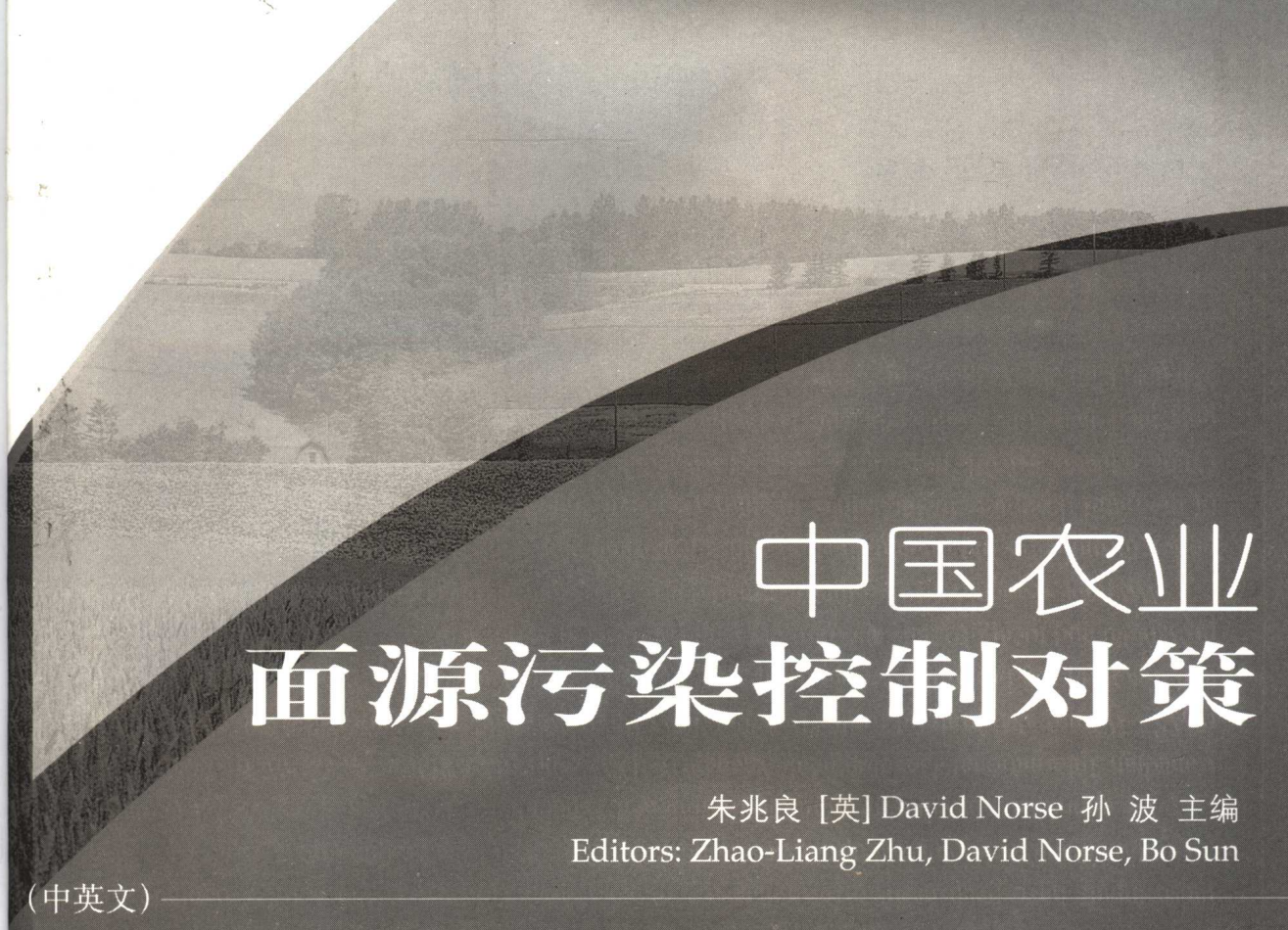
中国农业面源污染控制对策

朱兆良 [英] David Norse 孙 波 主编
Editors: Zhao-Liang Zhu David Norse Bo Sun

（中英文）

POLICY FOR REDUCING NON-POINT POLLUTION FROM CROP PRODUCTION IN CHINA

中国环境科学出版社



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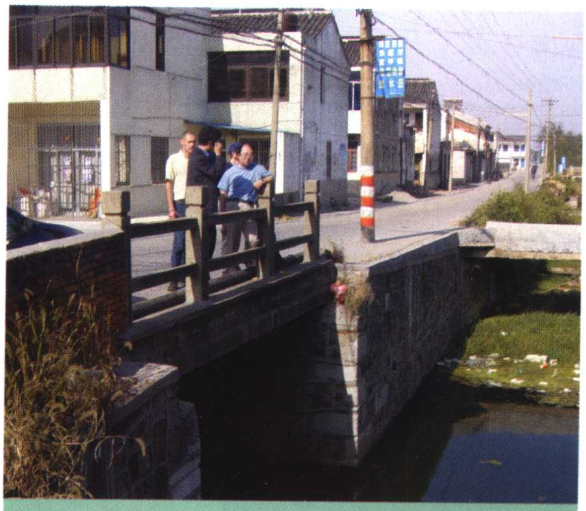

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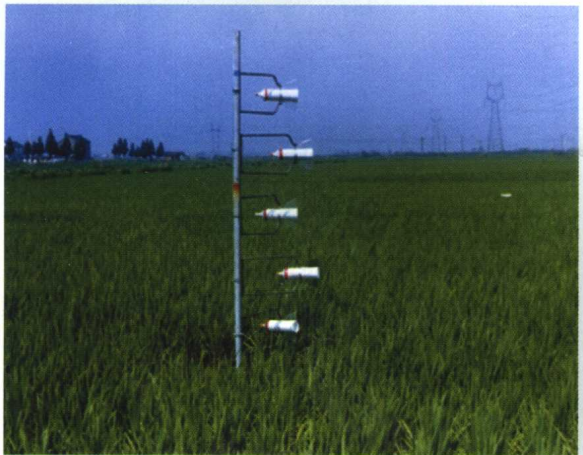

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农业面源污染工作组成员
Workgroup of agriculture non-point pollution taskforce

编 辑 委 员 会

前 言

中国在供养日益增长的庞大人口的同时，一直面临着耕地日益减少和保持环境质量的问题(Brown, 1994)。20 世纪 50 年代很多国家开始了农业的“绿色革命”，通过增加化肥、杀虫剂和除草剂的投入有效地增加了粮食的产量。但是，这种高投入的农业也对环境产生了一些负面影响。例如，温室气体（如 N_2O）的排放量(IFA and FAO, 2001) 和进入水体及土壤的污染物（如养分和农药等有机污染物）的数量大量增加，从而引起对流层臭氧的破坏和湖泊及河流的富营养化(Xing and Zhu, 2000)。中国目前已是世界上最大的化肥消费国，也是生产和使用农药的大国，农业非点源污染（或称面源污染）问题受到了广泛关注。

20 世纪 80 年代中期发展了可持续农业概念，90 年代后期发展了双重绿色革命的概念 (Conway, 1994)，当前，在食物安全、经济发展和环境保护之间保持平衡已成为世界共同追求的目标。但是在区域尺度上如何控制非点源污染一直是一个难题。这不仅需要根据对农田生态系统中养分循环的生物物理学研究的结果提出有效控制养分损失的技术，而且还需要根据社会经济学的研究结果制定有效的政策和法规体系，以促使这些技术在农业生产中推广应用。对欧洲和亚洲国家控制非点源污染结果的比较表明，有效的政策和法规是十分必要的。

本书的内容主要来自中国环境与发展国际合作委员会（简称“国合会”，CCICED）在 2003 年启动的“中国种植业的非点源污染控制对策研究”项目（简称“农业面源污染项目”）。“国合会”是一个高级国际咨询机构，成立于 1992 年，其委员包括中国国务院各有关部委的部长或副部长、国内外环发领域的知名专家、教授以及其他国家的部长和国际组织的领导。“国合会”的主席由国务院的领导同志担任（现任主席为国务院副总理曾培炎）。“国合会”的主要职责是针对中国环境和发展领域重大而紧迫的关键问题开展一系列的短期研究，提出政策建议并进行政策示范和项目示范。

本书吸取了中国科学院知识创新项目“中国主要农田生态系统氮磷钾的迁移、转化规律与优化管理”中关于农业生态系统养分循环和农业非点源污染控制的研究结果。这个项目于 2001 年由中国科学院启动，基于中国生态系统研究网络长期试验的联网研究（中国科学院资源和环境局中国生态系统研究网络科学委员会, 2002），采用生物物理学和社会经济学相结合的方法，在区域和国家尺度上研究农田生态系统养分的迁移转化规律与优化管理对策和措施（杨林章等, 2002）。

感谢中国环境与发展国际合作委员会北京秘书处、加拿大国际开发组织（CIDA）和中国科学院（CAS）对本书出版工作的资助。同时感谢“国合会”环境与自然资源定价与税收课题组吕悦来（Lü Yuelai）博士、参与项目的所有研究人员和地方政府部门的人员以及农户对本项研究的支持。

本书由这两个研究项目中的 9 个报告组成。这些报告总结了中国农业（特别是种植

业）的非点源污染状况，综述了中国农药污染和湖泊富营养化的现状，并通过对生物物理学—社会经济学研究结果的综合分析，在总结治理农业非点源污染的国际经验的基础上，提出了中国控制农业非点源污染的政策、法规和技术建议。我们希望本书能为读者在农业非点源污染控制对策和多学科的研究方面提供参考。

由于水平所限，加之工作时间较短、撰写仓促，本书一定存在着不少错误和不妥之处，真诚欢迎读者批评指正。

朱兆良　David Norse　孙波

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Preface

This monograph arose from work initiated by the China Council for International Cooperation on Environment and Development (CCICED) to examine non-point pollution (Npp) from crop production, which is one of the most serious environmental problems caused by China's agriculture. The CCICED was established by the State Council of China in 1992. It is a high-level advisory body with approximately 40 Chinese and international members with ministerial responsibilities or experience in matters relating to environment and development. It draws on international experience and specially commissioned studies in China to make recommendations to the Government of China on policy, institutional and technological changes to support sustainable development. The specially commissioned studies are the responsibility of a number of task forces of Chinese and international members that undertake short-term assessments of sustainable development issues of interest to the Government of China. The Task Force on Reducing Non-point pollution from Crop Production in China undertook the work in this monograph.

China is facing the challenge of feeding its large and increasing population from a limited and decreasing area of cultivated land while achieving a clean and safe environment (Brown, 1994). After the onset of the green revolution in the 1950s, increasing inputs of synthetic fertilizers, organic manures, pesticides, and herbicides was an efficient tool to ensure the high yield in agriculture over the world. Now China is the biggest user of synthetic fertilizers in the world. However this agro-chemical based intensive agriculture contributes substantially to the emission of greenhouse gases such as N_2O (IFA and FAO, 2001) and the entry of pollutants (nutrients, pesticide, heavy metals) into water bodies and soils. These pollutants cause adverse effects on environmental quality and public health, for example, ozone depletion in the upper atmosphere, the eutrophication in lakes and streams (Xing and Zhu, 2000), the pollution of soil and food.

With the development of the new concept of sustainable agriculture in the middle 1980s and of ideas about a double green revolution in the late 1990s (Conway, 1994), the target for global agriculture became development of production systems that satisfied food safety, economic and environment protection objectives. This led to the development of many new techniques and integrated resource management practices to mitigate the adverse effects of intensive farming on the environment. However, controlling the non-point pollution at the regional and continental scale is a complex problem. First we need to use advances in bio-physical research on nutrient cycling in agro-ecosystems to develop efficient techniques and policy measures to control the loss of nutrients. At the same time, we need to undertake socio-

economic research to set up effective policy and institutional mechanisms to transfer the above techniques and management practices to farmers. This socio-economic research highlights the necessity of drawing on the experience of other countries in Europe and Asia.

This monograph draws on two activities to accomplish and integrate these objectives. It uses the results of a Chinese Academy of Sciences (CAS) project to identify the advances in nutrient cycling in agro-ecosystems and Npp control techniques. The socio-economic research and integrating analysis comes primarily from the work of the above mentioned CCICED Task Force on Reducing Non-point pollution from Crop Production in China.

The CAS project was launched in 2002 to study the translocation and transformation of nutrients in agro-ecosystems, and put forward optimized management measures for non-point pollution control. This project has been conducted using a combination of long-term research into China's ecosystems (Scientific Committee of CERN and Bureau of Resources and Environment of CAS, 2002) and socio-economic investigations at regional and national scale (Yang et al., 2002). The CCICED Task Force was launched in 2003 to study the main causes and impacts of to non-point pollution from China's crop production and key policy, institutional and technological options for preventing or controlling it.

This monograph collects 9 reports from these two projects. These reports provide an overview of the current state of non-point pollution in agriculture, especially in crop production in China, including the status of pesticide pollution and lake eutrophication in China. Then the monograph introduces the investigation and case study results for Npp control in the important regions. This research combined biophysical and economic analysis to understand the comprehensive reasons for Npp formation and identify integrated measures for Npp control. The monograph also examines the experience of Npp control in other parts of the world, which was discussed at an International Policy Workshop organised by the Task Force in June, 2004. All of these inputs have been used to formulate recommendations concerning the policy, regulatory, institutional and technological options for controlling Npp from crop production.

We appreciate the funding from the Beijing and Vancouver Secretariats of the CCICED, the Canadian International Development Agency (CIDA), and the Chinese Academy of Sciences (CAS). We are also grateful to the Task Force on Environmental and Natural Resources Pricing and Taxation for providing research support through Dr Lü Yuelai, and to the many scientists, provincial and local officials and farmers who contributed to our work.

We hope readers will find that the material in this monograph is helpful to their research or policy formulation and implementation duties regarding Npp control, for example, through the use of the multi-discipline methodology to study regional environment problems. The Npp control in China remains a work in progress, and so we would welcome comments on the data and ideas presented here (the contact person is Professor Bo Sun, bsun@ isssas.ac.cn, Institute of Soil Science, Chinese Academy of Sciences, No. 71 East Beijing Road, Nanjing 210008, P. R. China).

Zhao-Liang Zhu, David Norse, Bo Sun

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