

中国是一个多灾之邦。治国必先治水。治水才能安民兴邦。这是历史经验的总结。新中国成立半个世纪以来。党中央、国务院十分重视水利建设。动

员亿万人民群众。进行大规模的水利建设。兴修了数以万计的各类水利基础设施。为保障国民经济发展和社会安定发挥了巨大作用。特别是中国以

仅占世界平均水平1/4的人均水资源量。实现了其社会经济连续20年的高速增长。以占世界9%的耕地。解决了占世界22%人口的粮食问题。

其成就举世瞩目。可以说。通过水旱灾害防治和水资源开发利用。在水利事业为社会与经济的发展提供安全保障。资源保障和环境保障方面。中国提供了一个范例。

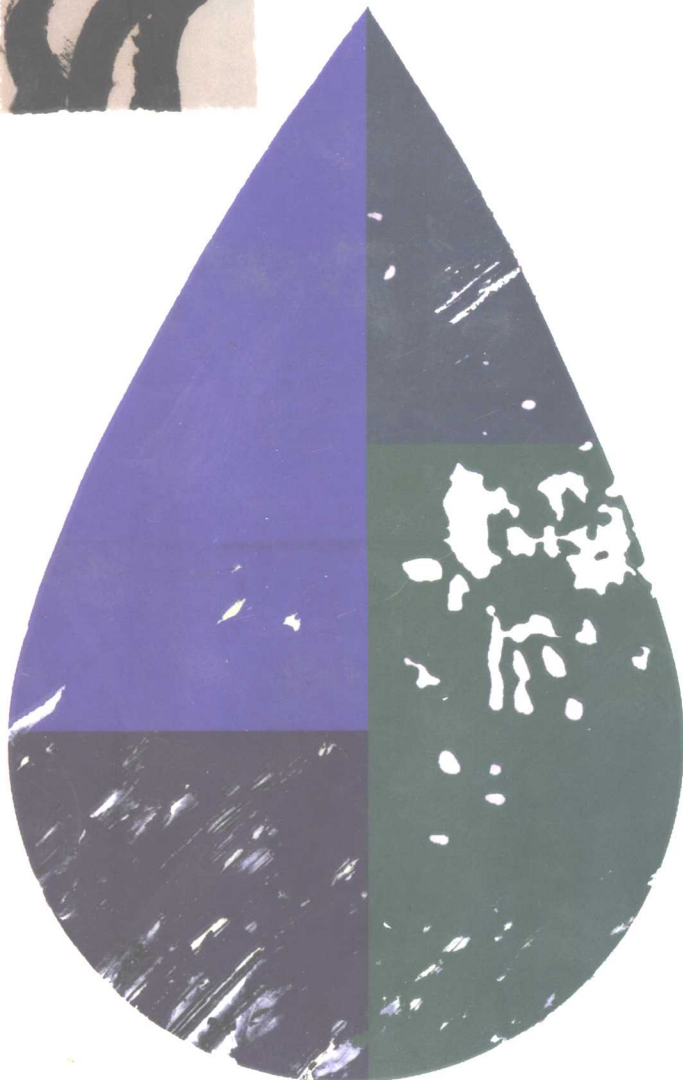
# 中国水资源与可持续发展

水是人类生存的生命线。我们必须高度重视水的问题。我们要坚持不懈地搞好节约用水和防治水污染的工作。

ZHONGGUO SHUI ZIYUAN YUKE CHIXU FAZHAN

广西科学技术出版社

张岳  
主编



水与可持续发展  
水资源与人口  
水资源与环境  
水资源与经济  
水资源总量和可利用量  
水资源开发与利用  
水资源现状供需分析  
水能源开发及水电站建设  
存在的主要问题  
规划与设想  
需水形势展望  
21世纪供需态势  
供用水的变化  
水旱灾害的演变  
社会因素的影响  
未来科技发展趋势

ZHANG YUE ZHUBIAN

中国水资源

ZHONGGUO SHUI ZIYUAN YUKE CHIXU FAZHAN ZHONGGUO SHUI ZIYUAN YUKE CHIXU FAZHAN

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ZHANGYUEZHUBIAN

张岳 主编

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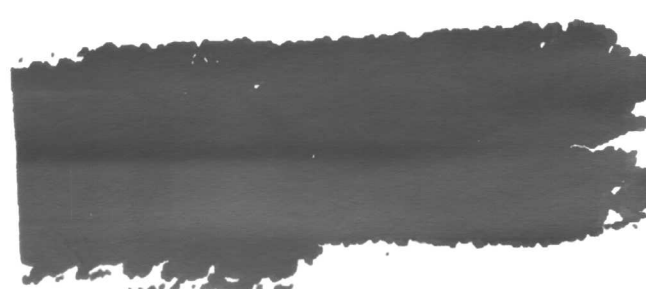
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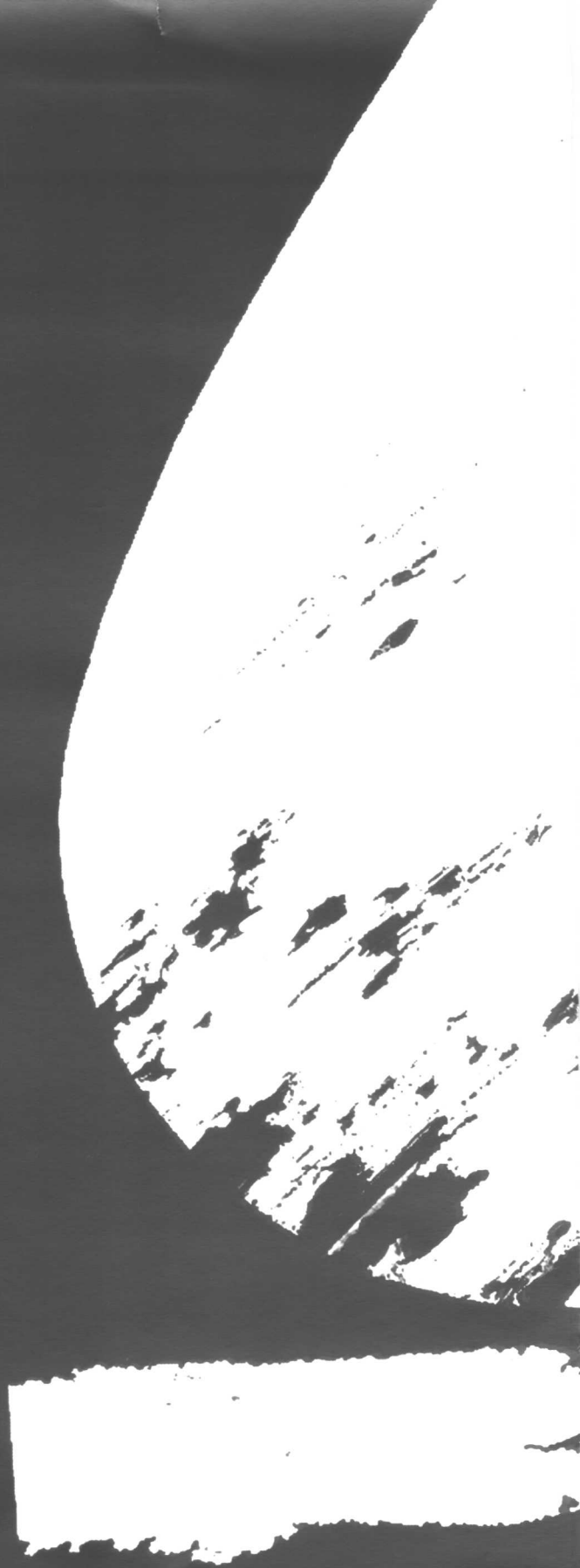
# 导言

水是人类生存的生命线,也是农业和整个经济建设  
的生命线。我们必须高度重视水的问题。人无远虑,必有近忧。一方面洪涝灾害历来是中华民族的心腹之患,另一方面水资源短缺越来越成为我国农业和经济社会发展的制约因素。我们要在全民族中大力增强保护和合理利用水资源的意识,把兴修水利作为保证实现我国跨世纪发展目标的一项重大战略措施来抓。当前,要抓紧落实党和国家已经确定的各项方针政策和措施,加固大江大河大湖堤防,修复水毁工程,搞好灾后重建。同时从长计议,全面考虑,科学选比,周密计划,适时进行关系国计民生的重大水利工程建设,并坚持不懈地搞好节约用水和防治水资源污染的工作,努力开创我国治水事业的新局面。

——摘自1999年1月1日江泽民在全国政协新年茶话会上的讲话







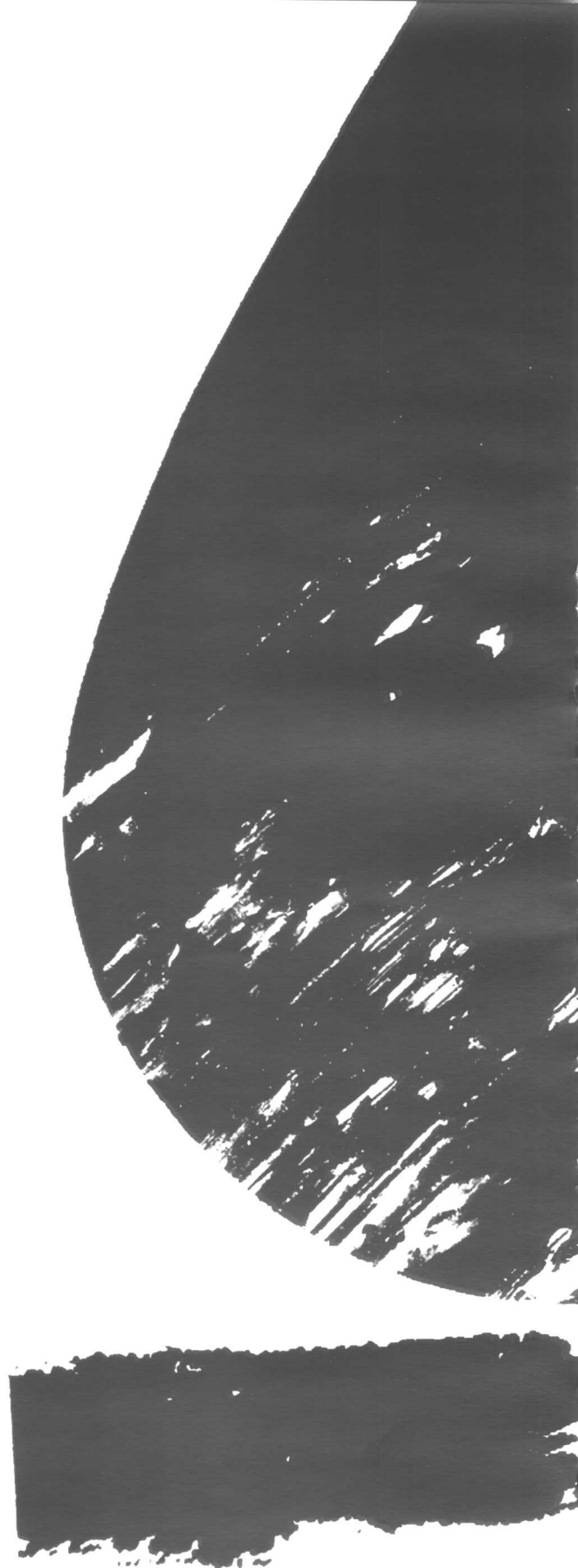


# 序

中国是一个多灾之邦，治国必先治水，治水才能安民兴邦，这是历史经验的总结。新中国成立半个世纪以来，党中央、国务院十分重视水利建设，动员亿万人民群众，进行大规模的水利建设，兴修了数以万计的各类水利基础设施，为保障国民经济发展和社会安定发挥了巨大作用。特别是中国以仅占世界平均水平 $1/4$ 的人均水资源量，实现了其社会经济连续20年的高速增长；以占世界9%的耕地，解决了占世界22%人口的粮食问题，其成就举世瞩目。可以说，通过水旱灾害防治和水资源开发利用，在水利事业为社会与经济的发展提供安全保障、资源保障和环境保障方面，中国提供了一个范例。

中国的改革开放已经走过20年的光辉历程。党的十一届三中全会以来，随着我国以经济建设为中心的伟大战略决策和改革开放路线的全面贯彻实施，水利的改革与发展发生了深刻变化。20年来，随着国家经济体制改革的进一步深化，水利改革与发展呈现了一系列明显的转变：由主要为农业服务，逐步向服务于国民经济和全社会转变；由计划经济下的运行机制，逐步向适应社会主义市场经济的运行机制转变；由以社会效益为主，逐步向实现社会、经济和环境的综合效益转变。特别是把水利建设放在国民经济和社会发展的基础设施建设的首位，标志着水利在国民经济中的地位发生了根本性的变化。近十年来，水利在带动大江大河大湖的治理、农田水利建设、水电和农村电气化建设、城乡供水工程建设、水环境保护和水土流失的防治等方面取得了很大的成绩，标志着水利事业进入了一个新的发展阶段。

但是，中国的水问题始终是个大问题，洪涝灾害历来是中华民族的心腹大患，干旱缺水和水环境恶化对中国的社会发展已构成重大威胁。1996年淮河污染、1997年黄河断流、1998年长江和嫩江、松花江发生的特大洪水，连续3年发生的这三大灾害，充分说明了洪涝灾害、水资源短缺、水污染已越来越成为我国经济社会发展的重要制约因素。因此，21世纪的中国水利面临着严峻挑战，水利事业任重而道远。江泽民总书记在1999年元旦致辞中指出：“水是人类生存的生命线，也是农业和整个经济建设生命线。”“我们要在全民族中大力增强保护和合理利用水资源的意识，把兴修水利作为保证实现我国跨世纪发展目标的一项重大战略措施来抓。”“努力开创我国治水事业的新局面。”我们一定要以对党和人民高度负责的精神，努力完成党中央、国务院赋予我们水利建设的光荣任务。







1998年发生的特大洪灾，在党中央、国务院的直接领导和指挥下，这场抗洪抢险斗争取得了全面的胜利。对这次抗洪的经验，我们一定要认真地进行总结，加深我们对自然规律的认识和把握，不断增强我们抗御洪涝灾害的能力。另外，我们要清醒地认识到，我国水资源短缺的形势已越来越严峻。从长远来看，中国水资源的短缺对社会经济的发展将构成更大的威胁。因此，在新的形势下，我们要转变传统观念，要把水资源与国民经济和社会发展紧密联系起来，进行综合开发、科学管理。抓好对水资源的开发、利用、治理、配置、节约和保护工作，特别是在统一管理下进行水资源的优化配置与综合调控，提高水资源的利用效率与综合承载能力，建立以科学用水为基础的节水型社会的经济发展体系，保障水资源的可持续利用。

当代人口、资源和环境的协调发展已成为国际社会共同关注的重大问题。传统的发展模式，以单纯追求经济高速增长为目标，以过度消耗资源和牺牲环境为代价，导致了人类的基本生存条件受到威胁，直接影响到社会经济长期发展的基础。1992年6月在巴西里约热内卢召开了联合国环境与发展大会，会议通过了《21世纪议程》，提出了可持续发展的战略。可持续发展作为一种价值观和发展模式，具有三重涵义：一是和谐性，即在国家和区域范围内要实现其社会、经济和环境的协调发展，在追求经济目标的同时，对生产活动的社会效益和环境效益予以更高程度的重视；二是公平性，即不但要注重代际公平，也要注重当代人之间的社会分配相对公平，还要注重不同区域间发展水平的相对公平；三是可持续性，即通过提高资源利用效率和清洁生产的方式来实现增长，始终将发展需求控制在资源与环境的承载能力限度之内。

可持续发展的基础是资源。水是生命之源，是人类生存与发展的命脉。它直接关系到国计民生、社会发展和国家兴衰。水多为患，水少成灾，水脏贻害，处理不好，就会制约国民经济的可持续发展。面对我国社会主义现代化建设事业的发展需求和人口增长的压力，水资源整体态势将更为严峻。节约和保护水资源是我国的一项重大国策。认真解决好水的问题，已成为21世纪我国经济建设战略重点。

《中国水资源与可持续发展》是由张岳同志组织有关专家编著的一部专著，对水资源的可持续利用进行了系统的论述，并提出了有益的见解和建议，对深入研究我国的水资源问题具有指导意义。衷心希望全国水利工作者共同努力，为走出一条符合我国自然与人文特点的水资源可持续利用之路，贡献出自己的全部聪明才智。

汪恕诚

1999年6月9日



## 前言

当今世界普遍关注水资源短缺问题,无论是当代还是未来社会,其中最突出的矛盾就是水资源短缺。联合国预言到2000年,水将成为全世界最紧迫的自然资源问题,并特别指出,亚洲缺水问题已引起了人们对这个地区能否保持经济增长、社会发展和政治稳定的忧虑。科学家们警告,30多亿人口的亚洲,如果不立即采取行动保护水资源,水资源危机将难以控制。在缺水的背后不仅存在着粮食、土地或能源之争,而且已成为邻国之间和同一民族的不同地区之间发生争执,甚至爆发战争的根源。专家们一再警告,我们正进入一个新的水资源紧缺时代。1992年6月联合国环境与发展大会通过的《21世纪议程》,提出了可持续发展的战略。1993年联合国回顾了《21世纪议程》第十八章的有关条款,考虑到虽然一切社会和经济活动都极大地依赖于淡水的供应和质量,但人们并未普遍认识到水资源开发对提高经济生产力、改善生态环境和社会福利所起的作用;还考虑到随着人口增长和经济发展,许多国家将很快陷入缺水的困境,经济发展将受到限制;并进一步考虑到推动水的保护和持续性管理需要地方一级、全国一级、地区间、国际间的公众意识。第47届联合国大会通过决议,决定从1993年起把每年的3月22日定为“世界水日”。联合国召开一系列的会议和产生的决议,其目的就是唤起世界公众对水资源短缺有一个清醒的认识。

中国是世界上的人口大国,又是一个发展中的大国。党的十五大报告在论述我国跨世纪经济发展战略时强调指出:在现代化建设中必须实施可持续发展战略。这是基于我国人口众多,资源相对不足,环境污染严重,生态平衡遭受破坏等基本国情提出的重大决策。可持续发展是人类对生存与发展的一种新的认识,是认识上的质的飞跃。为保护人类能世世代代延续生存与发展,走可持续发展的道路,这是中国 and 世界各国未来生存与发展的共同选择,也是必然的选择。因此,可持续发展是带有战略性,并具有深远历史意义的必然选择。

可持续发展的基础是资源,因此,人口、资源和环境的协调发展的核心问题是资源能否满足人类世世代代的生存与发展的需求。水是生命之源,土是生存之本。人类的生存与繁衍,经济与社会的持续发展最基本的资源是水和土地。俗话说,“一方水土养一方人”。可持续发展的核心问题是人类与自然的和谐统一,使人口、资源和环境更加协调发展,这是可持续发展的根本目的。水是我们居住的星球上的一种特殊的物质和资源,它具有可循环性和独特的物理化学特性:耕地是一种特定的土地,是土地的精华,这两者都是不可替代的生活和生产资料。水资源和耕地又是一种持续性资源,只要合理利用,它可以永续地使用,而不致枯竭。但水土资源的有限性又注定了水资源和耕地利用的有限性。因此,水和耕地资源的有限性就决定了对其开发利用有根本性的制约,其开发利用只能在有限的资源数量上作文章,使有限的资源发挥出最大的作用,为可持续发展提供坚实的物质基础,以满足人口增长和经济社会发展的需要。总之,水资源在可持续发展中,是基础的基础,已成为世界公认的21世纪可持续发展的瓶颈,这正是中国共产党十四届五中全会将水利排在基础设施建设首位和把节水排在资源节约首位的原因所在。

1998年是中国不平凡的一年,南方的长江与北方的嫩江、松花江发生了特大洪水,但汛情未过,9月初约翰斯·霍普金斯大学发表的报告中就警告中国将面临水荒问题。认为目前饱受水灾蹂躏的中国大陆已有若干地区面临长期缺水的问题,而25年后几乎整个





中国大陆都将面临水荒。可见中国的水资源短缺问题已成为全世界关注的一个热点。中国经济社会发展要走可持续发展的道路,必须重视水资源的保护和节约使用。江泽民总书记特别强调要十分注意节约用地、节约用水。指出:“这两件事涉及农业的根本,人类生存的根本,在我国尤其意义重大。我们已经确立了可持续发展的重要战略,应该把节约用地、节约用水提到贯彻实施这一战略的高度来认识。”因此,要依法保护资源,决不能走浪费资源和先污染后治理的路子;要根据我国国情,选择有利于节约资源和保护环境的产业结构和消费方式。面对中国水资源日趋短缺的严峻现实,21世纪中国可持续发展的关键在水,因此,应当把节水作为水利改革与发展的战略重点。要坚持全面节流、积极开源、加强保护和有效管理的方针,在水资源开源与节流并举的方针上,节流必须放在首位。节流本身就是一种开源,但不意味着节流就可以不需要开源,节流是为了资源的有效利用和持续利用。因此,必须依靠科教兴水战略,全方位采取保护水资源和节约用水的措施,才能保障经济和社会的可持续发展。这不仅是实现两个根本性转变的重大举措,而且也是缓解我国水资源短缺的惟一出路。

水是人类生存与发展的命脉。在中国历史上,中国文明和经济区的形成和转移都是与水利兴衰分不开的。水又是一种战略资源,不仅牵动一个国家的发展和稳定,而且关系到世界的和平与发展。因此,要未雨绸缪,从战略的高度来研究水的问题,并制定相应的水政策。纵观21世纪经济与社会的发展问题,21世纪中叶中国要达到中等发达国家的水平,水仍然是保障经济社会可持续发展的一个关键问题,但实现水资源可持续利用,必须实现工程型水利向资源型水利的战略性转移,这种转移不仅需要改变传统观念,依靠现代科学技术和技术创新,通过资源的优化配置和措施的优化组合,实现水资源可持续利用,还必须有一个全方位的社会行动,有赖于社会各方面的支持和参与。因此,我们一定要高举邓小平理论的伟大旗帜,紧密团结在以江泽民同志为核心的党中央周围,增强全民族的水忧患意识,动员全体公民开展一场以“保护地球、全方位节水”为主题的“碧水绿洲”行动,大家都来关心水、保护水、爱惜水,并依靠国家政策性的调整和水资源的优化配置和有效利用,把中国建成一个水资源可持续利用的节水型社会。中国的水资源短缺不仅可以找到缓解办法,走可持续发展的道路,而且在人口、资源和环境的协调发展中,水可以发挥其主导作用。

本书在编写过程中得到有关领导和很多专家及有关同志的赐教和大力支持帮助,特别是全国政协副主席杨汝岱、陈俊生、钱正英及全国人大农业和农村委员会杨振怀副主任为本书赐墨题词,水利部部长汪恕诚为本书作序。水利部南京水文水资源研究所对完成书稿给予全力支持和帮助,中国水科院水资源所杨小柳、王浩、裴源生、于福亮等同志为本有关章节提供了资料。广西科学技术出版社的总编辑覃春同志对本书出版给予大力支持,在此一并表示衷心地感谢。

我们编著《中国水资源与可持续发展》一书,由于时间短,涉及面广,难度很大,特别是可持续发展的理论本身还在发展之中,水利改革与发展也在不断深化,面对21世纪的许多新情况和新问题都需要进一步研究和探索。因此,在短短的一年时间内完成书稿,有很多问题还很难研究深透,不妥或错误之处更是难免,敬请各位领导、专家和广大读者不吝指正。

张 岳  
1999年6月

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# Foreword

China is often afflicted by natural disasters related to water. The sustainable management of its water resources is essential for China's prosperity. This is an undeniable fact. During the 50 years since the founding of the People's Republic of China, the Central Committee of the Communist Party of China (CCCPC), the State Council has given high priority to water resources. A thousand million people have been mobilized to participate in large-scale water-control activities. A large number of basic water resources works have been built. All of these play a very important role in social stability and economic development. On a global average China consumes only one fourth of the world's water percapita but socio-economic development has significantly increased over the past 20 years. China has 9 per cent of the world's cultivated land, but it goes towards solving the food supply problem of 22 per cent of the world population. These facts have attracted the attention of the economic community. China is an excellent example of guaranteed socio-economic development as a result of protected water resources.

China's reform and open-door policy has been renowned for more than 20 years. Since the third plenary session of 11th CCPCC in 1978, water resources reform and development has changed radically based on economy-orientated strategies and policies. Over the past 20 years, national systems and water resources have undergone reforms and development has gone through a series of changes: from mainly agricultural to essentially national economic sectors; from planned economic system mechanisms to socialism market-orientated economic system mechanisms, from mainly social benefits to integrated socio-economic and environmental benefits. Water resources has been given high priority in the infrastructure of the national economy, which is a fundamental change. During the past 10 years, greater attention has been paid to the treatment of large rivers and lakes, irrigation and drainage, hydropower and rural electrification, rural and urban water supply, water environmental protection, water and social erosion prevention and treatment. This underlines the fact that water resources has entered a new development stage.



However, China's water problem is still enormous. Floods and logging disasters are a potential threat at all times. Drought and the degradation of water due to pollution also seriously threaten socio-economic development in China. 3 large disasters took place during the past 3 years, i.e. the pollution of the Huai River in 1996, the flow-stop of the Yellow River in 1997, and the large floods of the Yangtze, Nen and Songhua rivers in 1998. It has become apparent that floods and logging, water resources shortage and water pollution are amongst the most important obstacles to socio-economic development in our country. Therefore, water resources in China for the 21st century is a big challenge. Water resources is of the utmost importance and much still remains to be done. Mr. Jiang Zemin, Secretary-General of CCCPC, in his celebration speech on 1 January 1999, reminded us that "Water is the life-blood of human beings. Water is also the life-blood of agriculture and economy". "We will greatly enhance consciousness of water protection and utilization in China. Water resources should be considered as an important strategy towards guaranteeing trans-century development objectives". "We should strive to inaugurate a new phase of water control". We have to complete the glorious task of water resources, in a spirit of complete responsibility to the Party and the people.

Under the direct leadership of the CCCPC and the State Council, we won the battle against the 1998 floods. Experience gained while fighting the floods should be given the deepest thought in order to enable us to better understand and control nature, and gradually enhance our capacity to protect ourselves from and prevent and mitigate natural disasters. On the other hand, we should clearly recognise that water shortage problems are becoming more and more serious. From a long-term point of view, water shortage will be one of the biggest menaces to socio-economic development in China in the next Century. Bearing this in mind we should endeavour to change our traditional concepts. It is imperative to closely link water resources and socio-economic development, in order to improve integrated development and scientific management. Water resources development, utilization, regulation, allocation, saving and protection must be carried out in an efficient manner. In particular within the union management framework, water resources management should be carried out in an optimal manner with integrated operation and control in order to increase water resources utilization efficiency and capacity thereby establishing a new economic development system for saving water.

Today, population, resources and environmental development are very important issues. The traditional mode of development was pursuing high-speed economic objectives at the expense of the natural resources. Traditional methods may lead to the exhaustion of resources and threaten the environment, which will have a direct impact on socio-economic long-term development. In June 1992, Agenda 21 was issued during the United Nations Environment and Development Conference in Rio de Janeiro, Brazil. A sustainable development strategy was proposed including three

requirements: the first is harmony which means striving to achieve social, economic and environmental co-ordinated development in a country and/or a region while at the same time pursuing economic objectives the social and environmental benefits should be emphasized. The second is equity, which implies a sustainable development that not only emphasises equity among generations but also social resources distribution today as well as a relevant equity at the development level in different regions. The third is sustainability-economic achievement through increased efficiency thereby lessening the depletion of the natural resources linked to technologies that are productive without harming the environment. The quantity and quality of the available resources will always restrict development.

The basis of sustainable development is the availability of resources. Water is the source of life, the life-blood of human beings and is essential for development. It is directly related to the national economy, the livelihood of the people as well as social development. It is necessary for the prosperity of nations. Disasters brought about by too little or too much water as well as water pollution restrict the sustainable development of the national economy. Modern socialism influenced by the ever-increasing population growth, demands that water resources development be given serious attention. The safeguarding of this precious natural resource should be one of the top priorities of our national policy as it is a key issue towards economic development in 21st Century China.

On China's Water Resources and Sustainable Development is a special issue written by Mr. Zhang Yue and other specialists in this field. The book systematically summarises the development of sustainable water resources and includes points of view and recommendations. It will serve as a guide to water resources problems in China. I sincerely hope that all those involved in water resources will do their best to achieve the sustainable use of our water resources, bearing in mind our natural resources and the characteristics of the Chinese people, by seeking contributions of wisdom and genius from all concerned.

*Wang Shucheng*

Minister of Ministry of Water Resources





# Preface

The whole world is concerned by water scarcity both now and in the near future. According to the United Nations, water will be one of the major issues of the 21st Century and one of the most serious natural resources problems ever. Water shortage in Asia is already a source of concern and solutions must be found to enable economic growth and social development trends to continue and thus achieve political stability in the region. Scientists have predicted that in Asia, with a population of three billion, it will be difficult to control the water crisis if no active measures are taken to remediate the situation. Disputes over food, land and energy are often a result of water problems, as are conflicts between adjacent countries or adjacent areas in a country. Water or lack of it can even be a main reason for war. International experts have repeatedly warned that a water crisis is imminent. A sustainable development strategy was proposed in Agenda 21 issued by the United Nations Conference on Environment and Development in June 1992. "It was recognised that water is needed in all aspects of life and that it should be made certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and combating vectors of water-related diseases. Innovative technologies, including the improvement of indigenous technologies, are needed to fully utilise limited water resources and to safeguard those resources against pollution." It is imperative to raise awareness, at local, national, regional and international levels, with regard to all aspects of the world's water resources and its sustainable development. Many countries will be faced with water scarcity problems during the next Century and, as a result, economic development will be restricted. The 47th session of the United Nations designated 22 March each year as the World Day for Water. Since then, many conferences and symposia have been held and resolutions have been adopted with the aim of drawing the attention of governments, decision makers and the public at large to the imminent water crisis and the importance of water for survival. China is a developing country with a huge population. The report of the Central Committee of the Communist Party of China (CCCC) advocates a trans-century economic development policy through the implementation of a sustainable water resources strategy which should go hand-in-hand with modernisation.