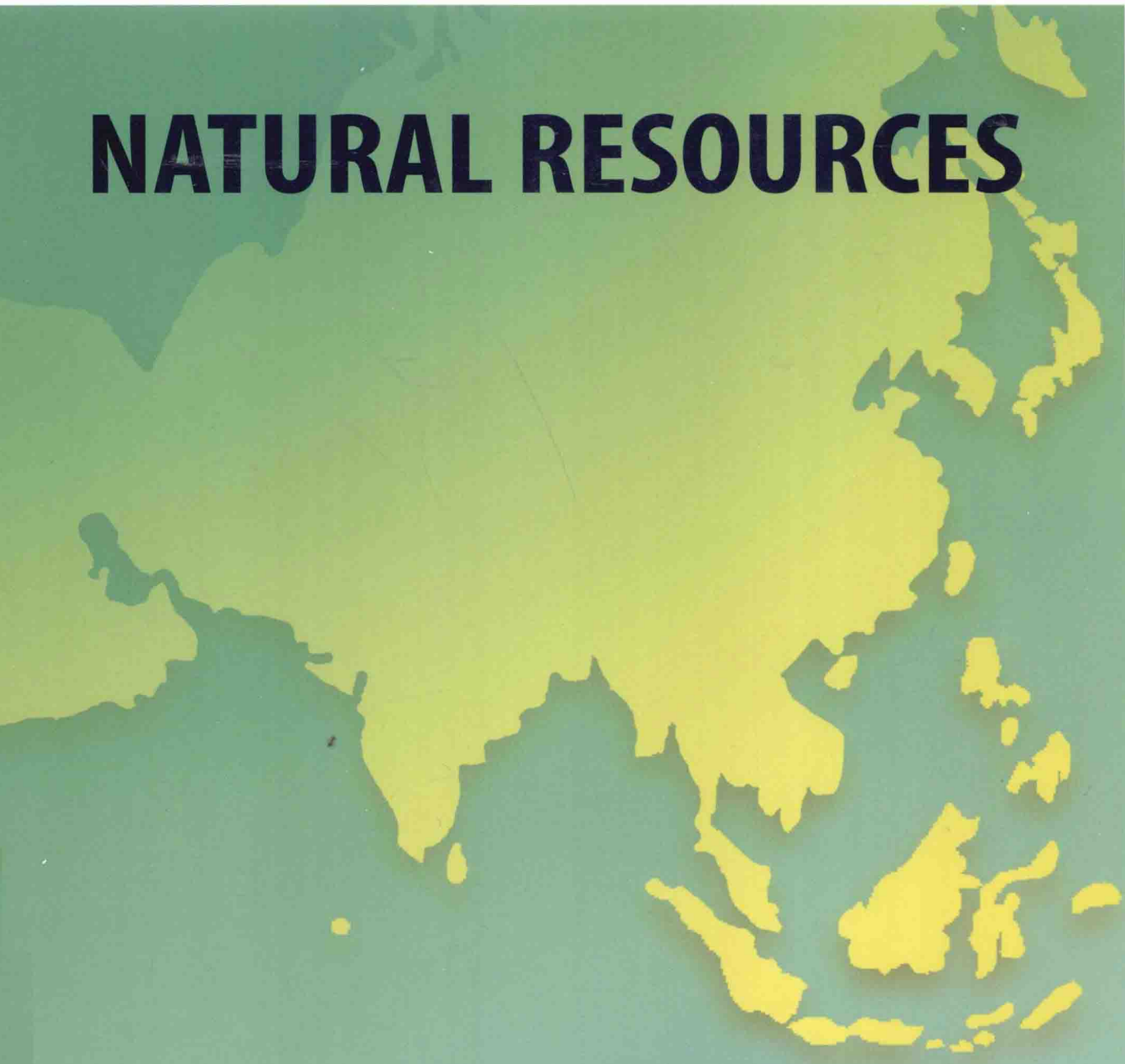
The Association of Academies of Sciences in Asia (AASA)

TOWARDS A SUSTAINABLE ASIA

NATURAL RESOURCES



Science Press
Beijing

Springer

The Association of Academies of Sciences in Asia (AASA)

TOWARDS A SUSTAINABLE ASIA: NATURAL RESOURCES

With 27 figures

Science Press
Beijing

Springer

Author

The Association of Academies of Sciences in Asia (AASA)

KAST Building, 7-1, Gumi-Dong
Bundang-Gu
Seongnam-Shi
Gyunggi-Do, 463-808
Republic of Korea
E-mail: aasa@kast.or.kr

ISBN 978-7-03-028996-4
Science Press Beijing

ISBN 978-3-642-16677-8 e-ISBN 978-3-642-16678-5
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2010937229

Cover design: Huabin Huang

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Not for sale outside the Mainland of China (Not for sale in Hong Kong SAR, Macau SAR, and Taiwan, and all countries, except the Mainland of China)

Foreword

Asia is not only the largest and most populated continent in the world, but also the region with the most diverse development models and most dynamic economies. In the past half century, Asia has been witnessing rapid economic growth and playing an increasingly more important role in world's political and economic arena. At the same time, Asia has developed the commonly-called "Asia Model", which has attracted worldwide attention. The Asia Model shows a new way for the developing nations or late-development countries on how to realize industrialization and modernization. All these achievements are made by Asian countries with a focus on the advantages of their late development, re-examination of their internal cultural values, active absorption of modern S&T and management experiences and constant exploration and innovation.

These social progresses have made great contributions to the realization of the UN Millennium Development Goals and have played a pioneering and demonstration role on what can be accomplished in today's world. However, Asia is facing big challenges. The most prominent one is that the rapid development of Asian economies is based on large input of production factors at the huge expense of natural resources and environment, which has been sharpening the conflicts in population, resources, environment, socio-economic development. The sustainable development in the region is being severely threatened and challenged. The rethinking and questioning of the Asia Model in the international community is growing especially in the era of post Asia Financial Crisis and Global Financial Crisis.

It is not only a common challenge for the governments of Asian countries, but also a common task for the Asian scientific communities to cope with the resources and environment crisis and to seek a new way of sustainable development in Asia. AASA, as a non-governmental and regional international scientific organization with 26 member academies, is mandated to initiate and conduct investigation on issues concerning S&T, economic and social development. As early as April 2007, AASA proposed to initiate a project on "Sustainable Development in Asia" (SDA) within AASA framework in the hopes to provide consultation and advice for national and regional governments in Asia and relative international organizations. This study proposal was approved at AASA board meeting held in Russia in August 2007 with the Chinese Academy of Sciences as the initiator. The project covers environment, energy,

resources and culture with the establishment of four working groups among AASA member academies.

Soon after, the SDA project was officially launched and implemented at different levels. The efforts include the clarification of the research content, emphasis, structure and division of tasks. Various meetings at the working level and international workshops have been held to coordinate the research activities and project progress: the first international workshop under this project was held in February 2008; the AASA Workshop on Sustainable Energy Development in Asia in November 2008; the AASA Workshop on Agricultural Culture and Asian Sustainable Development in August 2009; and the AASA Workshop on Environment and Resources in September 2009.

With the joint efforts of AASA member academies, the SDA project has now come up with a series of studies including four thematic reports, namely, "Towards a Sustainable Asia: Energy", "Towards a Sustainable Asia: Environment and Climate Change", "Towards a Sustainable Asia: Natural Resources", and "Towards a Sustainable Asia: The Cultural Perspectives" . Based on these four reports, a synthesis report has also been written entitled: "Toward a Sustainable Asia: Green Transition and Innovation". All these reports have looked deeply into the common issues and challenges for the Asian sustainable development from different perspectives.

The synthesis report is an integration and extension of the four thematic reports. It aims at the major resource and environmental challenges and issues in Asia in the general context of the challenges of financial crisis and climate change, and in line with green transition and innovation in Asia. Of its major findings, it includes: the diagnosis of key resource and environmental issues in Asia, such as water, minerals, land resource, environmental pollution, eco-degradation, energy and environment and climate change, the revelation and reflection of the diverse, different, complicated and severe nature of resource and environmental issues in Asia, the systematic analysis of the main driving forces and future trends of resource and environmental changes in Asia, the empirical analysis and discretion of current evolution of the relationship between environment and development in Asia with the establishment of theoretical and conceptual models, the initiation of principals, strategic framework, focus and advice for promoting the green development of Asia on the basis of summarizing Asia's advantages and disadvantages.

The synthesis report differs from other similar reports. It focuses more on the combination of theoretical and empirical research in the evolution of environment and development, on the combination of trends analysis in time series and comparative study at spatial scale, and on the combination of Asia's integrated analysis and regional and national differences. Besides, attempts have been made here on the innovative modeling of the evolutionary and theoretical relationship between environment and development, analysis of the driving

forces in environmental evolution, and utilization of newly developed composite index to conduct empirical research of Asia's environment and development relation in the evolution.

We hope the reports will be of good value to the facilitation of the green development in Asia, providing advice on dealing with the shortage of conventional resources, environment pollution and climate change, fostering new economic growth and enhancing Asia's competitive advantages. This is the first time that AASA has ever undertaken such a study, and it surely leaves grounds for more detailed study and analysis of various issues and challenges that Asian countries face in the future.

The SDA project is sponsored by AASA. I want to give my special thanks to all AASA member academies for their consistent support, advice and assistance, without which, the accomplishment of such an internationally interdisciplinary scientific project would be impossible. My thanks also go to all the members in the working groups, especially Professors Namık Aras and Yi Wang, co-chairs of this study, without whom, efficiency and quality of the study would not be guaranteed. I also need to thank United Nations Environment Programme (UNEP), InterAcademy Council (IAC) and InterAcademy Panel (IAP) etc. for providing us the references and various advice and inspirations. Last but not the least, I want to express my thanks to all friends and the institutions that have rendered us encouragement and assistance all the way along.

The SDA project features with a wide range of fields and a huge amount of data, some of which are still in their early stage of development. Any comments or suggestions from our friends and various international institutions are warmly appreciated.

Prof. Jinghai Li

President

The Association of Academies of Sciences in Asia (AASA)

September 20, 2010

Preface

Asia is an important continent with population of 3.8 billion and concentrates most developing countries in the world. Over the last several decades, many nations in Asia have seen quick economic development, while some strategic resources needs in Asia increase simultaneously. In the next 20 years and even long terms of the 21st century natural resources demand in Asia will increase largely. Asia occupies the important position of the resources supply and demand in the world. It has not only some key resources producing countries in the world, but main resources consuming countries as well. Unfortunately, Asian economic progress in general has been achieved at a high cost. Under combined pressure of climatic change and human disturbances, the natural environment in Asia has been steadily degrading, which compromises the future development and the livelihood of its huge residents. Impacts of climate change are especially visible in Asia on various sectors including agriculture, forestry, biodiversity conservation, water resources, human health, air quality, energy security, and others. Climate change related environmental deteriorations in Asia are already serious, and will very likely further worsen in future which is continuously challenging the sustainability of natural resources.

In 2008 the Association of Academies of Sciences in Asia (AASA) initiated a project of "Sustainable Development in Asia" which includes four research groups of energy, natural resources, environment and culture. In regard to the task of natural resources, it is required to take grasp of the status of natural resources in Asia, identify some common problems and challenges, summarize successful efforts that some countries in Asia have made, and propose several major projects and policy recommendations for sustainable use of natural resources in Asia.

To implement this task appointed by the whole project framework, we carried out large amounts of desk survey of literature review, data and information production, translation and dissemination of case studies that documented some so-called "best practices and models" of effective and sustainable use of resources in each country of Asia. A final policy report has been created and circulated among some limited scholar community.

This book is completed based on the final report of the sub-project entitled as "Sustainable Use of Natural Resources in Asia" under the whole

project of AASA. This sub-project aims to bring together a wide range of experts and scholars involved in development and management of natural resources in Asia, within the context of sustainable use of natural resources and effective improvement of resources use. We consider that there is a good opportunity of cooperation on the sustainable use and management of natural resources in Asia. Strengthening the cooperation is a demand for resources safety and environmental sustainability that guarantees Asian environmental health and promotes socio-economic development in all countries of Asia.

During 2008 and 2009 two workshops were organized in Beijing and Izmir. The first workshop was held on February 25-26 2008 in Beijing of China and devoted to the whole project, including four groups of energy, environment, natural resources, social development and culture, 27 experts from 10 countries attended. On September 24-27 2009 the second workshop in particular regard to "Environment and Resources in Asia" was held in Izmir of Turkey and aimed to highlight on interactions among these two major issues of environment and natural resources in the context of sustainable development in Asia, where 34 representatives from 10 AASA member countries and one observer contributed to the discussions.

At the first workshop, Prof. Dr. Lei Shen and Prof. Christopher C. Bernido as the group leaders hosted the discussion and Prof. Dr. Cahit Helvaci, Prof. Nikolay P. Pokhilenko, Prof. Yi Wang, Prof. Gaohuan Liu, Dr. Luguang Jiang, Dr. Zengrang Xu, and Dr. Tao Dai also joined the workshop. We concluded that the research on natural resources and sustainability should focus on issues relating to land, water, mineral resources and biodiversity and their common challenges and diversified features were also identified. We acknowledged that the following perspective issues, tendency, needs and problems should be included in the context of natural resources. First, database establishment and data sharing in AASA should be priority action to be carried out. Second, natural resource assessment, exploration and mapping are needed to cooperate among all countries of AASA. Third, future consumption and demand based on population profile (structure, growth rate, education, and employment) should be estimated. Fourth, active cooperation on natural resource management within AASA is encouraged. We also identified some basic opportunities for the role of science and technology, pilot projects are recommended to be implemented, including education and training of young generation, community participation capacity building, and improvement of research and technology innovation in natural resource exploration and development. We recommended that a science foundation in AASA be established and supported by member countries. AASA should establish a database of natural resources for all countries in Asia and select urgent problems within member countries and find some solutions to work out.

The second workshop, Prof. Gensuo Jia, Prof. Lei Shen, Prof. Cahit Helvacı, Dr. Alper Baba and Prof. Namık Aras as co-chairs, was organized by AASA and Turkish Academy of Sciences (TUBA), hosted by Turkish Academy of Sciences and Dokuz Eylul University (DEU), sponsored financially by Inter Academy Panel (IAP), Inter Academy Council (IAC), TUBA, AASA, Dokuz Eylul University (DEU), the Graduate School of Natural and Applied Sciences (DEU – FBE), Izmir Institute of Technology (IYTE) and Turkish Chamber of Geological Engineering (JMO). Participants shared information about resources situation, discussed interlinks with the environmental issues in their own country, and addressed the common challenges in Asia. Recommendations were also made on how to prepare a consultative report on sustainable use of natural resources in Asia. Some academic articles and viewpoints of attendees were presented in its conference proceeding and final suggestion report. The experts emphasized the following points in terms of resources use in Asia:

First, resource efficiency is cross-cutting and applicable to the use of all resources. Therefore it needs to be investigated in all resources contexts. Second, water availability with appropriate quality and water use efficiency in the region are among the key issues in Asia and should be given high attention. Third, impact of climate change on agricultural resources development and food security should be given high priority. Strong support should be given to research in genetic engineering to increase the production of rice, wheat and corn; as well as control of erosion and natural hazards should be paid urgent attention to be controlled. Fourth, coal mining and its consumption is one of the core issues that concern the natural resources management, environmental quality, and climate change. Problem-solving oriented projects should be promoted and cooperation between member countries should be supported. Fifth, about 60% of the coastal areas of the world are in Asia-Pacific region. Coastal resources, however, have not been effectively developed. Sixth, establishment of technology and information-sharing platform and mechanism would contribute to the advancement of the collaboration and sustainable development in resources utilization in Asia. Last but not least, resources and environment are linked on the basis of all types of ecosystems. Biodiversity conservation is not only very important for the sustainable development of Asia but can also contribute a lot for our world.

Except two workshops mentioned above, we have undertaken a large amount of literature reviews and data analysis. These works are mainly attributed to some of my colleagues, doctoral and post doctoral students, including Profs. Jiyuan Liu, Gaohuan Liu and Zhijun Yao, Dr. Yao Lv, Ms. Litao Liu, Mr. Tao Dai, Mr. Hongqiang Li, Ms. Yang Zhao and Ms. Lan Fang.

Since Asia is undergoing a dynamic transition process, this book is inevitable to be imperfect due to the limitation of knowledge and time of the

research group. We acknowledge that some major references might be omitted and forgotten but any comments and corrections are warmly welcomed.

Study Group on Natural Resources

August 2010

Executive Summary

Under current trends of economic globalization and regional economic integration, as well as increasing urbanization and industrialization, Asia's natural resources landscape has changed dramatically. The protection, development, processing and consumption of natural resources, and the socio-economic and environmental issues associated with them have aroused great concern of countries in Asia and the world. Over-exploitation and over-consumption of some natural resources, and the resulting environmental damage, social instability, single economic structure, are all facts that cannot be ignored. These require us to better understand the status of various natural resources in Asia, its existing problems, sustainability, and measures which might be taken by some countries in the region.

This book attempts to systematically analyze the status of natural resources in some major Asian countries, identify some common problems and challenges, summarize successful efforts that some countries in Asia have made, and propose several pilot projects and policy recommendations for sustainable use of natural resources in Asia.

The book is drawn from the major research report of "Sustainable Use of Natural Resources in Asia", the sub-project of "Sustainable Development in Asia", which is a consultancy project of the Association of Academies of Sciences in Asia (AASA). The book covers 48 countries in Asia (excluding Pacific region). For better analysis and discussion, we divide Asia into 5 sub-regions, namely, Northeast Asia, South Asia, Southeast Asia, Central Asia and West Asia. The major points and core contents of the book are drawn as follows:

1. Asia is in shortage of fresh water and land resources, and rich in mineral resources with very low utilization efficiency, in additon, biodiversity conservation is subject to many shocks

In this book, study on status and trend of resources use in Asia is mainly based on four aspects of natural resources, that is, water, land, minerals and biodiversity.

One of the major challenges facing Asia is the shortage of freshwater resource. Asian water resource pressure is mainly caused by extraction of surface water and underground water, pollution of freshwater resource made by industrial development, and inefficient utilization of water

resource. Spatial and sector differences are significant in water resource distribution and allocation, average annual fresh water consumption of the South Asia and Northeast Asia accounts for 75% of the total, while agriculture is the largest sector of water consumption. The reverse relationship between water consumption and economic development in Asia is noteworthy.

Nearly 65% of the world's population is raised by less than 25% of the world's land in Asia. Land use in Asia can be divided into three parts: agricultural land, woodland and the other, of which the largest share is agricultural land, accounting for more than 50%; minimum share is woodland, accounting for 19%; and other use of land is just 30%. Agricultural land mainly consists of arable land, perennial crops, grass and pasture. Spatial variation is distinct in agricultural land. Nearly half of agricultural land comes from the Northeast Asia, followed by that of South and Central Asia, and Southeast Asia has the smallest agricultural land. Cereals crop production is dominated in harvested area in Asia, the past 50 years saw the biggest change amplitude. Since 1961, cereals production in Asia has grown rapidly but could not fully meet the consumer demand yet, with the growing gap between supply and demand and the rise of external dependence.

Mineral resources of Asia take an important position in the world. Asian non-ferrous metals and precious metals reserves account for 25%-50% of the world's total; ferrous metal such as manganese, chromites reserves are more than or close to 50% of the world's total reserves; and there are some sylvite resources reserves in non-metallic mineral resources. Countries in Asia can be divided into three categories in this book based on their different proportions of mining economics, namely, pillar mining countries (the share of mining economic output in total GDP is more than 10%), mineral-driven countries (the share between 1%-10%), mining auxiliary countries (the proportion <1%). Strong growth trend in mineral production and consumption is also an important feature of Asia's mineral resources.

Biodiversity conservation is subject to various shocks. Due to the rapid changes in land use, rich irrigation water with poor management, overloading utilization of mountain resources and rare species resources, blindly construction of water facilities, and fuel-wood harvesting have been serious threats to biodiversity and ecosystem services in Asia. 50% of the left mangrove resources in the world are scattered in Asia (including the Pacific Region, Australia and New Zealand), but these resources are severely damaged by industrial development and infrastructure constructions. 60% of coral reefs are at risk because of exploitation and destructive fishing. In addition, as a result of water shortage, increasing demand for agricultural land and accelerated development of urbanization, the forest area in West Asia is under considerable pressure and the quality degradation occurred in a large forest area of West Asia in recent years.

2. Problems and challenges coexist for sustainable use of natural resources in Asia

Resources use in Asia is faced with many problems and challenges in fresh water, land, mineral resources and biodiversity. At present, the major issues of resources use in Asia include: first, the shortage and declining quality of fresh water resource; second, food security threatened by desertification and degradation of land resources and ecosystem in Asia, in which China and Mongolia are particularly serious in land degradation and desertification; third, biodiversity loss of mountain and marine regions; fourth, inefficient use of mineral resources. The consumption elasticity per ton of steel and non-ferrous metals in Asia are both more than 1, in which the use efficiency and the rate of recovery of mineral resources in Asia are far lower than that in the developed countries, and even worse than that in Africa.

It is clear that future sustainable development in Asia would face more difficult challenges in natural resource management. On the one hand, countries in Asia should effectively protect precious natural resources and environment, on the other hand, the majority of countries in Asia are relying on the limited natural resources to eradicate poverty and improve living standards. There are constraints to the above-mentioned challenges at both domestic level and sub-regional level. The major challenges come from: first, high dependence on natural resources, which has become a serious constraint on economic and social development; second, lack of funds and technology deprivation, which is serious impeding efficient and sustainable resources use; third, lack of public awareness in sustainable resources use; and fourth, resource management capacity building and sub-regional resource development cooperation should be strengthened.

3. There are some successful experiences towards sustainable resources use in Asia

Despite many problems still existing in the current sustainable use of natural resources in Asia, it is worth noting that, in order to solve these problems or mitigate the negative impact, some countries in Asia have accumulated a lot of successful experiences as well as lessons in resources use. In this regard, five typical cases are identified in this book: First, taking China and West Asia as typical regions, water resource model on demand side management is introduced; their layer use pattern of arid desert land is a particular pattern for better land use. The achievement of Keerqin Prefecture, which is in China's Inner Mongolia, is worth learning. Second, the mulberry-embankment fishpond, the three-dimensional comprehensive development model of agriculture, forestry and fisheries, in southern China has been proven to be an effective multi-level model of comprehensive use of resources. Third, comprehensive utilization and recycling mode of mineral resources is one of

the recommended use types, which was applied at Baiyun'ebo, Dexing and Panzhihua deposits in China and played an important exemplary and leading role. Fourth, in regard to the quantitative use of biological resources, the total allowable catch (TAC) in management of fisheries resources in Japan is specifically introduced in this book.

4. Asia could achieve sustainable resources use through conservation policies, technology and management innovations, and capacity-building

This book argues that Asia could realize its sustainable use of natural resources by ways of five aspects of policy recommendations below:

First, regional policies of resource conservation in countries and regions of Asia should be encouraged. The resources use and economic development of countries in Asia have many advantages, including associating interaction, complement and gradient development. Therefore, a mutually beneficial system for regional resources cooperative development and security can be established on the complementary characteristics of geographical, market, financial strengths, which can be expanded gradually into areas such as water resource, land degradation and desertification.

Second, policies of technology sharing and transfer in resource development and utilization should be placed onto the highest priority. The formation and perfection of policies of technology sharing and transfer can be achieved by the establishment of information-sharing website on resource development and use in Asia. The establishment of organizations would focus on resource development and use, and technology transfer and promotion, carry out academic exchanges, and improve the resources development and use, technology sharing and transfer policy.

Third, policies of cross-border resources use and management should be highlighted. Spatial dislocation in resource distribution, production and consumption bring the cross-border resources development and use of essential sense. The resources development and use should take strategy such as "go outside and bring in", in which financial, tax and fiscal policies should be established to service the "going out" resource development strategy, and the joint venture mechanism for overseas geological survey and exploration should be strengthened to reduce the risk. Some preferential policies for investment, taxation, import and export should be set up and a sound service system should be helpful for the cross-border resources use.

Fourth, establishment of technology and information-sharing platform and mechanism would contribute to the advancement of the collaboration and sustainable development in resources utilization in Asia. The establishment of the Asia resources technology sharing networks and domestic resources technology communication mechanism may facilitate this development.

Fifth, capacity-building for sustainable resource consumption should be highlighted. On the one hand, the concept of consumer savings need further

promotion; on the other hand, the sustainable consumption of resources should be carried out over the whole Asia.

5. Priorities for future implementation of resource sustainability projects should be placed on the agenda of action in Asian countries

This book aims to propose some operational major projects. To this end, we brings up five major project proposals in the fields of land degradation, urban sewage treatment, tourism resource development, biodiversity conservation, small and medium-scales of city wastewater treatments and local capacity-building.

First, monitoring and assessment of technology development could be implemented in the fields of land degradation and desertification in Asia. Through this project, land degradation and desertification monitoring in various countries and regions in Asia can be monitored and evaluated, some financing mechanisms and institutional building can be improved, a united action programs of countries and regions in Asia combating land degradation and desertification can be promoted, and the collaborative mechanism between domestic and regional action programs can be established.

Second, technology development could be realized at cost of return wastewater treatment plants in small and medium-scales of cities. In this project, we recommend that small and medium-scales of municipal wastewater treatment plants could be introduced by cost recovery mechanisms, together with sewage and sewage recycling system, taking some sub-regional cities as pilot targets followed by a promotion.

Third, capacity-building could be carried out in sustainable tourism development and biodiversity conservation. Sustainable tourism resources development and biodiversity conservation building would be promoted by eco-tourism, combined with biodiversity survey, feasibility of the evaluation of eco-tourism, scenic spots' tourism planning and construction, scenic spots' dynamic environmental monitoring, tracking evaluation of biological diversity and so on.

Fourth, technology development and demonstration could be tested in the fields of resources recycling and land reclamation in small and medium-sized mines. This book takes Guiyang of China as a typical area, analyzing its resource recycling system model based on phosphorus chemical system, the coal chemical industry system, chlor-alkali industry system, thermal power construction and by-product system, with a view to carrying out follow-up project as reference.

Finally, local capacity-building could be enhanced in resource development and use. Four aspects should be improved, that is, human capital development projects, social capital development projects, capital system development projects, and economic capital development projects.

Contents