

陕西省

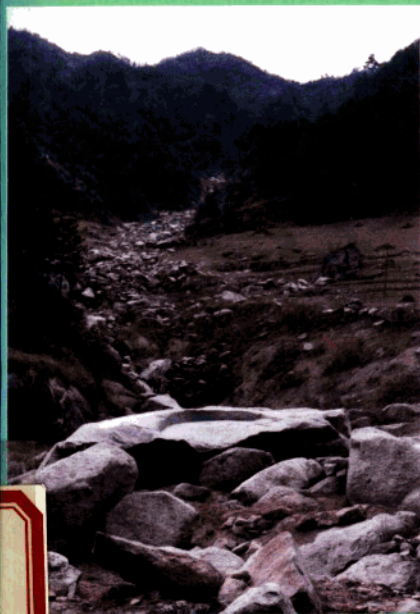
泥石流灾害

NISHILIU ZAIHAI

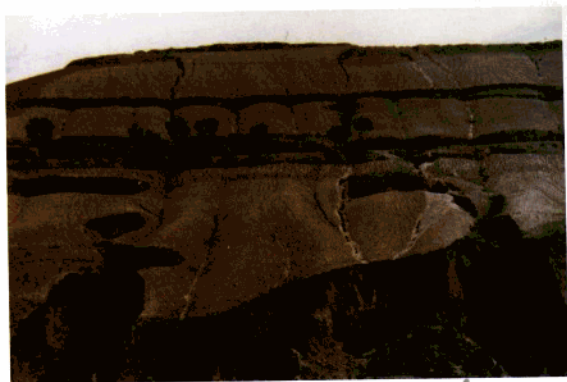
FANGZHI

防治

李昭淑 著

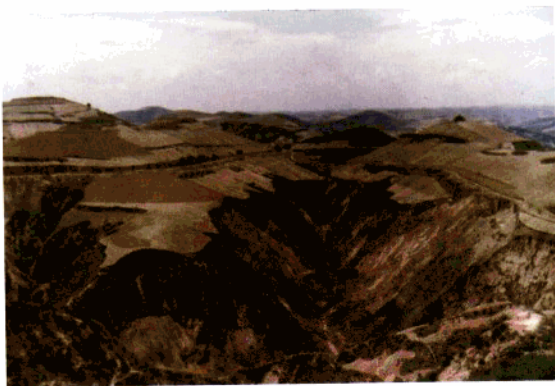


西安地图出版社



志丹县李家嘴子  
沟黄土坡面侵蚀现象  
(细沟、浅沟、陷穴)

杏子河上游  
黄土阶与沟谷  
侵蚀地貌



吴旗县合家沟谷坡重力侵蚀



渭川县壁坡过陡发生塌窑



太白山主峰  
八仙台(3676m)与  
石环地貌



太白山  
大爷海的冰  
川谷



太白山  
二爷海的冰  
斗湖



太白山跑马  
梁现代冻土的  
“石多边形”

1994年潼关县  
西峪金矿泥石流淤  
埋拉矿石的汽车

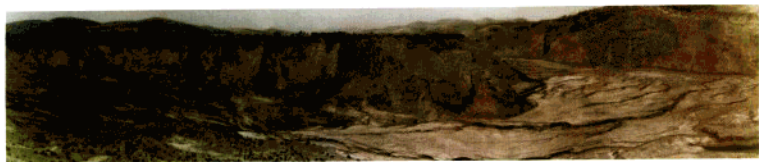


1994年潼关县  
西峪金矿淤埋  
民房



1556年华县  
8级地震太平峪  
崩塌堵河

吴旗县泥流沟全景





作者在九间房乡  
进行泥石流容重测量

华山峪 1884 年  
水石流搬运特大漂石  
“鱼石”(直径长 23m)



1988 年华山  
峪水石流冲毁上  
山的道路

1988 年蓝  
田县葛牌乡发生  
泥石流冲毁仓库



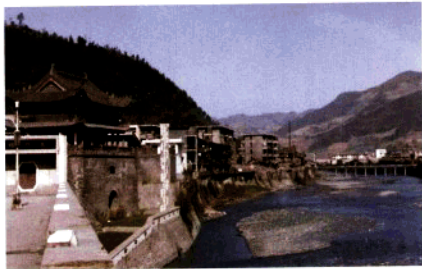




姜太公钓鱼——  
蟠溪泥石流堆积的  
漂石



柞水县七里坪乡  
泥石流堆积的乱石滩



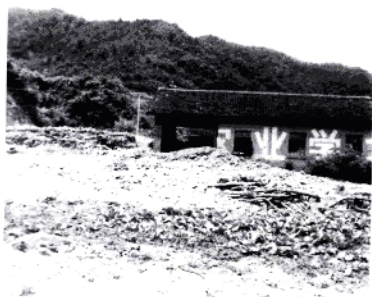
略阳县东门水  
尺、是昔日洪水淹没  
的高度



1992年略阳县  
纪家沟泥石流毁灭了  
一家人的遗痕

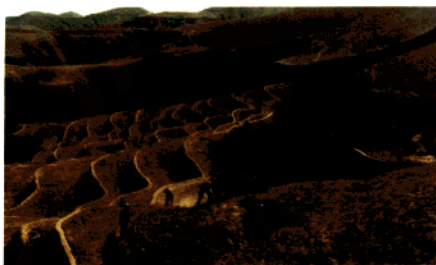


1981年凤县红花铺车站一列火车被庙沟泥石流淤埋



1. 1981年陈家沟泥石流淤埋了宝成铁路
2. 1981年泥石流淤埋凤县067厂房
3. 1981年泥石流冲毁凤县067厂房
4. 1981年凤县青风寺沟泥石流冲毁民宅

延安地区  
群众兴修梯田  
(马磊 摄)



山区群众改造  
泥石流荒石滩搬移  
巨大漂石

柞水县七里坪乡  
群众在泥石流堆积的  
荒石滩上建堤修田



泥石流冲毁  
农田重新修建堤  
防工程





华山车站 1988  
平灾后修建的防治  
工程



1988 年华山车  
站被泥石流淤埋情景



华山车站  
泥石流沟修建  
的格栅坝



宝成铁路凤  
县新修的渡槽与  
明洞工程



洛南泥石流  
沟综合防治工程  
(马磊 摄)

未署名的照片均  
为作者拍摄

## 内 容 简 介

《陕西省泥石流灾害与防治》是我省第一本泥石流基本理论和综合防治的专著。全书系统地论述了泥石流的类型、分布、成因。形成的机理流态与流速流量计算。从灾情指标评价了陕西省洪水、泥石流灾害的严重性。较全面系统地深入地论述了黄土高原和秦巴山区泥石流特点及规律。依据区域泥石流灾害特征，阐述了防治泥石流的各种有效的工程与预防措施。

本书通过实际野外考察，参阅了大量前人研究成果，全面总结了我省泥石流危害和综合防治措施，内容广泛、资料翔实、论证充分，可供山区防治泥石流部门及环境保护、水土保持、国土资源开发、交通建设等单位科技人员和大专院校师生参考。

# 前 言

泥石流是高浓度水沙的混合流，暴发突然，来势凶猛，具有强大的破坏力，成为危害全球中低纬度地区的突发性灾害。因此，掌握泥石流的基本理论，有效地治理泥石流，就成为当今世界发展山区经济，保障人民生命财产和安全的首要任务。

陕西境内地质、地貌、气候、水文等自然条件复杂，泥石流活动频繁，危害严重。尤其是随着山区经济日益发展，人类需求过度增强，生态环境不断被破坏，泥石流危害随之不断加剧。泥石流主要分布在陕北黄土高原和秦巴山区，约占陕西省总面积的  $2/3$ ，每年在这些地区屡有发生，灾情范围小则几十平方千米，大时可达数千乃至十余万平方千米，泥石流往往能够摧毁城镇，居民住宅，破坏交通，危及人民生命财产，造成极大损失，加深区域贫穷，影响国民经济的发展。尤其是陕北黄土高原，因黄土岩性松软，植被破坏严重，暴雨径流易于产生高强度侵蚀的泥流与泥河，形成了世界上罕见的水土流失区，不仅给当地也给黄河下游造成难以估计的灾难。

泥石流学是一门新兴的边缘科学，我省依据区域自然环境特征，结合发展经济，开展了多学科的防治研究措施。新中国建立后，黄河水利委员会、中国科学院、陕西省水土保持局、地矿厅和大专院校等单位，在陕北黄土高原地区开展了长期防治水土流失的治理工作，已获得初步明显效果。以往因对山区泥石流认识不足，在防治工程设计、施工、管理和环境保护等方面，存在着不少问题。如 1981 年陕西省秦巴山区西部，发生了大面积泥石流灾害：铁路、公路、水利和城镇等部门，皆因防治工程较差而损失严重。灾后认真总结了经验教训，采取

了许多防治措施。在“国际减灾十年”(1991~2000年)中,省人民政府把秦巴山区农村防治山地灾害(洪水、泥石流和滑坡)列为重点科学研究课题,成立了由省减灾协会、省地震局、省水文总站和西北大学组成的科学研究小组。经过三年考察,对广大山区农村泥石流提出了有效的防治措施。总之,我省泥石流防治结合相邻学科,不断在向前发展。

作者经过多年野外考察研究,收集了大量有关资料,写成了《陕西省泥石流灾害与防治》一书,首次全面系统地论述了陕西省泥石流的类型、分布、成因、危害和防治等。书中详细地分析了泥石流的形成的条件;介绍了其流速流量与冲击力的计算方法;从洪水泥石流灾害指标评估了全省的灾情;分析了陕北黄土高原灾害与特征;阐述了秦巴山地泥石流的成因与灾情;全面总结了泥石流防治与预防的经验。旨在加强泥石流的防治,减轻灾害损失,促进西部大开发,建成山川秀美的优越环境,以尽微薄之力。

全书共分七章,除第二章中的第三节,泥石流形成的气候条件,由省气象局肖永全先生和我共同撰写外,其余章节由我自己完成。由于本人水平有限,书中难免有错误之处,敬请读者批评指正。

香港乐施会为了支援防灾减灾,就本书的出版给予了大力的资助,并赠书给政府有关机关及科研、生产与教学等单位参考。在此谨表示诚挚的感谢!惟书中内容与观点,概不代表乐施会的立场。

李昭淑

2001年10月于西北大学

# Preface

Debris flow is a mixed fluid what is composed of water and sand with a high concentration in loess plateau and mountainous area. Its outburst is sudden; the oncoming force is furious. Besides, it possesses a powerful force to do great damage so that becomes an unexpected disaster which makes a lot of hazards in the middle and low latitudes over the world. Consequently, it is an important task of both developing economy and protecting the property and safety of people lives in the world at present to have a good command of a fundamental theory of debris flow for the effective prevention and control of its hazard.

There exist a complex natural environment including geological, geomorphological, climatic, hydrological components and so forth, a strong activity of debris flow and a serious hazard from it inside the boundary of Shaanxi Province. In particular, with an increasing development of the economy in mountainous district the activities of human being become frequently day by day so that the ecological environment is often destroyed and it follows that disasters from debris flow are rising drastically. The main distribution of debris flow is located in the loess plateau of the Northern Shaanxi and the mountainous areas of the Qinling and the Dabashan which have occupied about two thirds part of the total area in the province. There are cases of hazard always taking place every year in those areas where the suffered scope is from number tens square kilometers of the small to several and up to one hundred thousands square kilometers of the large. These disasters can often exterminate towns and resident houses, destroy traffic facilities and endanger the security of people lives and property, thus cause the regional poverty and hinder the growth of the national economy. Especially in the loess plateau of the Northern Shaanxi vegetation has been destroyed heavily due to the loose and soft lithological character of loess soil. Because a run-off from rainstorm is easy to result in the muddy flow and stream with the high erosive intensity, the loess plateau has become a region of the soil erosion where is rarely seen in the world. Debris flow has caused catastrophes what are difficult to estimate in not only the local areas but also the lower reaches of Yellow River.

The science on debris flow is a new interdisciplinary subject. According to the regional characteristics of the natural environment a multidisciplinary research into the measures of prevention and control has been carried out together with the economic development in our province. After foundation of the new China many organizations such as the Water Conservancy Committee of Yellow River, the Academy of Sciences of China, the Conservation Bureau of Soil and Water of Shaanxi Province, the Geological and Mineral Department of Shaanxi Province and universities and colleges etc. have engaged in a long term effort of preventing and controlling soil erosion in the loess plateau of the Northern Shaanxi and achieved



the preliminary tangible results. There exist no less problems in the engineering design, construction and management of prevention and control, the environmental protection and so forth due to an insufficient knowledge of debris flow in mountainous areas in the past. For example, the disasters from debris flow within the large area occurred in the western part of both Qinling and Dabashan Mountains in Shaanxi Province in 1981. A great number of departments such as railway, highway, water conservancy, towns and so on had suffered heavy losses owing to the worse engineering for prevention and control. After the catastrophe it has been made to sum up the experiences and lessons, conduct the measures for prevention and control in accordance with the way of both scientific reconstruction and new construction. In the "International Hazard Mitigation Decade" (1991—2000) preventing and controlling the mountainous disasters (flood, debris flow and landslide) in the countryside of both Qinling and Dabashan Mountains had been placed on a key subject of the scientific research by the people's government of the province; a group of the scientific research had been founded at the same time as well, it was composed of the Association of Shaanxi Hazard Mitigation, the Seismological Bureau of Shaanxi Province, the General Hydrological Station of Shaanxi Province and Northwest University. Through a field survey which took three years it has put forward the effective measures for preventing and controlling debris flow in the broad mountainous countryside. In a word, the activity of preventing and controlling debris flow is incessantly progressing forward in cooperation with the adjacent subjects.

Through the field investigation and study for many years, the author has collected a great deal of the relevant material and written a book, *Disasters from Debris Flow and its Prevention and Control in Shaanxi Province*, in which types, distribution, factors of formation, harm, prevention, control and so forth of debris flow in Shaanxi Province are expounded comprehensively and systematically at the first time. In the book the author analyses conditions for the formation of debris flow in detail, elaborates the calculative methods of its velocity, discharge and impact force, evaluates the disastrous situation within a scope of the whole province by means of the indexes of disasters from the flood debris flow, dissects disasters of loess plateau in the Northern Shaanxi and their characteristics, discusses formation factors and disaster cases of debris flow in both Qinling and Dabashan mountains, sums up the experience of preventing and controlling debris flow thoroughly. The purpose of the author is to try his best within a limited ability in order to improve prevention and control of debris flow in Shaanxi Province, mitigate losses suffered from disasters, promote the great western development, construct a favourable environment with the beautiful hills and rivers.

The complete content in this book is divided into seven chapters in which the section three of the second chapter, climatic conditions for the formation of debris flow, is written by Mr. Xiao Yongquan in the Meteorological Bureau of Shaanxi Province together with the author. The rest parts of all chapters are completed by the author alone. There are certainly some unavoidable errors in the book owing to the limitation of my own level, so it is welcome that any criticisms and instructions come from readers.

Oxfam of Hong Kong subsidizes the writer for the book publication in order to assist

prevention and mitigation of disasters, and donates the books to the relative agencies of research, production and education for their reference. Here the author would like to express his earnest gratitude. Any points of view in the book do not represent the stand of the Oxfam at all.

Li Zhaoshu  
Northwest University  
October 2001.

## 乐施会介绍

乐施会 (Qxfam Hong Kong) 是在香港注册的一个独立发展及救援机构。乐施会跨越种族、性别、宗教和政治的界限，与贫困群体一起面对贫穷和苦难，让所有人都得到尊重与关怀，享有食物、居所、就业机会、教育及医疗卫生等基本权利，在持续发展中建设一个公平的世界。

要解决贫穷问题及达致社会公正发展，单靠提供物资和金钱援助并不足够，最重要是从根本入手，让贫困群体得以改善生活，摆脱贫穷。乐施会特别注重有利于发展的条件、社群的参与及其能力的培养，与贫困群体一起找出问题所在、共同制定对策、推行项目及评估成效。

乐施会所有发展项目均以下列五项人人享有的权利为基础：

- 得到可持续的生活保障的权利

贫困群体可以使用及控制生产资源；使贫困人能有效运用市场，增加收入；保护或改善自然环境；及保障劳工、流动人口等权益。

- 接受基本服务的权利

贫困群体可以得到卫生及基础教育

- 生命安全受保障的权利

增强贫困群体抵御人为或自然灾害的能力；进行紧急救援、灾害回应及重建。

- 被聆听的权利

加强民间组织及贫困群体自助及互助的能力。

- 平等的权利

促进两性平等；揭露和阻止性别歧视及其导致的暴力。

乐施会现时在亚洲和非洲多个发展中国家推行发展项目。由1987年开始，乐施会便致力在中国大陆推行扶贫发展及防灾救灾工作，项目内容包括：社区组织发展、农村综合发展、增加收入、小型基本建设、卫生服务、能力建设、政策倡议及教育等。乐施会目前在国内的重点工作地区为：云南、贵州、广西、广东、甘肃、陕西和北京。

**乐施会地址：香港北角马宝道28号华汇中心17楼**

**地话：(852) 25202525**

**传真：(852) 27899545**

**电子邮件：china@oxfam.org.hk**

**网址：WWW.oxfam.org.hk**