmental Protection as a Common Understanding**

Wide spread of environmental problems beyond national border and globe-wide occurrence of environmental pollution have decided that the protection of environment is the common responsibility of the entire human beings, something not completed simply by the developed countries or individual organization; it requires full participation of the vast developing countries and underdeveloped countries to actively push the negotiations about international environment issues and carry out global collaboration. Since the 1960s, in order to strengthen environmental protection, series of environment conference have been held all over the world, which have approved series of environment declarations and environmental protection conventions and reached comprehensive common understanding. Among these, there are seven global environment conferences of significance deserve focal attention: (1) United Nations Conference on Human Environment held in 1972 in Stockholm of Sweden, which passed Declaration of United Nations Conference on Human Environment, for the first time put the issue of global environment before the world and determined the “top-down” global environment governance pattern of inter-national cooperation and coordinated actions inside and outside the UN system. (2) United Nations Conference on Environment and Development held in 1992 in Rio de Janeiro of Brazil, which reached world’s first international covenant regarding the issue of climate change for the purpose of overall control of emission of greenhouse gases like CO<sub>2</sub> and combating the adverse effects on human economy and society due to global warming – United Nations Framework Convention on Climate Change, and produced three documents of principle, including Rio Declaration on Environment and Development, Agenda 21 and Statement of Forest Principles. (3) The World Summit on Sustainable Development held in 2002 in Johannesburg of South Africa, which released the Johannesburg Declaration on Sustainable Development and Plan of Implementation of the World Summit on Sustainable Development. (4) Bali Climate Change Conference 2007, which approved Bali Roadmap, initiated the negotiation process for strengthening full implementation of the Convention and Kyoto Protocol, and hammered at completing the first commitment period of Kyoto Protocol by the end of 2009 and the negotiations about new arrangement against global climate change in 2012 when the Protocol expires. (5) Copenhagen Climate Change Conference 2009, which reached the Copenhagen Agreement that maintained the principle of common but different responsibility established in the United Nations Framework Convention on Climate Change and Kyoto Protocol, made arrangement regarding compulsory emission reduction by developed countries and voluntary mitigation by developing countries, and reached wide common understanding on focal issues like global environment long-term objectives, fund and technical support and transparency. (6) Durban Climate Change Conference 2011, which established the Ad Hoc Working Group on the Durban Platform for Enhanced Action, decided implementation of the second commitment period of Kyoto Protocol and launched framework cooperation agreement like

Green Climate Fund. (7) Rio +20 Earth Summit held in 2012 in Rio de Janeiro of Brazil, which proposed system framework for promotion of sustainable development and concrete ways to realize it.

We could see that after years of hard negotiations and efforts of all countries, the world has reached a common understanding with respect to global environmental protection: social progress and economic development must be in coordination with environmental protection and ecological equilibrium, to improve the standard and quality of living for humans and promote the prosperity and thriving of entire human society must be accomplished through global sustainable development. The existence of global environmental problems has their historical background and also the reason of flaws in international system; a responsible attitude is not to blame each other, but to positively cooperate with joint efforts. Therefore, to solve issues like global ecological environment destruction and climate warming up, governments must show wisdom and bravery to shatter the narrow concept bondage of national interests and work towards international cooperation, collective security, common benefit and rational negotiation. Only through mutual efforts of international community can the sustainable development objectives be realized with harmony between economic development on one side and population, resource and environment on the other. Global climate change, perhaps, will provide great prospect for strengthened cooperation and mutual benefits for the entire international community, though it also brings about potential crisis.

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