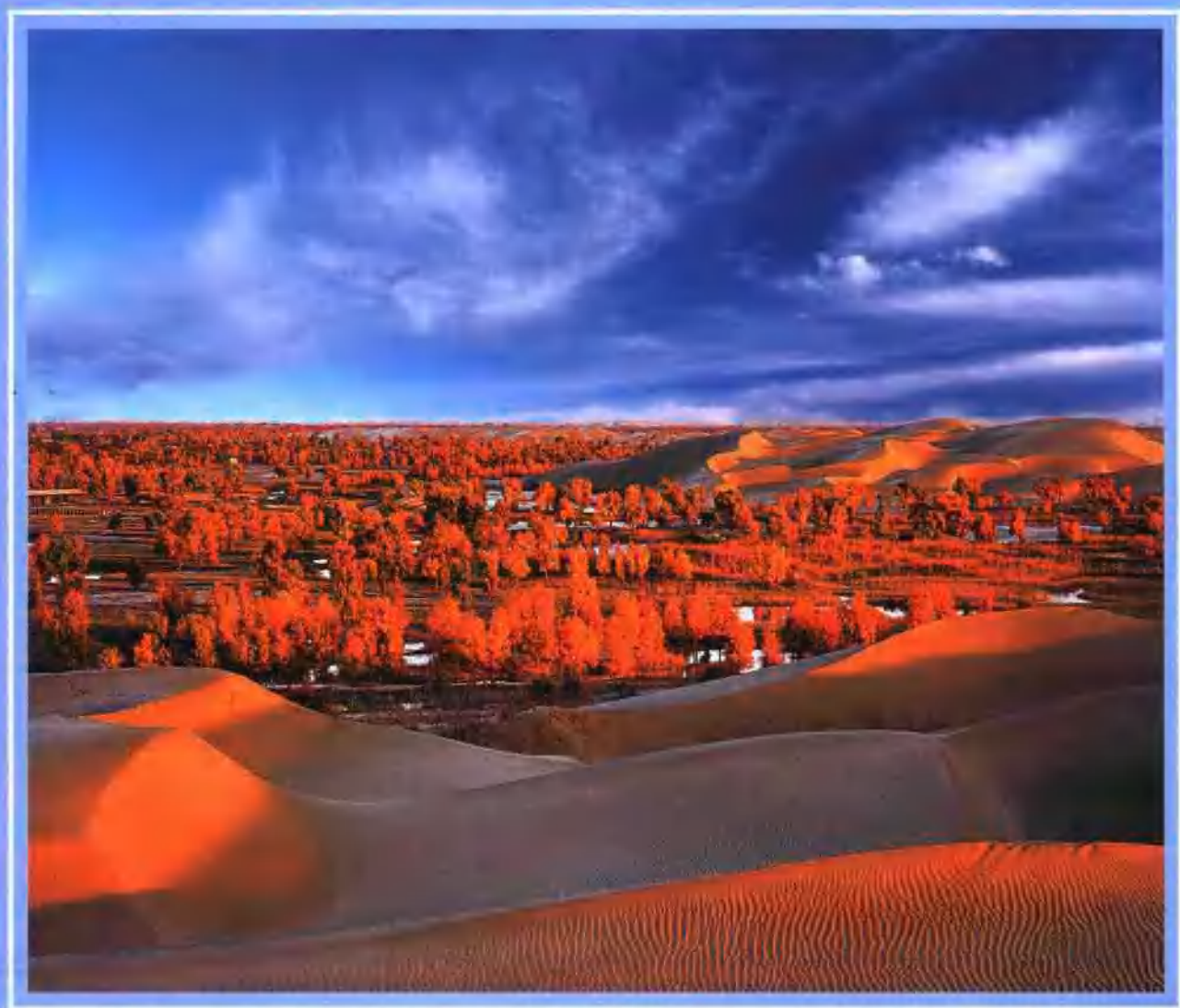


# 中国荒漠化和沙化动态研究

Dynamics of Desertification and  
Sandification in China

祝列克 主编



中国农业出版社

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# 序

荒漠化和沙化是我国最为严重的生态环境问题之一，它不仅直接阻碍了北方干旱地区经济社会的发展，而且对当地乃至我国东部地区的大气环境以及人民群众的生活造成严重影响。为了及时准确地掌握我国荒漠化和沙化的现状、动态变化及其驱动因素，国家林业行政主管部门根据《中华人民共和国防沙治沙法》的规定和履行《联合国防治荒漠化公约》规定义务的需要，定期组织开展全国荒漠化和沙化监测工作，为国家防沙治沙科学决策及治理方案的编制和调整提供了可靠的依据。

作为我国荒漠化和沙化监测的咨询专家，我有幸见证了我国荒漠化和沙化监测从开创到发展完善的全过程。荒漠化和沙化监测是一项技术难度很大的工作，在全球尚无先例可循的情况下开展整个国家的荒漠化和沙化监测，更是一项开创性的工作。与其他类似的监测一样，开展荒漠化和沙化监测必须处理以下几个难题：其一，建立监测指标是开展荒漠化和沙化监测的基础。应当说建立监测指标并不难，然而要使这些指标既能客观反映荒漠化和沙化的主要特征，又能便于实际操作却不是一件容易的事。其二，遥感技术的发展为开展大范围荒漠化和沙化监测提供了便利、快捷的手段，于是有些人就觉得似乎卫星遥感就可以代替一切，其实并不尽然。目前常用的卫星遥感，其分辨率尚无法对地表植被、土壤等微观因子进行准确判断，而这些因子的准确判断对于荒漠化和沙化监测却是至关重要的。实践证明，传统的人工调查却在这些地表微观因子的判断方面具有明显的优势。重要的是两者科学的结合。第三，对于定期开展的监测项目，不仅要获得不同监测阶段的现状数据，还要依据前后不同时段的数据对比提出动态变化。这就要求历次监测成果具有可比性，而保证可比性的最简单方法就是保持监测指标和方法的完全一

致。但是，像任何新生事物一样，荒漠化和沙化监测也需要不断地完善和发展。因此，必须处理好既要不断完善、发展，又要保持相对的稳定性和延续性的关系，以提高前后数据的可比性。

我们高兴地看到，监测的组织者较好地处理了监测工作中的这些关系和问题，使得监测结果能够客观、真实地反映不同阶段我国荒漠化和沙化的实际状况及其变化趋势，并使监测的指标、方法得到不断完善。

经过十多年的风雨历程，我国已经初步建立了一个适合我国国情和荒漠化与沙化实际的监测体系，并在做好全国范围面上监测的同时，又注重长期定位（站）监测和围绕荒漠化和沙化实际中的重大和敏感问题进行专题监测与研究。《中国荒漠化和沙化动态研究》反映了第三次全国荒漠化和沙化监测中专题监测的主要成果。透过书中一个个深入浅出的案例剖析，向我们揭示出我国荒漠化和沙化土地的现状、动态变化及其动因，主要扩展及好转的区域以及近年来保护和治理的成效等社会各界关注的问题。通过此书，我们既可清晰地感觉到近年来我国土地荒漠化和沙化时空变化的跳动脉搏，也为下一步的防治决策提供了可靠的基础和依据。

我们欣喜地看到，荒漠化和沙化监测成果已经在我国荒漠化和沙化防治决策制定及具体的保护与治理中得到了广泛地应用。我也衷心地希望荒漠化和沙化监测要坚持不懈，持之以恒，要在继续保持相对稳定性和延续性的基础上，不断创新和发展。

《中国荒漠化和沙化动态研究》是一部具有较高学术水平和实际应用价值的专著，内容丰富，图文并茂，值得一读。感谢本书的作者们为我们，也为所有关注人类生存环境问题的人们提供了一个深入、全面了解我国荒漠化和沙化问题的机会，我也热切地期待着有更多更好地反映我国荒漠化和沙化监测成果和治理成效的文献著作问世。

中国工程院院士

石玉林

2005年12月

## Foreword

Desertification and sandification as the most serious ecological problem of China not only affected directly the socioeconomic development of the northern arid areas, but also imposed an effect on the atmospheric environment and human life of locality and eastern China. To have a timely, accurate understanding of the current situation, trends and the driving forces of desertification and sandification of the country, the forestry authority of the State Council in accordance with the Desertification Combating Law of P.R.C as well the obligatory demands of the UN Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, regular national desertification and sandification monitoring and assessment should be conducted in China, to build up reliable basis for decision making and formulation and adjustment of desertification and sandification combating programme.

As a consultant of the desertification and sandification monitoring team of China, I have had the honor to witness the whole pioneering, developing and maturing process of the desertification and sandification monitoring of the country. Desertification and sandification monitoring is a technically demanding work, and a pilot work because so far no other country in the world has conducted a similar inventory. Like other types of inventories, the desertification and sandification inventory should well resolve several important issues. Firstly, establishment of monitoring indicators are the foundation of the desertification and sandification inventory. It is easy to establish monitoring indicators but difficult to establish inventory indicators reflecting the main

practical features of desertification and sandification and facilitating field work. Secondly, remote sensing is a easy and quick tool technology for large-scale inventory of desertification and sandification, but to the contrary of the understanding by some people, remote sensing does not replace the main work. The routine satellite remote sensing with limited resolution does not identify accurately such microelements as ground vegetation, soil condition etc. that are vital to the judgment making of the inventory. Field practices prove that the traditional artificial survey remains advantageous in the determination of the ground micro-factors. Therefore, integration of the two means is more meaningful. Thirdly, for periodically conducted inventories, status quo data of time spans should be obtained and comparisons should be made to find out the dynamic features or trends. Comparable data is necessary and the simplest method to realize such comparability is to have consistent uniform indicators and methods for inventory work. However, like all other innovative activity, desertification and sandification monitoring await continuous improvement and development. Therefore, the relationship between innovation, stability and consistency should be well dealt with to improve the comparability of the data flows.

It is pleasing to see that the organizers of the monitoring have well resolved this relationship, making the inventory results objectively and factually reflect the situation and changing tendency of the desertification and sandification in China and having the indicators and inventory means on continuous improvement.

After an arduous time over ten years, a desertification and sandification thematic monitoring system reflecting the national special condition and the practical field situation of desertification and sandification of the country has been come into being. While well conducting the national inventory work, effective efforts are made regarding the monitoring work by permanent



monitoring stations (posts), and thematic monitoring and studies of significant or sensitive issues. The Dynamics of Desertification and Sandification in China reflects the accomplishments of the thematic monitoring of the third national desertification and sandification monitoring. By the delicate case studies by the authors, the current situation, the development trend and causes of the desertification and sandification are disclosed, and the desertification and sandification expanding areas, improved areas and the protection/ field measure impacts in recent years as well as other socially interested issues are discussed. By the publication we tangibly feel the spatial time process of desertification and sandification and the improvement endeavors made in this territory in recent years. The related studies made by the authors should also be a foundation for related decision-making in the future.

I am delighted to see that the achievements from the desertification and sandification monitoring have been applied in the general policy formation and fieldwork conduction of the country. I sincerely hope that the desertification and sandification inventory shall persist on the basis of relative stability, innovative development and sound consistency.

The Dynamics of Desertification and Sandification in China with appealing illustrations is a specialized book with moderate academic strength and practical applicative value. Congratulations should go to the honored authors who allow us and the people that care for the human survival environment an opportunity to understand in depth and width the desertification and sandification issues of the country. I look forward to publishing of more works reflecting the monitoring result and improvement achievement of the desertification and sandification work in China.

By Shi Yulin

Academician, Chinese Academy of Engineering

December 2005

# 前言

环境与发展,是当今国际社会普遍关注的重大问题。防治荒漠化<sup>1</sup>,保护生态环境,实现可持续发展,是世界紧迫而艰巨的任务。全球2/3的国家和地区,1/5的人口,陆地面积的1/4受到荒漠化的危害,每年因荒漠化造成的直接经济损失高达423亿美元。荒漠化直接造成对人类社会生存和发展基础的破坏,是导致贫困和阻碍经济与社会可持续发展的重要因素。

中国是世界上荒漠化和沙化面积大、分布广、危害重的国家之一。荒漠化和沙化<sup>2</sup>威胁着国土安全、生态安全和社会经济的可持续发展,事关国家兴衰、民族的生存和发展,成为中华民族的心腹之患。新中国成立以来,党和国家高度重视生态建设与荒漠化和沙化的防治工作,国务院先后主持召开了四次全国防沙治沙会议,制定了工作方针和若干政策措施,在重点地区有组织地开展了以植树种草为主要内容的荒漠化和沙化防治工作,从1952年起建设东北西部防护林带,1978年开始实施“三北”防护林体系建设工程,1991年又上马了全国防沙治沙工程。荒漠化和沙化防治工作取得了一定的成绩,局部地区的荒漠化和沙化防治呈现出可喜的局面。

然而,我国的荒漠化和沙化防治工作走过了一条艰苦曲折的道路。20世纪六、七十年代以来,随着人口的急剧增加、经济社会发展及利益的驱动,沙区的盲目开荒、草原过牧、滥伐乱樵、滥挖滥采沙生植物及水资源的不合理利用等人为破坏活动严重。加之,防治投入不足,治理

<sup>1</sup> 荒漠化是指包括气候变异和人为活动在内的种种因素造成的干旱、半干旱和亚湿润干旱区的土地退化。这些退化土地为荒漠化土地。

<sup>2</sup> 沙化是指在各种气候条件下,由于各种因素形成的、地表呈现以沙(砾)物质为主要标志的土地退化,具有这种明显特征的退化土地为沙化土地。

规模小、速度慢等因素的共同作用,使得我国的荒漠化和沙化防治整体上治理速度赶不上恶化速度,导致了新中国成立以来至20世纪末我国土地荒漠化和沙化一直处于持续扩展态势。

进入新世纪,党和国家更加重视防沙治沙,关注沙区发展,把以防沙治沙为主的生态建设纳入了国民经济和社会发展全局之中,相继作出了若干重大举措。颁布实施了我国乃至世界上的第一部《防沙治沙法》,出台了《国务院关于进一步加快防沙治沙的决定》,制定了《全国防沙治沙规划》。并相继启动实施了六大林业工程、草原保护和治理、小流域综合治理等项目。在沙区广大干部群众共同努力下,我国防沙治沙步伐大大加快,从2001年起年均治理面积达190万公顷。

为全面掌握全国荒漠化和沙化土地的状况及动态变化,为国家荒漠化和沙化防治宏观决策提供科学依据和基础数据,履行《联合国防治荒漠化公约》,国务院林业行政主管部门于1994年组织开展了首次全国沙化土地调查,1999年又组织开展了第二次全国荒漠化和沙化监测工作。监测成果为全国生态建设与荒漠化和沙化防治重大决策提供了科学的基础依据,为推进生态建设和防沙治沙起到了重要作用。目前,已经初步建立了适合我国国情和实际的,由宏观监测、专题监测和定位监测三个层次组成的全国荒漠化和沙化监测体系。

《防沙治沙法》规定“国务院林业行政主管部门组织其他有关行政主管部门对全国土地沙化情况进行监测、统计和分析,并定期公布监测结果”,把荒漠化和沙化监测工作作为一项法律制度固定下来。《防沙治沙法》的出台,使我国的荒漠化和沙化监测工作步入了法制化的轨道。国家林业局于2004年组织完成了第三次全国荒漠化和沙化监测,采用地面调查与遥感数据判读相结合、以地面调查为主的技术路线,全面应用了“3S”技术。直接参加本次监测的专业技术人员达4000多人,区划和调查地面小班502万个,获取各类信息1.56亿条。监测成果全面反映了当前我国荒漠化和沙化现状及其动态变化趋势,科学评价了我国荒漠化、沙化防治所取得的成绩,准确把握了当前我国荒漠化和沙化形势。监测结果表明,20世纪后半期以来我国荒漠化和沙化持续扩展的趋势目前得到初步

遏制,荒漠化土地由上世纪末年均扩展  $1.04 \text{ 万 km}^2$  转变为现在的年均缩减  $7585 \text{ km}^2$ ,沙化土地由上世纪末年均扩展  $3436 \text{ km}^2$  转变为现在的年均缩减  $1283 \text{ km}^2$ ,沙区生态建设状况已从治理小于破坏进入了治理与破坏相持的阶段。

这里奉献给广大读者的《中国荒漠化和沙化动态研究》是以第三次全国荒漠化和沙化监测中的专题监测为基础,通过对专题监测成果的整理、汇编而成的。专题监测由包括林业、农业、水利、气象和中国科学院等部门的相关单位、科研院所和大专院校共计20多个单位共同参与完成。本书主要包括以下内容:新中国成立以来我国北方地区气候变化分析;当前国家生态建设主要政策及其对荒漠化和沙化动态变化的影响分析;近年末我国北方地区水土流失、草地退化和土壤盐碱化状况分析;重点地区不同时期荒漠化和沙化动态变化状况、原因分析及防治对策建议。本书的出版旨在让国内外广大读者对我国当前荒漠化和沙化状况及其时空动态变化有个概观的了解,以唤起更多的人士关心我国的荒漠化和沙化防治工作。本书由于研究时间短,编写比较仓促,不足和疏漏在所难免,希望广大读者不吝指正。

祝列克

2005年12月

## Preface

Environment and development are dual concerns of the international community. Desertification<sup>1</sup> combating ecological improvement and sustainable development is an imperative hard task of the world. About two-thirds of the countries of the world, one-fifth of the global population and one-fourth of the land of the earth are now affected by desertification with a direct economic loss about 42.3 billion US dollars every year. Desertification that erodes the foundation of human survival and progress has become a source of poverty and a constraint of socioeconomic sustainable development.

China is one of the countries with large area, wide coverage of and heavy losses from desertification and sandification<sup>2</sup> in the world. Desertification and sandification that threat the territorial safety, ecological security and sustainable development and impede the prosperity of the Chinese nation, survival and development of the nationality have become a serious hidden trouble of the nation. Following the founding of P.R.C, Chinese government has paid great attention to ecological improvement and issues regarding desertification and sandification. For four times the State Council has convened national conferences on desertification combating establishing principles and policies, In the key affected areas such as grass planting and afforestation. Specifically, the shelterbelt protection forest in the western part of northeast China started in 1952, the three-north shelterbelt protection forest system started in 1978 and

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<sup>1</sup> Desertification is defined as land degradation in arid, semi-arid or sub-humid arid areas a resulting from various factors including climatic variations and human activities. The degraded land thereby is desertified land.

<sup>2</sup> Sandification is defined as land degradation indicated by sand/ gravel materials in all climatic conditions and as a result of all factors. The degraded land thereby is sandified land.

more recently in 1991 the government initiated the National Desertification Combating Program. Due to all these efforts, achievements were made and the improved condition in some sandified or desertified areas is encouraging.

The desertification and sandification combating in China has already undergone a hard experience since 1970s. With rapid increase of population, the pursuit of pure economic benefits in socioeconomic development, sandy wasteland cultivation, grassland overgrazing, deforestation, excessive fuelwood and arenicolous plants collection, irrational water resource use and artificial damages etc. had prevailed. In addition to the lack of input for the prevention and control work, limited fieldwork scale, the treated/ improved acreage turned out to be an undersize compared with the added desertified area, leading to the continuously worsening condition of desertification and sandification of the country since the end of the last century.

Upon the entry of the twenty-first century, the Chinese government raised its attention to desertification combating and the development of the desertified / sandified area by incorporating desertification / sandification management oriented ecological improvement into the national economic and social development plan. Consequently several significant actions were taken, including promulgation and execution of the Desertification Combating Law, the first of its type in the country and in the world; release of the State Council Decision About Further Accelerating the Desertification and Sandification Combating Work, formulation of the National Desertification and Sandification Combating Plan, and implementation of the six major forestry programs, grassland protection and improvement program, small watershed integrated program etc. With joint efforts from the local people, the steps of prevention/control of desertification and sandification of China sped up. Since 2001, the annual improved area reached 1.9 million hectares.

To have a full clear picture of the situation and trend of the desertification and sandification of the country, build up scientific basis and decision-making

data for national desertification/ sandification combating, and to exercise the obligations of the United Nations Convention to Combat Desertification the forestry authority of the State Council organized in 1994 the first national sandification inventory, and in 1999 the second national desertification and sandification inventory. It has been proved that the inventory result played a fundamental, contributive role to the decision-making of the ecological improvement and field desertification combating work of the country. Up till now a triple-level inventory system comprising macroscopic monitoring, thematic monitoring and fixed position monitoring and reflecting Chinese national practical condition has been initiated in the country.

The Desertification Combating Law of the People's Republic of China stipulates that the forestry authority of the State Council should organize related other administrative sectors to carry out inventories, statistics and analysis on the nationwide sandification and desertification condition and publish the results periodically. The Law made desertification and sandification inventory a legal binding regular work. In 2004, the State Forestry Administration organized the third national desertification and sandification inventory. With ground survey and assisted with remote sensing image interpretation, the latest technologies of remote sensing, GPS and GIS were adopted. Totally more than 4,000 professionals participated directly in the inventory, 5.02 million ground compartments were zoned and surveyed, and 156 million entries of data were obtained. While portraying the current condition and trend of desertification and sandification of the country, the inventory assessed practically the achievements made and judged accurately the changes occurred. The inventory concludes that the persistent expanding situation of desertification and sandification in the country since the second half of last century has been curbed preliminarily, and it is now a critical time of "stalement of improvement and deterioration".

The Dynamic of Desertification and Sandification in China based on the

accomplishments of the thematic monitoring in the third national desertification and sandification monitoring, is a collection of works contributed by the special-topic monitoring team composed of scholars from over twenty institutions of forestry, agriculture, water resources, meteorology, the Chinese Academy of Sciences and other research institutes or universities. The book covers the climatic change of northern China for the past five decades, the current ecological improvement policies and their effect on desertification and sandification over time, soil and water erosion, grassland degradation and salinization conditions in northern in recent years, the dynamic condition and causes of key desertified or sandified areas, and related countermeasures or recommendations. The publication of this book intended to brief domestic and international readers the current condition, spatial time changes of desertification and sandification in China and to arouse attention of more interested personages to the sandification and desertification issue of the country. With limited time for the studies and compiling work, comments, corrections and suggestions from the readers are expected and appreciated.

Zhu Lieke  
December 2005



# 目 录

## 序

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