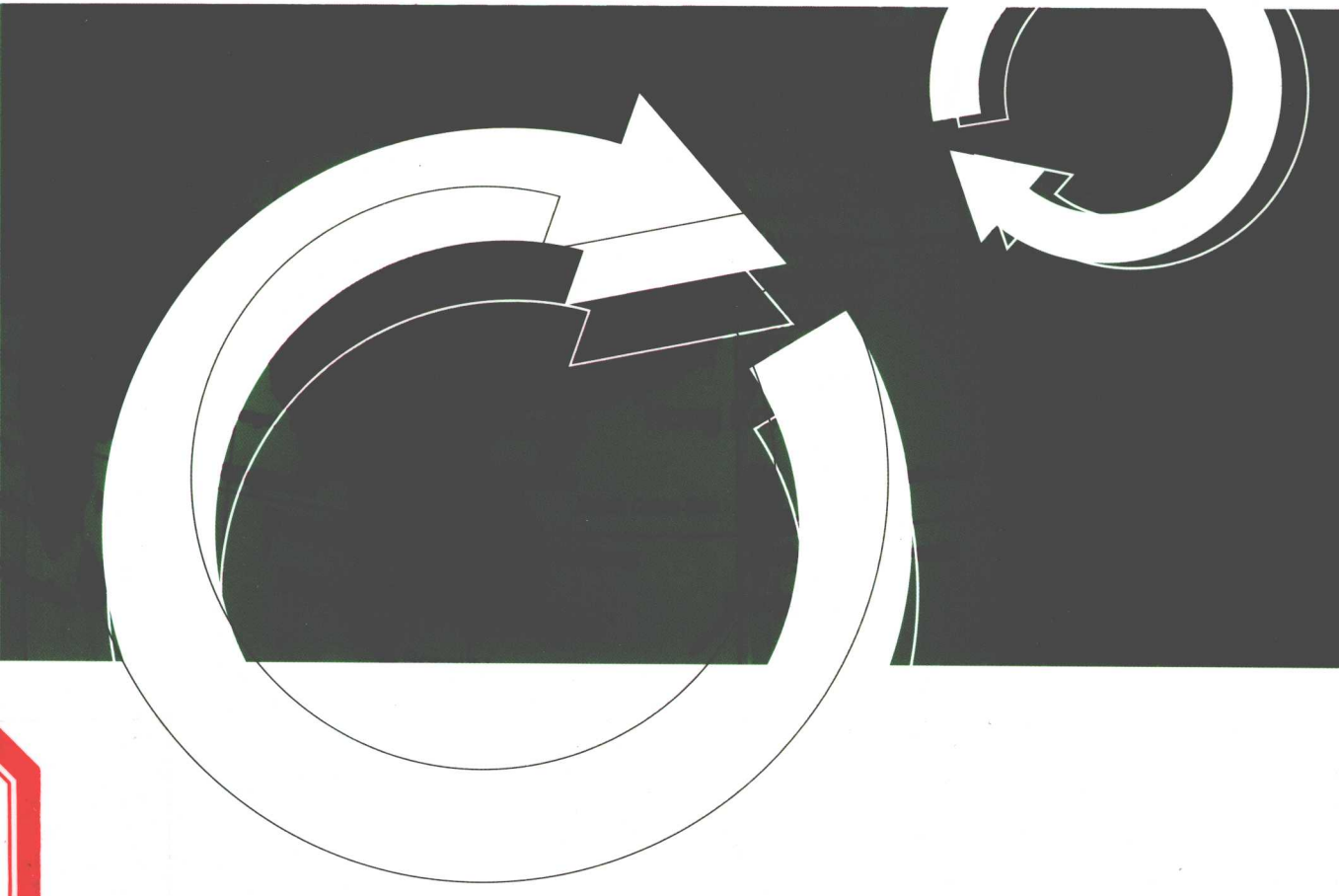
百国考察廿省实践生态修复
——兼论生态工业园建设

A 100-Country Field Study & 20-Province Pilot Projects on Ecological Restoration

—— The theory of the construction of eco-industrial park

吴季松 著



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内 容 简 介

本书是一本综合作者30年全球生态考察工作的专著，主要介绍了生态系统及其修复的理论；在全球百国生态考察中，记述了作者1979—2009年整整30年间对100个国家和地区的主要河流、湖泊、湿地、森林、草原和海岛的考察和研究，也记述了对人类改变自然生态系统的大型电站、水库和供水工程及水资源利用管理体制的考察和研究。作为全国水资源管理的最高负责人，作者于6年半的时间内在黑龙江、内蒙古、河北、山西、北京、新疆、青海、甘肃、陕西、宁夏、河南、山东、上海、江苏、浙江、四川、云南、广西、广东、海南和香港共21个省市区主持和参与了恢复断流、恢复湿地、保住绿洲、保护水源、治理污染、生态系统修复和保证水资源供需平衡的规划、实施和监督工作，创建新的管理体制——水务局；指导生态系统修复的新机制——生态工业园的建立。

本书集理念、调查、研究和实践于一体，追求理论的科学性和创新，尤为强调的是理论的系统性和逻辑性；几乎全部实例都是作者本人亲眼所见，亲历亲为。

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前　言

70年前，当作者的父亲吴恩裕教授(1909—1979)于1939年在发表的文章中使用“生态”一词时，不用说在中国知道“生态”的人寥寥无几，就是在世界上也为数极少。而今天，“生态”已经是当今世人耳熟能详的一个时髦词语，生态文明已经成为人类的共识，人与自然和谐已经成为我们的国策。生态的科学术语是“自然生态系统”。

现在大家都说要维系“生态平衡”，但是今天这个动态平衡的生态系统是什么时间形成的呢？史前有彗星撞击和冰河期等大扰动，尽管在彗星撞击以后和冰河期期间地球生态系统也达到了动平衡，但那不是今天人类生存的生态系统。据2008年发掘出12 900年前金刚石的最新科学研究表明，12 900年前在北美洲地球遭到了迄今为止最后一次彗星大撞击，这场突如其来的变化彻底改变了北美洲大陆。一支繁荣的史前美洲文化即克洛维斯人一夜之间消失了，陆续消失的还有大型动物马、骆驼、狮子、猛犸、乳齿象、剑齿虎和巨型犰狳，所以在哥伦布到达之前，美洲大陆是没有马的。撞击之后，地球部分地区重新回归冰川状态长达1 500年之久。

此后，也就是12 000年来地球生态系统再没有发生如此巨大的突变，所以说我们今天生活的这个地球生态系统定型于12 000年前，虽然经历了大地震、火山爆发、山体滑坡、大海啸、大洪水泛滥和大面积持续干旱等无数次各种自然小突变，但仍在系统自修复能力之内，整个系统得以恢复平衡，没有变成一个新的自然生态系统，这也就是人类能够生存发展到今天的最重要原因之一。同时，这也是至今世界各国有实物证据的连续文明史都以万年为上限的原因。所以，在经过人类活动万年、尤其是近200年的破坏后，我们生态修复的目标，也是尽可能地恢复这个生态系统。

究竟什么是生态系统呢？人类如何与之和谐呢？人类的不文明行为破坏了生态系统，它又如何修复呢？这些都没有确切的答案，因为生态学还是一门不成熟的科学，对生态系统的研究还没有共识的计量方法。所以如何发展生态系统学，目前在国际研究界都是正在探讨的巨大难题，以下仅简述本人的看法。

(1) 自然生态系统属非平衡态复杂巨系统

依钱学森院士的观点，非平衡态复杂巨系统属于数学模型无法科学地建立，且目前的计算机无法在容量和速度上满足模拟运算要求的系统。因此，目前的一些自然生态系统的数学模型，正如在美国造成次贷危机的金融衍生产品的数学模型一样，是不科学的。现在经济学界评论金融衍生品为“过分的”，从科学角度来讲只有是否正确的问题，没有“过分”与否的问题，倒是一些诺贝尔奖获得者敢于直言，称之为“欺骗”；美国新任总统奥巴马斥之为“可耻”。为生态系统建立模型方面也有类似的情况，目前不少一流的自然生态系统的数学模型从数学上看都是有错误的，因此是不科学的；而且，只是为了各种需要做做而已，也不打算去实施。如果实施，恐怕不只是浪费投入的问题，还会破坏现有生态系统。这些都应该由谁负责呢？应该参

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照包括我国领导人在内的国际政界对解决金融危机的观点。美国曾经在20世纪90年代按模型投巨资建造了一个人工生态系统，以失败告终，从此再不实施。所以关于生态系统修复的真正的科学研究就显得尤为必要。

（2）生态系统不是不可知的

生态系统就在每一个人身边，所以，人们是可以认识的。如何科学分析呢？一是依据已有监测数据作序列延长的统计分析，二是以科学的观点实地考察，三是以国际较好的同类生态系统作为修复的重要参照，四是努力建立符合实际的、科学的模型，而且只能作为参考。在国际上对自然生态系统的监测始于20世纪20年代，在我国始于20世纪50年代，序列太短，难以做准确的外延，因此实地考察是最为重要的。

作者在担任全国节水办公室常务副主任兼水利部水资源司司长时主持制订的《21世纪初期首都水资源可持续利用规划(2001—2005)》、《塔里木河流域综合治理规划》、《黑河流域近期综合治理规划》和《黄河重新分水方案》得到了相关院士的高度评价，被朱镕基总理批示为“一曲绿色的颂歌”，温家宝总理说“以水资源可持续利用保障可持续发展这句话讲得好”，现已成为水利工作的总方针，温总理还说吴季松主任提出“生态水”是提出了新概念。而制订这些规划的指导思想就是要以实地调查和国际比较作为规划的基础。

（3）生态系统只能修复，而无法人工创造

如前所述，书中还要详细说明，美国的尝试已失败，而且这已经是国际生态学界的共识。通过循环经济和知识经济可以使人类经济发展与自然生态系统协调，也已经是世界的共识。但是，我们要通过循环经济把自然生态系统修复到什么程度？这是最重要的问题。因为，地球上现在住了68亿人，要恢复到史前是不可能的，而且也没有必要。同时大小不同程度的恢复都要巨大的经济投入，而现有资料又不能反映生态系统大规模破坏以前的情况，如何才能使投入不付诸东流呢？解决这个问题的唯一科学方法就是考察世界上同类型、而破坏较小或恢复较好的自然生态系统，以此为标准，做力所能及、有实效的适宜修复。

鉴于以上情况，作者用30年时间做了一项全球生态考察的工作。

作为改革开放后第一批出国访问学者，作者早在1979年就与联合国教科文组织(UNESCO)接触，是最早把“可持续发展”、“科学研究三分类”、“科技园区”、“知识经济”、“互联网”(时称“信息高速公路”)和“循环经济”的系统概念引入国内的学者(见书后参考文献)。此后，作者又任中国常驻联合国教科文代表团参赞(对外副代表)、联合国教科文组织科技部门高技术与环境顾问，借此便利条件，开始了世界少见的、由同一学者所做的全球生态考察。

至今这项工作已进行了整整30年，作者考察了6大洲100个国家和地区，包括世界国内生产总值、人口和土地前10名的国家。其中在法国住了6年、瑞典1年，日本和德国前后去过8次，英国和意大利去过5次，美国、俄罗斯和澳大利亚去过3次，印度、巴西、墨西哥、哈萨克斯坦和印度尼西亚都去过2次，南非和沙特阿拉伯去

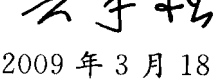
过1次，写了一套20本的《看世界》系列书，共400万字。

考察过世界前8大河中除俄罗斯勒拿河外的7条，其中，尼罗河、长江、黄河和湄公河都做了全流域考察。考察过世界8大淡水湖中的5个：苏必利尔湖、维多利亚湖、休伦湖、密歇根湖和贝加尔湖。考察过世界8大有人湿地中的6个：长江三角洲、东北三江平原、湄公河三角洲、布拉马普德拉河三角洲、多瑙河三角洲和尼日尔河三角洲的湿地。考察过世界3大优质草原：欧洲的顿河—第聂伯河草原、南美阿根廷的潘帕斯草原和呼伦贝尔草原。考察过世界上4个百万平方千米以上的大沙漠：北非的撒哈拉大沙漠、阿拉伯半岛的鲁卜哈利沙漠、澳大利亚的维多利亚大沙漠和我国的塔克拉玛干沙漠。2009年初考察沙特阿拉伯（沙漠和人工生态系统）后100国考察最后完成，作者认为这些实地考察是制订我国生态修复规划必不可少的基础。

在上述考察基础上，作者创建的“新循环经济学”提出了把经济学与生态学结合的生态修复理念，不仅在国内重大规划中得到应用，受到国内相关权威与中央领导的高度评价，而且2005年在阿联酋举办的“世界思想者节日论坛”和2007、2008“诺贝尔奖获得者北京论坛”上得到共21位诺贝尔奖获得者的认同与称赞。

自1998年3月，作为生态修复的实践者，且准备上任全国节水办公室副主任、水利部水资源司司长，作者开始了北京水资源调查，到2004年10月退休前交接工作完成的整整80个月里，作者在全国黑龙江、内蒙古、河北、山西、北京、新疆、青海、甘肃、陕西、宁夏、河南、山东、上海、江苏、浙江、四川、云南、广西、广东、海南和香港共21个省市区主持和参与生态系统修复和水资源供需平衡的规划、实施和监督工作，恢复断流、恢复湿地、保住绿洲、保护水源、治理污染、保证供水和修建生态型水利工程。直至进行水务管理体制的改革，建立水务局。这些工作得到我国水资源、环境和生态方面权威专家的高度评价。

本书正是基于上述理念、调查、研究和实践的一本研究著作，不追求理论的深奥性，而追求理论的科学性，尤为强调的是理论的系统性和逻辑性；不着力于他人实践的搜集和引录，几乎全部实例都是作者本人亲眼所见，亲历亲为；在创新方面不追求在原有框架、包括外国人的框架上添枝加叶，而追求理论的革新。如果冒昧地回答一些读者提出的“为什么是这样”的问题的话，答案其实很简单，这是作者接受过9年的系统数学训练；自1979年接触生态系统理论后，在30年内对生态系统理论不断钻研，并在100个国家中进行了实地调研；作为全国水资源的主管实干了6年多，不断以实践印证和理论修正的结果。



2009年3月18日

Preface

Seventy years ago, when the "ecology" was put forward by the author's father——professor Wu Enyu (1909—1979) in his published paper in 1939, there were very few people knowing that word in the world wide, and not to speak of Chinese people. But "ecology" has now become a vogue——a word that can be frequently heard by all the people, eco-civilization has become a consensus of the human beings and harmonious co-existence between man and nature has become our national policy. "Natural ecosystem" is the scientific terminology of ecology.

Maintenance of ecological balance has now become a common knowledge, but when is the formation time of this homeostasis of ecosystem? Although the earth ecosystem reached balance state after the destabilization of comet shock and ice age, it was not the ecosystem for human beings. It has been proved by the diamonds dug up in 2008 that North America was hit by comet for the last time 12900 years ago and the sudden change revolutionized that place. The once populus prehistoric culture of America——Clovis People disappeared overnight, and some larger animals, such as horse, camel, American lion, mammoth, mastodon, saber-toothed tiger and beautiful armadillo extinguished successively. So there was no horse in America pre-Columbian. After the hit, some areas of the earth returned to glacier state and sustained for 1500 years long.

After that, the earth ecosystem retrained itself from such mutation again during the following 12000 years, thus the ecosystem that we live in now may be considered to be formed 12000 years ago. Although there were some small nature mutations such as earthquake, volcanic eruption, landslide, tsunami, flood and large-acreage drought, it was within the capability of self restoration. So there was no new ecosystem to be generated and that was one of the prime conditions for human beings to survive and develop. This also explains why the consecutive civilizations in the world can only be traced back with physical evidence to 10 thousand years ago as the history boundary. After tens of thousands of years of mankind's activity, especially the destructions in recent 200 years, the goal for restoration of the ecosystem is to regain the ecosystem as far as possible.

What on earth is that ecosystem? How do people coexist with it harmoniously? How can it repair itself when it was destroyed? All these questions have no definite answers, because ecology is not a fully-flagged academic subject, and its metering

method has not reached a consensus. So how to develop the science of ecosystem is a difficult task faced by academic cycle of the world. The flowing is just the opinion of the author.

1. Nature ecosystem is a complex macrosystem in nonequilibrium state

According to the viewpoint of academician Qian Xuesen, the macrosystem in nonequilibrium state is a system that can't be described by mathematic models and can't be stimulated by the current computer capacity due to its limited memory size and speed. So the exiting mathematic models that are built to describe ecosystem are unscientific, just like the models which were built to describe the subprime crisis caused by financial derivatives in Amercia.

Economic academia criticize that these models are "excessive", but there is actually only the difference between right or not, not excessive or unexcessive from a scientific angle. On the contrary, some Nobel laureates dared to open up and criticized that those were deceiving; the new president of the USA——Obama criticized that those were shameful things. The same thing comes to the modeling for ecology, and some leading mathematic models for ecology are not plausible from a mathematic angle, lacking scientific proof.

Moreover, some of the models are nothing just for a show and not designed to be put into practice. If those are carried out, perhaps there is not only a problem of wasting resource, but also destroying the current ecosystem. Who will be responsible for these? It should be referred to the strategies on the financial problems taken by international politician and our nation's leaders. In the 1990s, an artificial ecosystem was built in the USA based on some models with a large amount of money but ended in failure. Such experiment has never been tried out again. In view of these, the real scientific researches on the restoration of ecosystem are paramount.

2. The ecosystem is not beyond our knowledge

Ecosystem exists around everybody, so it can be cognoscible by people. But how to analyze it scientifically? The first way is to make statistical analysis in extended time series on the exiting data. The second way is to make scientific field survey. The third one is to study the lessons of other countries and then to build models that are practical and scientific, and the models can be treated only as a reference. The monitoring mechanism on ecosystem started from 1920s in the world and in China from 1950s, so the data sequence is too short and it is hard to do precise projection. Comparably, the field survey is the most important way to tackle the problem.

When the author worked as the executive director of National Water Saving Office and director-General of Department Water Resources, Ministry of Water Resources of China, he presided over the plans "Sustainable Utilization Programming of Water Resources in Beijing for the 21st Century", "The Planning for the Tarim River Valley Future Engineering Project", "The Short-term Planning for the Heihe River Valley Engineering Project" and "The New Water Allocation of the Yellow River". All these projects won high recognitions from corresponding academicians and were remarked as "a green tune" by former Premier Zhu Rongji. Premier Wen Jiabao viewed the proposal as to"ensure sustainable development through sustainable utilization of water resources", which has become a general policy of national water reservation. Premier Wen Jiabao also pointed out that the "eco-water" put forward by director Wu Jisong was a new concept. All these achievements were based on the field survey and international comparative study.

3. Ecosystem can only be restored and can't be man-made

Saying thus far, and to be detailed further in this book, the man-made ecosystem failed in the USA had become a consensus among the international ecology academia. And it is also a consensus that coordinated development of the economy and nature ecosystem can take place by means of recycle economy and knowledge economy. However, to what level will nature ecosystem can be restored by recycle economy? There are 6700 million people on the earth, so it is impossible and unnecessary for the earth to be restored to the prehistorical state. In addition, it requires a large amount of money for ecological restoration in various degrees, and the available data can't reflect the ecosystem conditions before ecodoom, so how to make a wise investment is an important problem. The only scientific method to treat this problem is to study those natural ecosystems of similar kinds with lesser deterioration or being well restored and then work on our own capacity.

With these inview, the author initiated a study on global ecosystems using in the past 30 years. In 1979, the author started contact with the United Nations Educational Scientific and Cultural Organization (UNESCO) when he was among the first batch of visiting scholars abroad after the open door of China. He was the scholar first introducing the concepts of "Sustainable Development", "Trichotomy R&D and Science Policy", "Science Park", "Knowledge Economy", "Internet (which was called 'information superhighway' at that time)" and "Recycle Economy" into China. After that, the author was appointed as the deputy representative, Counselor of Chinese Permanent Delegation to UNESCO and high-tech and environ-

ment consultant of science sector of UNESCO. Availing himself of these opportunities, the author set off a rare study on global ecosystems solely done by oneself in the world.

This work has continued for 30 years until now, and the author has studied the ecosystems of 100 countries across the six continents including the top 10 countries of GDP, population and area rankings. The author stayed in France for six years, in Sweden for one year and travelled to Japan and Germany eight times, to England and Italia five times, to America, Russia and Australia 3 times, and twice went to India, Brazil, Mexico, Kazakhstan and Indonesia, once to South Africa and Saudi Arabia. He published a series of books named "The world in my eyes" with 20 volumes and 4 million words in total.

The author has made a field study on seven of the eight biggest rivers in the world with only Lena in Russia missing. Of those studied rivers, he has travelled through the whole river basin of Nile, Yangtza River, Yellow River and Mekong. The author also made field studies on five of the eight biggest fresh water lakes in the world, including Superior Lake, Victoria Lake, Huron Lake, Michigan Lake and Lake Baikal and studied six of the eight biggest wetlands, including the wetlands on Yangtza River Delta, and three River Plain in Northeast China, Mekong River Delta, Brahmaputra Delta, Canube River Delta and Niger River Delta.

The author has tripped to the world's three best grasslands, including the Don-Dnieper River Grassland in Europe, Pampas Steppe in South America and Hulun Buir Grassland in China. The author also ventured into four deserts each with an area of more than million square kilometers, including Sahara Desert in the North Africa, Rub Al Khal Desert in Arabia, Great Victoria Desert in Austria and Taklimakan Desert in China. With the field studies on the desert and artificial ecosystem in Saudi Arabia in the beginning of 2009, he acomplished the 100-conutry field study tour. The author believes that these field surveys are requisite for working out the ecological restoration plans in China.

Based on these first-hand study, the author put forward the concept of ecological restoration integrating economics and ecology in the concept of "New Recycle Economics" created by him, which has been adopted in some great plans in China and has been recognized as of a high value integrating home and abroad, especially by 21 Nobel laureates at "Festival of Thinkers" held in UAE in 2005 and "Nobel laureates Beijing Forum 2007 and 2008".

In the process of the eighty-month working career, beginning with as a practi-

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cer of ecological restoration, later as executive director of national Water-saving Office and director-General of department of Water Resources, Ministry of Water resources of China in March 1998, until October 2004 when he retired, the author presided or took part in the projectings, implementing and supervising the ecological restoration programs and planning supply and demand of water of 21provinces and cities including Heilongjiang, Nei Monggol, Hebei, Shanxi, Beijing, Xinjiang, Qinghai, Gansu, Shaanxi, Ningxia, Henan, Shandong, Shanghai, Jiangsu, Zhejiang, Sichuan, Yunnan, Guangxi, Hainan and Hongkong. Among the tasks undertaken, there were restoration of water interceptions, restoration of wetlands, oasis protection, water source protection, environmental pollution improvement, water supply security, construction of ecological water conservation projects, reform on water utilities management system and the set-up of water resource agency. All these tasks fulfilled and gained high marks of authorities in the circles water source, environment and ecology.

This book is written on the above thoughts, investigations, studies and practices and is not targeted at the profundity of theories, but scientificity, especially with a focus on the systematics and logicality of theories. The sample cases in this book are all the firsthand experiences of the author with no efforts in searching and quoting other scholars' findings. This book pursues the innovation of theories instead of embellishing of existing theoretical debates home and aboard. Some readers may ask questions as to "Why is it that?" The answer is very simple and all is the result of testifying and improving theories by practices. The author has a background of systematic training in math for 9 years and has worked on ecology for 30 years since 1979, enriched with a first hand study in 100 different countries. Moreover, the author has worked as director of Ministry of Water Resource of China for more than 6 years.

Wu Jisong

March. 18, 2009

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