

高等院校土地整治工程专业系列教材

# 土地利用工程 专业英语

*Professional English  
for Land Use Engineering*

主 编 张建军

副主编 王 萍  
谢苗苗



中国地质大学出版社  
ZHONGGUO DIZHI DAXUE CHUBANSHE

## 图书在版编目(CIP)数据

土地利用工程专业英语 = Professional English for Land Use Engineering/张建军主编.  
—武汉: 中国地质大学出版社, 2016. 12  
ISBN 978-7-5625-3943-8

I. ①土…

II. ①张…

III. ①土地利用-英语-高等学校-教材

IV. ①F301.2

中国版本图书馆 CIP 数据核字(2016) 第 298891 号

土地利用工程专业英语

张建军 主 编  
王 萍 谢苗苗 副主编

责任编辑: 张 林 张 琰

责任校对: 张咏梅

出版发行: 中国地质大学出版社(武汉市洪山区鲁磨路 388 号)

邮政编码: 430074

电 话: (027) 67883511

传 真: 67883580

E-mail: cbb @ cug. edu. cn

经 销: 全国新华书店

http: //www. cugp. cug. edu. cn

开本: 787 毫米×1 092 毫米 1/16

字数: 531 千字 印张: 20. 75

版次: 2016 年 12 月第 1 版

印次: 2016 年 12 月第 1 次印刷

印刷: 武汉市籍缘印刷厂

印数: 1—1 000 册

ISBN 978-7-5625-3943-8

定价: 42. 00 元

如有印装质量问题请与印刷厂联系调换

# 《土地利用工程专业英语》

主 编 张建军

副 主 编 王 萍 谢苗苗

编写人员 (按姓氏拼音排序)

付 薇 中国地质大学(北京)

刘洪彬 沈阳农业大学

刘洪洁 北京城市学院

王 萍 曲阜师范大学

王淑晴 中国地质大学(北京)

徐丽萍 新疆石河子大学

谢苗苗 中国地质大学(北京)

张建军 中国地质大学(北京)

# 前言

随着工业化、城镇化和农业现代化同步加快推进,耕地保护形势更加严峻,土地供需矛盾更加尖锐,土地利用结构和方式亟待转变,土地工程技术与生态环境的关系进一步凸显,生态文明建设与城镇化战略背景下的国家粮食安全、经济安全、生态安全、新农村建设与城乡统筹发展,对土地开发、利用、整治和保护形成了巨大的压力和挑战。作为国土资源管理的重要工程技术内容——土地利用工程,是根据国民经济和各项生产建设发展的需要,因地制宜地采用工程措施和生物措施相结合的方式对土地进行合理开发利用与治理改造的综合性工程技术,为“山水林田湖”生命共同体建设提供了重要手段。实施土地利用工程是保障发展、保护耕地、统筹城乡土地配置的重大战略。土地利用工程已经成为我国当前深化改革、科技创新、工程实践和人才培养的重要领域之一。

全球一体化与教育国际化的发展,促使培养复合型人才成为我国高等教育的重要方向之一。为适应培养国土资源类复合型人才的需求,《国土资源“十三五”规划纲要》提出“加大国外相关领域理论成果研究,拓展国际合作,借鉴发达国家经验”,同时《国土资源“十三五”科技创新发展规划》进一步明确要求“培养具有国际视野的复合型科技人才”。此外,土地整治工程技术人才也列入《中华人民共和国职业分类大典》(2015年版)。为此,《土地利用工程专业英语》立足我国国土资源管理的紧迫形势,以工程技术人才培养为导向,旨在将国际土地工程技术领域的基础理论、先进技术、成功案例等引入我国土地科学相关专业的教学课堂,重点使学生掌握该领域的专业词汇、英语表达和国际前沿思想,为推动我国国土资源事业的国际化发展、培养具有国际视野的复合型人才奠定基础。

当前,我国土地科学领域设置了土地资源管理与土地整治工程两个专业。已经出版的《土地资源管理专业英语》(谭淑豪主编),偏重于土地资源管理中的资源、经济、管理、政策等内容。而《土地利用工程专业英语》是顺应我国国土资源管理形势而编写,侧重于土地开发、利用、整治、保护和修复的科学、技术、工程等内容,是我国土地整治工程专业的第一本专业英语课程教材。本教材在介绍土地利用工程国际研究领域的传统理论、方法与技术的基础上,还尝试性地引入了探地雷达技术和无人机技术等国际前沿技术。基于此,本教材按照土地利用工程的技术实施过程,将全书分为6个部分共21章。第一部分绪论,主要包括基本知识、土地分类与评价、全球土地工程;第二部分土地利用工程类型,主要包括土地开

发、土地整理、土地复垦与生态修复、景观与土地保护;第三部分规划、设计与施工,主要包括土地利用规划、土地平整工程、灌排工程、运输工程、植被重建与绿化工程;第四部分产权与定价,主要包括土地产权概述、产权定价;第五部分项目管理与运营,主要包括项目管理概述、质量管理、成本管理、项目风险管理;第六部分技术与应用,主要包括“3S”技术、测量与制图技术、理化与生物技术。

中国地质大学(北京)土地科学技术学院付梅臣教授对本教材的撰写、终审及出版给予了全程指导和大力支持,在此表示特别的感谢!作为土地整治工程专业系列教材,本教材的出版还得到国家级特色专业和北京市级特色专业项目、教育部卓越工程师培养计划项目、中国地质大学(北京)土地科学技术学院、国土资源部土地整治重点实验室的支持和资助,以及中国地质大学(北京)土地科学技术学院全体教师的支持!中国地质大学(北京)土地科学技术学院的硕士研究生黄卉、徐泽、朱晓磊、刘静、王琳、万虹骏和度苗苗为本教材基础资料的收集与整理付出了辛苦的劳动,在此表示衷心的感谢!此外,还要感谢本教材中所引用直接文献和间接文献的所有具名和未具名作者,他们为本教材的编写提供了宝贵的资料!

《中共中央关于制定国民经济和社会发展第十三个五年规划的建议》明确提出了“大规模推进农田水利、土地整治、中低产田改造和高标准农田建设”“推进城镇低效用地再开发和工矿废弃地复垦”和“实施山水林田湖生态保护和修复工程,构建生态廊道和生物多样性保护网络”等发展规划,《国土资源十三五科技创新发展规划》要求全力实施“三深一土”国土资源科技创新战略,希望本教材的出版能为开设土地整治工程专业、土地资源管理专业和相关专业的高等院校及研究机构的人才培养发挥应有的作用。

由于编者水平有限加之时间仓促,本教材一定存在诸多不足和值得商榷之处,希望得到广大读者的批评指正。

编 者

2016年10月于北京

# Contents

<b>PART A INTRODUCTION</b>	(1)
1 General Knowledge	(3)
1.1 Land and Land Use	(3)
1.2 Land Use Cover/Change	(6)
1.3 Land Engineering	(11)
2 Land Classification and Evaluation	(16)
2.1 Land Cover/Use Classification System	(16)
2.2 Land Suitability Classifications	(27)
3 Global Land Project	(35)
3.1 Globalization and Land Change	(35)
3.2 Population Dynamics and Land Use Change	(38)
3.3 Impacts of Land Use Change	(40)
3.4 Coping Capacities of Land Systems	(44)
<b>PART B CATEGORIES OF LAND USE ENGINEERING</b>	(47)
4 Land Development	(49)
4.1 What is Land Development	(49)
4.2 The Dynamics of Land Development	(52)
4.3 Engineering Standards for Land Development	(56)
5 Land Consolidation	(61)
5.1 What is Land Consolidation	(61)
5.2 Agricultural Land Consolidation	(64)
5.3 Urban Land Consolidation	(72)
6 Land Reclamation and Ecological Rehabilitation	(78)
6.1 Key Terms and Comparison	(78)
6.2 Mining Techniques	(80)
6.3 Dump and Tailings	(83)
6.4 Mine Water	(86)
7 Landscape and Land Conservation	(89)
7.1 Landscape Ecology	(89)
7.2 Land and Environment Conservation	(95)

7.3	Ecological Engineering .....	(105)
<b>PART C PLANNING, DESIGN AND CONSTRUCTION .....</b>		<b>(113)</b>
8	Land Use Planning .....	(115)
8.1	The Planning Issue .....	(115)
8.2	What is Land-Use Planning .....	(118)
8.3	Overview of the Planning Process .....	(121)
8.4	Levels of Planning .....	(124)
8.5	Land Use Plan Decisions .....	(126)
9	Land Levelling .....	(130)
9.1	The Importance of Land Levelling .....	(130)
9.2	Small-Scale Land Levelling .....	(132)
9.3	Traditional Engineering Approach .....	(133)
9.4	Laser Land Levelling .....	(135)
10	Irrigation and Drainage Engineering .....	(139)
10.1	Crop Water Requirements .....	(139)
10.2	Irrigation Methods .....	(141)
10.3	Land Drainage .....	(145)
11	Transport Engineering .....	(149)
11.1	Introduction .....	(149)
11.2	Rural Road Networks and LTRs .....	(151)
11.3	Classification of (Rural) Roads .....	(154)
11.4	Construction of Rural Roads .....	(157)
12	Revegetation and Greening Engineering .....	(159)
12.1	What is Revegetation .....	(159)
12.2	Revegetation Process and Restoration Techniques .....	(160)
12.3	Revegetation as a Stabilizing Agent on Dump Slopes .....	(168)
12.4	Selection of plant species .....	(170)
<b>PART D PROPERTY RIGHTS AND VALUATIONS .....</b>		<b>(173)</b>
13	Property Rights in Land Use .....	(175)
13.1	Defining Property and Property Rights .....	(175)
13.2	Dispute Resolution Mechanisms .....	(177)
13.3	Many Sources of Property Rights .....	(180)
13.4	Property Rights, Agricultural Production and Livelihoods .....	(183)
14	Valuing the Land Property .....	(187)
14.1	How Land Acquires Value .....	(187)
14.2	How to Measure Land Values .....	(191)

<b><u>PART E PROJECT MANAGEMENT AND OPERATIONS</u></b>	(199)
15 Understandings of Project Management	(201)
15.1 Project Management Defined	(201)
15.2 Project Context	(203)
16 Quality Management	(207)
16.1 Quality Management	(207)
16.2 Relevance of Quality Programs to Project Quality	(209)
17 Cost Management	(211)
17.1 Project Costs	(211)
17.2 Estimating Costs	(213)
17.3 Managing the Budget	(217)
18 Managing Project Risk	(220)
18.1 Defining Project Risk	(220)
18.2 Risk Management Process	(221)
18.3 Project Risk by Phases	(226)
<b><u>PART F TECHNIQUES AND APPLICATIONS</u></b>	(229)
19 “3S” Techniques in Land Use	(231)
19.1 Land Remote Sensing	(231)
19.2 Geographic Information System	(240)
19.3 Global Positioning System	(252)
20 Land Surveying and Mapping	(266)
20.1 Land Surveying	(266)
20.2 UAV Map Drawing	(278)
20.3 Ground Penetrating Radar	(283)
21 Physical, Chemical and Biological Techniques	(292)
21.1 Physical Techniques	(292)
21.2 Chemical Techniques	(296)
21.3 Biological Techniques	(298)
<b><u>GLOSSARY</u></b>	(301)



# PART A

## INTRODUCTION



## 1

## General Knowledge

## 1.1 Land and Land Use

## 1.1.1 Definition of land and land resources

Land is not regarded simply in terms of **soils** and surface **topography** but encompasses such features as underlying **superficial deposits**, climate and water resources, and also the **plant and animal communities** which have developed as a result of the interaction of these **physical conditions**. The results of human activities, reflected by changes in **vegetative cover** or by **structures**, are also regarded as features of the land. Changing one of the factors, such as land use, has potential impacts on other factors, such as **flora and fauna**, soils, **surface water** distribution and climate. Changes in these factors can be readily explained by ecosystem dynamics and the importance of their relationships in planning and management of land resources has become increasingly evident.

Land and land resources refer to a delineable area of the Earth's terrestrial surface, encompassing all attributes of the **biosphere** immediately above or below this surface, including those of the near-surface climate, the soil and **terrain forms**, the **surface hydrology** (including **shallow lakes**, rivers, **marshes and swamps**), the near-surface **sedimentary layers** and associated **groundwater** and geo-hydrological **reserve**, the **plant and animal populations**, the human **settlement** pattern and physical results of past and present human activity (**terracing**, **water storage or drainage structures**, roads, buildings, etc.)

土地不仅指地球陆地表面的土壤和地表形态,还包括其下的表层沉积物、气候、水资源,以及由这些自然环境交互作用而形成的动植物群落。

土地和土地资源是指地球陆地表面的特定区域,包含地表上下生物圈的所有属性,包括近地表气候、土壤、地形、地表水文(包括浅水湖、河流、湿地和沼泽)、近地表沉积层及相关的地下水与地质水文储量、动植物种群、人类聚落形态以及过去和当前人类活动(梯田、蓄水或排水设施、道路、建筑物等)的自然(演变)结果。

### 1.1.2 Functions of land

The basic functions of land in supporting human and other **terrestrial ecosystems** can be summarized as follows:

- a store of wealth for individuals, groups, or a community;
- production of food, fiber, fuel or other biotic materials for human use;
- provision of biological habitats for plants, animals and micro-organisms;
- co-determinant in the global energy balance and the global hydrological cycle, which provides both a source and a sink for **greenhouse gases**;
- regulation of the storage and flow of surface water and groundwater;
- storehouse of minerals and raw materials for human use;
- a **buffer**, filter or modifier for chemical pollutants;
- provision of physical space for settlements, industry and recreation;
- storage and protection of evidence from the historical or pre-historical record (fossils, evidence of past climates, **archaeological remains**, etc.);
- enabling or hampering movement of animals, plants and people between one area and another.

In the terminology of environmental economics, land can be regarded as a stock renewable resource. Land resources do not easily fit into the categories of renewable or non-renewable. In general, they are slowly renewable; however, their rate of **degradation** far exceeds their natural rate of **regeneration**. In practical terms, this means that land that is lost to degradation is not naturally replaced within a human time frame, resulting in a loss of opportunities for the next generation.

### 1.1.3 What is land use

Land use is characterized by the arrangements, activities and inputs people undertake in a certain **land cover type** to produce, change or maintain it. A more inclusive definition of land-use is often used in practice. "Land use" actually includes

全球能源平衡和全球水循环的共同决定因素(之一),为温室气体提供了源和汇。

土地利用的特征是人类为开垦、改变或者维持某种土地覆被类型而进行的整理、活动和投入。

near-surface water. Any given area of land is usually used to satisfy multiple objectives or purposes.

Land use information provides answers to one or more of the following questions concerning the current use of the land.

- What; the purpose of activities undertaken, e. g. , the specific products and services, that are sought.
- Where; the **geographic location** and extent of the spatial unit under consideration.
- When; the temporal aspects of various activities undertaken, e. g. , the sequence of carried out operations like planting, weeding, etc.
- How; the technologies employed, e. g. , technological inputs/materials such as **fertilizer, irrigation**, labor, etc.
- How much; quantitative measures, e. g. , areas, products.
- Why; the reasons underlying the current land use, e. g. , **land tenure**, labor costs, market conditions, etc.

Agricultural land-use data are important for many of the regional to global activities currently undertaken by FAO (e. g. , the validation of **agricultural land evaluation**; the preparation of perspective studies on agricultural production and **food security; early warning** for food security; natural **disaster relief** operations; **farming systems** studies; **policy formulation**). Thus, knowledge of current land use (and land resources) is needed for formulating changes leading to sustainable use of the resources.

对于 FAO(联合国粮食与农业组织)承担的诸多区域性及全球性项目(例如,农用地评价的验证,农业产量和食品安全前景研究前的准备,粮食安全预警,自然灾后援助,农耕制度研究,政策制定)而言,农业土地利用资料至关重要。

FAO/UNEP. The future of our land: facing the challenge[R]. Rome: FAO/UNEP, 1999.

### Words and Phrases:

agricultural land evaluation 农用地评价  
 archaeological remain 考古遗迹  
 biosphere *n.* 生物圈  
 buffer *n.* 缓冲区  
 degradation *n.* 退化  
 disaster relief 赈灾; 灾难援助  
 early warning 预警  
 farming system 耕作制度; 农作制度  
 fertilizer *n.* 肥料  
 flora and fauna 动植物; 动植物群

food security 食品安全  
 geographic location 地理定位; 地理位置  
 greenhouse gas 温室气体  
 groundwater *n.* 地下水  
 hydrological cycle 水循环  
 irrigation *n.* 灌溉  
 land cover type 土地覆盖类型  
 land tenure 土地所有制; 土地占有制  
 marshes and swamps 湿地和沼泽; 沼泽地  
 physical condition 自然条件

plant and animal community 动植物群落	superficial deposit 表层沉积
plant and animal population 动植物种群	surface hydrology 地表水文
policy formulation 政策制定	surface water 地表水
regeneration <i>n.</i> 再生;重生;重建	terracing <i>n.</i> 阶地;梯田
reserve <i>n.</i> 储备;贮量;保护区;保留地	terrain form 地势形态
sedimentary layer 沉积层	terrestrial ecosystem 陆地生态系统
settlement <i>n.</i> 居民点	topography <i>n.</i> 地势;地形学
shallow lake 浅水湖	vegetative cover 植被覆盖
soil <i>n.</i> 土壤	water storage or drainage structure 储水或排水设施
structure <i>n.</i> 结构;构造;建筑物;构筑物	

(张建军编,王萍校)

## 1.2 Land Use Cover Change

### 1.2.1 What is land-use and land-cover change

**Land-use and land-cover change (LULCC)** (also known as land change) is a general term for the human modification of Earth's terrestrial surface. Though humans have been modifying land to obtain food and other essentials for thousands of years, current rates, extents and intensities of LULCC are far greater than ever in history, driving unprecedented changes in ecosystems and environmental processes at local, regional and global scales. These changes encompass the greatest environmental concerns of human populations today, including climate change, **biodiversity** loss and the pollution of water, soils and air. **Monitoring** and mediating the negative consequences of LULCC while sustaining the production of essential resources has therefore become a major priority of researchers and policymakers around the world.

Land cover refers to the physical and biological cover over the surface of land, including water, vegetation, **bare soil**, and/or **artificial structures**. Land use is a more complicated term. Natural scientists define land use in terms of syndromes of human activities such as agriculture, forestry and building construction that alter land surface processes including biogeochemistry, hydrology and biodiversity. Social scientists and land managers define land use more broadly to include the so-

尽管人类改造土地以获得食物和其他必需品已有数千年之久,但是当前土地利用和土地覆被变化的速率、范围及强度都远远超过了历史水平,迫使生态系统和环境过程在地方、区域和全球尺度上发生了空前的变化。

社会学家和土地管理者认为更广义的土地利用是指为社

cial and economic purposes and contexts for and within which lands are managed (or left unmanaged), such as **subsistence vs. commercial agriculture, rented vs. owned, or private vs. public land**. While land cover may be observed directly in the field or by **remote sensing**, observations of land use and its changes generally require the integration of natural and social scientific methods (expert knowledge, interviews with land managers) to determine which human activities are occurring in different parts of the **landscape**, even when land cover appears to be the same. For example, areas covered by woody vegetation may represent an undisturbed natural **shrubland**, a forest preserve recovering from a fire (use = conservation), regrowth following tree harvest (forestry), a plantation of immature **rubber trees** (plantation agriculture), swidden agriculture **plots** that are in between periods of clearing for annual crop production, or an irrigated tea plantation. As a result, scientific investigation of the causes and consequences of LULCC requires an interdisciplinary approach integrating both natural and social scientific methods, which has emerged as the new discipline of land-change science.

### 1.2.2 Causes and consequences

Changes in land use and land cover date to prehistory and are the direct and indirect consequence of human actions to secure essential resources. This may first have occurred with the burning of areas to enhance the availability of wild game and accelerated dramatically with the birth of agriculture, resulting in the extensive clearing (**deforestation**) and management of Earth's terrestrial surface that continues today. More recently, **industrialization** has encouraged the concentration of human populations within urban areas (**urbanization**) and the depopulation of rural areas, accompanied by the **intensification of agriculture** in the most **productive lands** and the **abandonment of marginal lands**. All of these causes and their consequences are observable simultaneously around the world today.

#### 1.2.2.1 Biodiversity loss

Biodiversity is often reduced dramatically by LULCC. When

会和经济目标及背景而开展的土地管理(或土地未管理),例如自给农业—商用农业、租用土地—自有土地及私有土地—公有土地。

木本植被覆盖区域可能代表未受干扰的天然灌木林,火灾后恢复的保育林(利用即保护),伐木后的再生林(林业),未成林的橡胶林(造林农业),一年生农作物收割间隔期间的临时性农地,或灌溉茶园。

工业化带动了城市区域人口的集聚(城市化)和农村地区人口的流失,伴随着最具生产力土地的农业集约化和边际土地的撂荒。

land is transformed from a primary forest to a farm, the loss of forest **species** within deforested areas is immediate and complete. Even when unaccompanied by apparent changes in land cover, similar effects are observed whenever relatively undisturbed lands are transformed to more **intensive uses**, including **livestock grazing**, selective tree harvest and even fire prevention. The habitat **suitability** of forests and other ecosystems surrounding those under intensive use are also impacted by the fragmenting of existing habitat into smaller pieces (habitat **fragmentation**), which exposes forest edges to external influences and decreases core habitat area. Smaller habitat areas generally support fewer species (island biogeography), and for species requiring undisturbed core habitat, fragmentation can cause local and even general extinction. Research also demonstrates that species invasions by non-native plants, animals and diseases may occur more readily in areas exposed by LULCC, especially in proximity to **human settlements**.

#### 1.2.2.2 Climate change

LULCC plays a major role in climate change at global, regional and local scales. At global scale, LULCC is responsible for releasing greenhouse gases to the **atmosphere**, thereby driving **global warming**. LULCC can increase the release of **carbon dioxide** to the atmosphere by disturbance of terrestrial soils and vegetation, and the major **driver** of this change is deforestation especially when followed by agriculture, which causes the further release of soil carbon in response to disturbance by **tillage**. Changes in land use and land cover are also behind major changes in terrestrial emissions of other greenhouse gases, especially **methane** (altered surface hydrology; wetland **drainage** and rice paddies; cattle grazing), and **nitrous oxide** (agriculture: input of inorganic **nitrogen** fertilizers; **irrigation**; **cultivation** of nitrogen fixing plants; **biomass combustion**).

Though LULCC certainly plays a critical role in greenhouse gas emissions, the complexity and dynamic interplay of land use processes favoring net accumulation versus net release of carbon dioxide and other greenhouse gases makes it a poorly constrained component of our global budgets for these gases. A further source of uncertainty in estimating the cli-

被集约利用的森林及其周边其他生态系统的生境适宜性同样受到现有生境破碎成更小区块的影响(生境破碎化),这就使得林缘暴露在外界影响中,并减少核心生境面积。

土地利用和覆被变化背后隐藏的主要变化是其他温室气体的陆地排放,特别是甲烷(改变地表水文:湿地排干和稻田、放牧)和氮氧化物(农业:无机氮肥投入、灌溉、固氮植物栽培、生物量燃烧)。

尽管土地利用覆被变化在温室气体排放中起着关键作用,但是土地利用过程的复杂性和动态交互作用倾向于



mate changes caused by LULCC is the release of **sulfur dioxide** and **particulates** by biomass combustion associated with agriculture, **land clearing** and human settlements. These emissions are believed to cause regional and global cooling by the reflection of sunlight from particulates and **aerosols**, and by their effects on cloud cover.

Land cover changes that alter the reflection of sunlight from land surfaces (**albedo**) are another major driver of global climate change. The precise contribution of this effect to global climate change remains a controversial but growing concern. The impact of albedo changes on regional and local climates is also an active area of research, especially changes in climate in response to changes in cover by dense vegetation and built structures. These changes alter surface heat balance not only by changing surface albedo, but also by altering evaporative heat transfer caused by **evapotranspiration** from vegetation (highest in closed canopy forest), and by changes in **surface roughness**, which alter heat transfer between the relatively **stagnant layer** of air at Earth's surface (the boundary layer) and the **troposphere**. An example of this is the warmer temperatures observed within urban areas versus rural areas, known as the **urban heat island effect**.

### 1.2.2.3 Pollution

Changes in land use and land cover are important drivers of water, soil and air pollution. Perhaps the oldest of these is land clearing for agriculture and the harvest of trees and other biomass. Vegetation removal leaves soils **vulnerable** to massive increases in **soil erosion** by wind and water, especially on **steep terrain**, and when accompanied by fire, also releases pollutants to the atmosphere. This not only degrades **soil fertility** over time, reducing the suitability of land for future agricultural use, but also releases huge quantities of **phosphorus**, **nitrogen**, and **sediments** to streams and other **aquatic ecosystems**, causing a variety of negative impacts (increased **sedimentation**, **turbidity**, **eutrophication** and **coastal hypoxia**). Mining can produce even greater impacts, including pollution by **toxic metals** exposed in the process. Modern agricultural practices, which include intensive inputs of nitrogen and phosphorus fertilizers

二氧化碳和其他温室气体的净积累而不是净排放,这使得它很难成为全球温室气体(排放)预算的组成部分。

这些变化不仅可以通过改变地表反射率来打破地表热量平衡,还可以通过改变植被(森林中最高的郁闭层)蒸腾作用引起的热传递以及地表粗糙度来实现,这些改变了地表大气(边界层)滞流层和对流层之间的热传递。

这不仅会引起土壤肥力日益退化、降低未来农业用地的适宜性,也会导致向溪流和其他水生生态系统中排放大量的磷、氮和沉积物,进而引发一系列不良影响(加剧的沉积作用、浑浊、富营养化和海岸缺氧症)。