杨玉坡 等著

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长江上游（川江）防护林研究

Researches on the Chuanjiang Protection Forests in the Upper Reaches of the Changjiang River

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内 容 简 介

本专集以国家"七五"重点科技攻关课题研究成果为基础，着重论述分析了长江上游川江部分水土流失地区防护林体系建设的自然环境条件、社会经济发展状况、农林与林种的合理结构、立地分类与评价、造林典型设计、防护林体系布局、小流域治理、森林的保土涵水作用等。以研究总报告及各子专题研究报告为主，兼论国内外防护林建设动态，提出防护林建设的技术纲要，观测计量的研究方法，达到有理论根据，有动态参考，有实际工作总结，有配套技术和研究方法的综述结果。

本专集可供从事防护林建设、森林生态、水土保持、绿化等方面的科技工作者参考及供大专院校有关专业师生阅读。

长江上游(川江)防护林研究

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前　言

四川省位于青藏高原东南缘与长江上游地区，地域辽阔，在中国总地势中处于第一、第二阶梯上。全省土地总面积 56.7 万 km^2，自然条件复杂，垂直差异明显，植物种类繁多，森林类型多样，是我国主要林区之一。四川省明显地分为东西两部分，西部地区地层破碎，山高坡陡，谷深流急，山地灾害频繁；东部地区的盆地西缘与西北缘山地，由于地形作用，是全国闻名的暴雨区；盆地中部的紫色丘陵，岩性松散，易于风化，土壤抗蚀力弱，人口稠密，垦殖指数高，是全国水土流失的严重地区之一。长江上游及其主要支流从西部海拔 4 000 m 以上的高山高原流经海拔 300—500 m 的四川盆地中部丘陵而注入长江中下游地区，因而有丰富的径流和巨大的落差，是我国水资源和水能资源富集的地区。全省年径流总量 3 182 亿 m^3，占长江入海口水量的 1/3，全国水源资源蕴藏量的 1/4。各主要支流不仅水量大，而且含沙量高，金沙江屏山站年输沙总量 4 亿 t 左右，占宜昌站的 50%；嘉陵江北碚站年输沙总量 1.7 亿 t，占宜昌站的 21%。由此可见，四川森林在维护长江流域的生态平衡，保持水土，保障水资源稳定，减少洪涝灾害，改善工农业生产的基本条件，保障人民的生活环境等方面上均具有十分重要的地位和作用。据《四川森林》研究(1992 年，中国林业出版社)，50 年代初，四川省森林覆盖率约 20%，其西部高山原始林区的森林覆盖率约 30—40%。自 1958 年以来，开始大规模的采伐，至 60 年代初，全省森林覆盖率下降到 9%，70 年代中期恢复到 13.3%。伴随着森林资源的急剧减少，造成西部原始林区集中过伐，森工企业可采资源面临枯竭。东部盆地的森林砍伐殆尽，大量林地在人口剧增等因素影响下，被辟为耕地，水土流失加剧，“四料”(木料、燃料、肥料和饲料)严重紧缺。全省生态环境恶化的迹象日益显露，雪线上升，森林线下降，干旱河谷扩展，旱灾频率增加，水土流失面积扩大。全省 50 年代水土流失面积为 9.4 万 km^2，80 年代增加到 23 万 km^2。长江干流上游年输沙量由 50 年代的 5 亿 t 上升到 80 年代的 6.2 亿 t 以上。岷江上游森林覆盖率 80 年代初较之 50 年代初下降了 11.2%，紫坪铺年平均径流量较 30 年代减少了 22 亿 m^3，成都平原及成都市冬春缺水日益突出。全省生态环境建设的紧迫性已经严峻地显示出来。

由于生态环境恶化，加上森林资源枯竭，林产品供需矛盾突出。四川省从 80 年代开始，陆续开展了森林与农业，森林与洪灾，林业发展战略，岷江上游森林生态考察，林业区划，四川森林专著等研究和讨论，对四川森林的防护地位和作用有了新的认识。1980 年，围绕 70 年代在四川各地连年发生的大面积旱灾，举行了农林关系学术讨论，在总结盐亭县灵山乡等地以林引路和山、水、田、林、路综合治理的实践基础上，第一次提出了建设川中农区防护林体系的建议。1981 年 7 月，四川发生特大洪灾，举国震惊，全国学术界举行了四川“81.7”洪灾考察和讨论，根据灾源在涪江、嘉陵江上游，危害在中下游盆地的事实，提出了流域治理与防护林体系建设的设想与建议。1982 年四川省正式向国家提出建设长江上游防护林体系的报告。1986 年 4 月，全国人大六届会议通过“七五”计划，明确提出

“要积极营造长江中上游水源涵养林和水土保持林”。1989年国家批准了《长江中上游防护体系建设一期工程总体规划》。同年，四川省在遂宁、南充、万县等地(市)的20个县的80个乡启动，1990年在规划的县份全面实施。

鉴于长江中上游防护林体系建设的重要性和迫切性，而且是在我国长江流域开展的规模最大的生态工程，有许多重大的技术关键和难题需要解决。只有依靠现代科学技术，大力开展各项试验示范，推广应用科技成果，才能提高工程质量，达到预期的建设目标。国家在制定“七五”期间重点科技攻关项目时，将长江上游防护林研究纳入计划。1985年受林业部和四川省林业厅委托，由四川省林业科学研究所(院)牵头，开展“长江上游水源涵养林、水土保持林营造技术研究可行性论证报告”的编写，后经多次修改定稿报国家审批。这一可行性论证报告，从长江上游地区的实际出发，以生态环境、社会经济条件、土地利用方式、林种结构、防护林布局、立地分类、小流域试验示范和综合治理等研究为主，着重从宏观与微观结合，软件与硬件并重，定性与定量兼容等技术路线出发开展研究工作。宏观研究的重点是为防护林体系建设的宏观决策服务和为其他研究专题提供背景资料和成果。微观研究则侧重不同类型区的小流域的试验示范，为长江防护林建设提供实战模式。因此，缩微必须注意其典型意义，扩宏一定要具有实用价值。由此可见，本课题研究的总目标非常明确，即是在长江上游地区为提高减沙涵水的功能的总前提下，紧紧围绕防护林的布局、结构、模式、效益等目标进行多学科的联合攻关，为长江防护林体系工程建设提供理论依据，总体布局，技术措施，小规模的试验示范以及配套技术系列等。

本课题组及其所属各专题，查阅了国内外大量有关的科技文献，吸取了前人研究成果。例如四川高山森林开发研究中关于保留森林防护骨架维护生态环境的概念，以及防护林分类与指标参数等；吸取了60年代初开始在理县米亚罗建立的当时世界较早的高山森林生态定位观测研究的方法与经验，运用了盐亭县灵山乡以林引路综合治理营造桤柏混交林模式以及南部、乐至营造大面积防护林等的成功作法；参考了国内外关于防护林树种选择原则、整地方式、造林技术和抚育管理等技术措施。本专集汇集了“七五”攻关研究的成果，主要内容有：研究总报告与专题研究报告，防护林体系建设的技术纲要，观测计量的研究方法等。对长江防护林作了理论上探讨、发展动态研究，提出了防护林体系建设的配套技术等，这些对提高长江防护林工程建设的质量将有一定的应用参考价值。值得指出的是，“七五”期间，基于长江上游(川江)的自然、经济条件和存在的主要问题，而提出了“长江上游水源涵养林水土保持林营造技术研究课题”，在长江防护林工程启动后，由于客观上需要，在课题实施过程中加重了水土保持林研究，并且从体系建设角度扩宽了研究内涵，这样就能更好地为长江防护林建设工程服务。

根据“七五”期间一系列研究，初步认为：在四川东部丘陵地区，由于人多地少，森林资源贫乏，对生态环境及多种林产品的需求都很强烈，不可能拿出更多的土地来营造防护林。在这一地区首先应当考虑的是建设“骨干防护林带”，它的位置是在江河分水岭和沿岸。再根据地理景观和因害设防原则，建设次一级的“主要防护林带”和“一般防护林带(网)”，形成流域上下游之间，坡面上下部位之间，不同土地利用方式之间的层层设防与滞流固土的防护林网络结构，发挥防护林的整体功能和效益。凡是“主体防护林带”所经过的地段，都应造林或退耕造林，在此基础上再将其他林种有机的组合与配置，实行多林互补，一林多效，形成生态经济型防护林体系，以发挥森林总体的多种功能和效益。值得指出的

是，凡“主体防护林”所经过的地带，应视立地条件好坏，注意树种选择，发展防护用材林、防护薪炭林、防护经济林等兼用林，以发挥其经济效益。而组合进防护林体系的其他林种，也应在维护防护功能的前提下，加以经营利用，以发挥其生态效益。在防护林体系建设中，由于主要经营目的是生态利用，尤应注意森林自然群落的特性，在创建人工林分结构时，既要注意立地条件的复杂性选择适宜的树种，又要形成群落层次结构的多样化。遵循生态学原理，防护林应成为多树种、多层次、异龄化与合理密度的林分结构，并且在乔、灌、草，针叶树与阔叶树，深根性与浅根性，耐阴性与喜光性，速生与慢生等不同树种特性的有机结合，同时还应考虑改良土壤与固土能力强弱，经济价值高低的森林植物材料等等因素而组合成不同的林分结构模式。林分结构模式应多样化和本土化。并且在防护林的总体布局上，除了将不同性质和用途的林分结构模式有机的组合进去，而且还应根据四川的自然条件和社会经济特点，以及现有的研究成果，划分成不同的森林功能区域：在川西高山和盆地西缘、北缘高海拔地带的河流上游，应建设成为以水源涵养林为主，用材林、特用林等相结合的专用防护林体系；在四川盆地丘陵区建设以水土保持林为主，薪炭林、经济林与农田林网相结合的兼用防护林体系；在川南、川西南和川东山地建设用材林、经济林和水源林、水保林相结合的森林防护体系。尚应指出的是，防护林是以发挥森林防护功能为主要经营目的的一种林种，在防护林体系建设中应处于主体地位。在营建防护林体系的地区，应将设置在不同地貌类型和部位，起不同防护作用的人工营造的或现有的森林，按照总体规划的要求，将它们有机的结合起来，自然形成一个完整的体系。只有这样才能称得上是“多林种有机结合”，达到多林互补，一林多用的防护效果。

长江防护林体系建设的技术研究，按其专题设置是属于组合性、层次性和配套性的技术体系研究，具有较强的针对性、实用性和综合性。本课题研究，就其总体而言，是以提高防护林生态效益和经济益为核心，研究不同类型区防护林体系的结构、布局、模式与功能、效益等生态林业工程建设技术，以及造林、绿化、营林、预测、评价等技术。从长江上游特定的自然、经济条件出发，今后应注意研究提出不同类型区的防护林分类技术，防护林空间配置技术，人工群落的组合技术，抗旱造林技术，更新改造技术，坡面治理技术，生态模拟技术，计量观测技术，动态监测技术，经营调控技术，效益评价技术，效益预测技术，灾害预警技术等等。经过归纳、组合和综合形成生态林业工程建设技术体系，为我国乃至世界上的林学和防护林学的理论和实践的发展作出新的贡献。

“七五”期间，本课题研究是在林业部主持下进行的。四川省林业厅、中国科学院成都分院联合组成的攻关项目领导小组、技术组和办公室具体领导了本项目的实施。林业部科技司刘效章副司长，王淑元、杨林梅、林升寿等专家对本项研究十分重视，给予了支持和指导。国家计委、国家科委和林业部、中国科学院曾于 1991 年 3 月对本课题进行了评估和验收。参加本项研究的单位有：中国科学院成都山地灾害与环境研究所、成都生物研究所、植物研究所、系统科学研究所、应用遥感研究所、四川省林业科学研究院、四川省林业勘察设计研究院、四川省水利水电科学研究所、四川农业大学、北京林业大学、成都科技大学、四川省林业学校、四川省林业干部学校、以及地市县的林业科研、生产和管理等单位共计 600 余名科技工作者参予的联合攻关。在 44 个四级专题中绝大部分进行了评审鉴定，三级专题全部评审验收，许多成果，特别是首次提出的“长江上游川江防护林体系建设技术纲要”已在生产上推广试用，受到好评。

本研究专集由杨玉坡任主编，李自刚、李信卫、银承忠、张江陵任副主编，程林、李代秀参加编辑工作，四川省教育学院外语系王荣生为本专集英文翻译。

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杨玉坡

1992年12月25日

PREFACE

Sichuan, one of the biggest provinces in China, is situated at the southeast edge of the Qinghai - Xizang Plateau, in the upper reaches of the Changjiang River and on the first and second ladders of China's general landscape. It covers an area of 567,000 square kilometers with geographical complexities and striking vertical differences. It is known as one of China's major forest regions for its great variety of plant species and forest kinds. Sichuan clearly falls into two parts: the west part and the east part. The west part, with its broken strata, features high mountains and steep slopes, deep valleys and swift rivers. Those topographical peculiarities leave its mountainous regions at the mercy of frequent natural hazards. In the east part, on the other hand, the mountain lands lying at the west and northwest edges of the Sichuan Basin are a notorious storm-hit area in China thanks to their special landform. Central Sichuan Basin, which is handicapped by loosely-structured, easy-to-wear and weak soil erosion-withstanding purple hills, as well as by a high farming index arising from a dense population, is among China's major areas that suffer the severest water and soil loss. The upper reaches of the Changjiang River, along with its main branches, originating from great mountains and plateaus more than 4,000 meters above sea level in west Sichuan, running across hills of 300—500 meters above sea level in central Sichuan Basin into the middle and lower reaches of the Changjiang River, has a prodigious runoff and a big fall of water head. A leading area in China in matters of water and water energy resources, Sichuan shows an annual runoff up to 318. 2 billion cubic meters, accounting for one third of the entire amount of the Changjiang River entering the sea and one fourth of the total water resource in the country. Apart from their huge water volume, the main branches in the upper reaches of the Changjiang River also have a high silt concentration. Pingshan Station in the Jialing River produces approximately 400 million tons of silt discharge per year, amounting to 50 percent of that of Yichang Station; Beibei Station in the Jialing River produces 170 million tons of silt discharge per year, being 21 percent of that of Yichang Station. This accentuates the importance of the forests in Sichuan in maintaining the ecological balance in the Changjiang River watershed, conserving water and soil, keeping sustained water resources, reducing flood and other natural disasters, improving the essential conditions for agriculture and industry and protecting the human environment. According to the book *Forests of Sichuan* (1992 edition, China Forestry Publishing House), the early 1950s found the forest coverage in Sichuan to be 20 percent as an average, and even as high as 30—40 percent in the mountainous primitive forest regions in the west part of Sichuan. Unfortunately, from 1958 on, Sichuan's forests were subjected to abusive cutting to the extent that by the early 1960s its forest coverage shrank to 9 percent. Only in the mid 1970s did the percentage gradually rise to 13. 3%. The drastic diminishing of the forest resources was followed by the concentrative cutting carried out in the primitive forest regions in west Sichuan, getting the forestry enterprises on the brink of having no forest resources to exploit. What is even worse, the forests that once covered east Sichuan Basin have practically vanished due to excessive felling, and vast

expanses of forestland have been turned into farmland on account of the population explosion and other human activities. With this has come a growing water and soil loss as well as an alarming shortage of timber, fuelwood, fertilizer and feed. This has also led to an increasing ecological deterioration in Sichuan as a whole, manifesting itself in the raise of snow line, the dropping of the forest line, the expansion of arid valleys, the higher frequency of droughts and the broadening of water and soil loss area. During the 1950s the province got only 94,000 square kilometers of water and soil loss, while during the 1980s the area of water and soil loss which it sustained rose to 230,000 square kilometers. In the upper reaches of the main branches of the Changjiang River the annual silt discharge increased from 500 million tons in the 1950s to more than 620 million tons in the 1980s. The forest coverage in the upper reaches of the Minjiang River dropped by 11.2 percent in the 1980s against the 1950s and the annual mean runoff in Zipingpu decreased 2.2 billion m^3 as compared to the 1930s. Chengdu City as well as Chengdu Plain where it is located suffers a growing water shortage in winter and spring. All this highlights the necessity of speeding up ecological construction in Sichuan.

The ecological worsening and the fast dwindling of forest resources together have precipitated a sharp contradiction between the supply of and demand for forest products. From the 80s forward, massive efforts have been made to study extensively the relationship between forestry and agriculture, between forestry and flood, and development strategy, to survey the forest ecology in the upper reaches of the Minjiang River and regionalization of forestry, and to publish writings on Sichuan's forests. Those efforts have deepened the understanding of the protective role on the part of the forests in the province. A forestry-agriculture symposium was held in Sichuan in 1980 to discuss the lessons from the large-scale droughts which hit many parts of Sichuan for years running in the 1970s. At the symposium the scientists originated the idea of building up a protection forest system in the rural areas of central Sichuan, by drawing the experience of Lingshan Township, Yanting County that forestry played a leading part in the combined harnessing of mountains, waters, farmland, forests and roads. Soon after July 1981 when Sichuan was violently struck by a China-shocking deluge, scientists from many parts of the country responded by conducting investigations and seminars on Sichuan Deluge (July 1981). They advanced ideas and proposals regarding how to control the valleys of the Fujiang and Jialing rivers as well as to establish a protection forest system against the dangers on Sichuan Basin imposed by the upper reaches of the two rivers. In 1982 Sichuan Provincial Government submitted an application to the state for the construction of a protection forest system in the upper reaches of the Changjiang River. Following that, the Sixth National People's Congress held in April 1986 passed "the Seventh Five-Year Plan", which specified that "vigorous efforts be taken to plant trees for water supply and water and soil conservation in the upper reaches of the Changjiang River." In 1989 the state approved "the Overall Plan for the First-Stage Construction Project of the Protection Forest System in the Middle and Upper Reaches of the Changjiang River". In the same year, the plan started to be executed in 80 townships in 20 counties of Suining, Nanchong and Anxian Cities in Sichuan; 1990 saw the plan well under way in the areas concerned.

Partly to its urgency in implementation, and partly to its importance as China's grandest e-

cological project in the Changjiang River watershed, the protection forest system project in the middle and upper reaches of the Changjiang River calls for great efforts to tackle many key technical problems and difficulties. So, up-to-date science and technology, testing demonstrations of various forms and practical application of scientific research results are essential to the successful fulfilment of the expected goal of the project. To that end, the state put the research project of the protection forest system of the Changjiang River on the list of the key projects of science and technology included in "the Seventh Five-Year Plan." Entrusted by Chinese Ministry of Forestry and Sichuan Department of Forestry in 1985, Sichuan Research Institute of Forestry led the effort to prepare "A Feasibility Study on Planting Techniques Related to the Water Supply Conservation Forest and Water and Soil Conservation Forest in the Upper Reaches of the Changjiang River". Having undergone repeated proof-reading and revisions, the study was presented to the state for approval. On the basis of the practical conditions of the regions in the upper reaches of the Changjiang River, it covers, in its researches, ecological environment, social and economic conditions, ways of land use, forest kind structure, protection forest arrangement, site classification, experimental models of minor basins, all-around control, etc. The research effort integrated macro and micro methods, software and hardware, qualitative and quantitative analyses. Macroscopically, the focus was laid on serving the general decision-making in the construction of the protection forest system and providing other research projects with background information as well as research results, whereas with the micro-approach the emphasis was placed on minor-basin experimental models for different zones in order to present simulation samples for the protection forest project. In view of this, the micro-research must be typical and the macro-research applicable. Seen from the foregoing description, the chief objective of the research project was clearly defined; under the prerequisite of improving the silt-reducing and water-harnessing functions of the protection forests in the upper reaches of the Changjiang River, it would offer theoretic reasons, general arrangements, technical possibilities, small-scale testing demonstrations and other complementary techniques for the Changjiang River Protection Forest System Project by conducting multi-subject researches centering around the layout, structure, modes and benefits of the protection forests.

Through extensive reading of scientific literature available in China and other countries, the scientists in this research group and its sub-groups absorbed the research achievements contributed by scientists of earlier generations. We borrowed the notion of preserving the forest protecting frame so as to keep the ecological environment unspoiled in the developing process of the alpine forests in Sichuan. We also drew upon the concepts of classification, indexes and parameters of the protection forests, turned to good account the world-pioneering approaches established in Miyaluo, Lixian County, west Sichuan in the early 60s in relation to positioning observation and research on alpine forest and ecology. Besides, we also adopted Lingshan Model in Yanting County in which forestry took the lead in the overall control and in the plantation of mixed forests of alder and cypress. Furthermore, we applied the successful practice in Nanbu and Lezhi counties as to the large-scale plantation of protection forests. Finally, we made reference to the principles on selecting tree species, patterns of soil preparation, forestation techniques, tending and management of protection

forests as practised both in China and abroad.

This collection of essays covers all major achievements of the research project, including a general report on the project, reports on specific researches under the project, a technological program for the construction of the protection forest system in the upper reaches of the Changjiang River, monitoring and measuring methods, etc. The papers contained herein have made theoretic studies and developed dynamic research approaches on the Changjiang River protection forests, as well as offered complementing techniques in connection with building the Changjiang River protection forest system. All those accomplishments are of considerable value of reference to improving the quality of the Changjiang River protection forest project. It deserves special mentioning here that during the Seventh Five-Year Plan period the technological research project on the forestation of water source forests and water and soil conserving forests in the upper reaches of the Changjiang River was conducted on the basis of the natural and economic conditions and their main problems in the watershed of the upper reaches. With its start-up, the Changjiang River protection forest project made the researches in this regard all the more important in implementing the general research project. The researches have opened up new horizons by addressing themselves to the protection forest system construction, and so contributes more significantly to the protection forest project.

The research project conducted during "the Seventh Five-year Plan" indicates that the hilly areas of east Sichuan do not offer much land for plantation of protection forests, simply because of the sharp disbalance between land shortage and population overgrowth, of the scanty forest resources and of the strong demand tor a better ecological environment as well as for a variety of forest products. For this reason, top priority is to be given to building "a key protection forest belt" in watersheds and along river banks. That is to be followed by the establishment of "a major protection forest belt" and "a general protectipn forest belt (or network) of the second level. In doing that, it is expected to bring about a water-intercepting and soil-fixing protection forest network which, extending between the upper and lower reaches of tne river basins, between the upper and lower parts of slopes, between different ways of land use, will perform overall functions and yield various benefits. Forests should be where "the principal protection forest belt" passes, followed by the organic integration and arrangement of different kinds of forest in an attempt to establish an ecological protection forest system in which several forest types join functions and a single forest type plays several roles. It must be pointed out that where "the principal protection forest belt" runs across, efforts should be taken to select, according to the natural conditions of sites, suitable species for protective timber forests, protective fuelwood forests and protective economic forests, so as to bring their economic role into full play. In addition, the other forest types making up the protection forest system are to be fully exploited in the matter of eco-economic gains under the primary condition of maintaining their protection role. As ecological utilization is the chief concern of forest management in constructing the protection forest system, the characteristics of forest natural communities deserve special attention. Accordingly, in establishing artificial stand structure, care should be taken not only to choose tree species adaptable to the complex conditions of sites, but also to create a diversity of community levels and structures. Adhering to the

ecological rule, a stand structure should be provided with various tree species and multiple levels, uneven-agedness and a desirable density. Diverse stand structure modes should be formed to incorporate trees, shrubs anbd grass, coniferous trees and broad-leaf trees, deep-rooted plants and shallow-rooted plants, sciophytes and heliophiles, and fast-growing plants and slow-growing plants. Moreover, it is necessary to consider adopting plants and other forest elements with different capacities in improving soil, hardening ground, and yielding economic benefit, in an effort to set up various modes of stand structure. The patterns of stand structure should be at once diversified and localised. Apart from blending stand sructure modes of different characters and applications, the general layout of protection forests should be categorised into diverse zones of forest functions in compliance with the natural, social and economic circumstances in Sichuan, and on the basis of the existing research results concerned. Namely, a special protection forest system mainly consisting of water supply conservation forests complete with timber forests and forests of special use, will be built up in the upper reaches of the rivers running across high mountains in west Sichuan, and the highlands touching the northern and southern edges of the Sichuan Basin. A protection forest system of many applications, which, with its water and soil conservation forests as the majority, integrates fuelwood forests, economic forests and a farmland forest network, will be established in the hilly areas of the Sichuan Basin; a protection forest system made up of timber forests, econmic forests, water supply conservation forests and water and soil conservation forests will be planted in the mountainous areas of the southern, southeast and east parts of Sichuan. It is pointed out that protection forest, a forest species which chiefly plays a protective role, holds a leading place in the construction of the protection forest system. Therefore, in regions where a protection forest system will be set up, artificial or natural forests distributed in localities of diverse topographic types and serving different protective purposes should be turned into an integral system in agreement with the requirements specified in the overall plan. All these measures are aimed to achieve "an organic combination of many forest types "featuring joint roles performed by several forest types and several roles by a single forest type.

The research project pertaining to the building of the protection forest system in the Changjiang River is by nature a technical research system of combinativeness, multilevels and complementarity, which have specific, practical and synthetic features. The project as a whole, conducted around the eco-ecological benefits of protection forests, covers the structure, layout, patterns, and functions of protection forest systems in different types of zones, involving such techniques as the eco-forestry project, plantation, afforestation, silviculture, prediction and assessment. As is required by the natural and economic circumstances in the upper reaches of the Changjiang River, future researches should direct attention towards classification of protection forests in various types of zones, spatial arrangement of protection forests, grouping of artificial communities, anti-drought forestation, regeneration and transformation of forests harnessing of slope surface, ecological simulation, measuring observation, dynamic monitoring, managerial control, benefit appraisal and prediction as well as hazard alarming. By dint of induction, combination and synthesis, those techniques have formed themselves into a complete techological system related to the eco-forestry construction project, making new contributions to the forestry science and and

the theory of forest protection both in China and in the world.

This research project was conducted under the sponsorship of Chinese Ministry of Forestry during "the Seventh Five-Year Plan." The leading group, technical group and office set up jointly by Sichuan Department of Forestry and Chengdu Branch of Chinese Academy of Sciences took charge of the execution of the project. The project also got support and guidance from Liu Xiaozhang, Deputy Director of the Department of Science and Technology under Chinese Minitry of Forestry, and Wang Shuyuan, Yang Linmei and Lin Shengshou, forestry experts from the Ministry. The State Planning Commission, the State Commission of Science and Technology, the Ministry of Forestry and Chinese Academy of Sciences joined effort to conduct evaluation and acceptance on the project in March, 1993. Approximately 600 scientists participated in the project, coming form Chengdu Institute of Mountain Hazards and Environment, Chengdu Institute of Biology, Beijing Institue of Plants, Changsha Institute of Agricultural Modernization, Sichuan Research Institue of Forestry, Sichuan Survey and Design Institute of Forestry, Sichuan Agricultural University, Beijing Agricultural University, Chengdu University of Science and Technology, Forestry School of Sichuan Province and a number of research institutions, production units and administrations of forestry at both county and prefectural levels. Most of the 44 fourth-grade research sub-projects and part of the third-grade research sub-projects passed checking acceptance. Many of the research achievements associated with the project, particularly "the Technological Program for the Construcion of the Protection Forest System in the Upper Reaches of the Changjiang River" advanced in China for the first time, have been in operation, winning considerable acclaimation.

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Prof. Yang Yupo
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