



Learning lessons from China's forest rehabilitation efforts

National level review and special focus on Guangdong Province

Editors

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The Center for International Forestry Research (CIFOR) is a leading international forestry research organisation established in 1993 in response to global concerns about the social, environmental, and economic consequences of forest loss and degradation. CIFOR is dedicated to developing policies and technologies for sustainable use and management of forests, and for enhancing the well-being of people in developing countries who rely on tropical forests for their livelihoods. CIFOR is one of the 15 centres supported by the Consultative Group on International Agricultural Research (CGIAR). With headquarters in Bogor, Indonesia, CIFOR has regional offices in Brazil, Burkina Faso, Cameroon and Zimbabwe, and it works in over 30 other countries around the world.

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Preface

Many tropical countries have achieved economic growth at the expense of converting their forests. Some of those countries have prospered and others remain impoverished despite converting their forests. Both have the will now to restore some of their lost forest cover and commit resources to this end.

Forest rehabilitation is not a new phenomenon. But as tropical forest conversion continues seemingly unabated, rehabilitating degraded landscapes is likely to become more and more important. Countries individually or collectively will increasingly turn to rehabilitation to undo the negative consequences of diminishing forest cover. Countries that had or still have large forested areas, like Brazil, Indonesia, Vietnam, Philippines and China, have initiated programs meant to restore millions of hectares.

Forest rehabilitation is a major concern for the Center for International Forestry Research and its partners. Future benefits from forests will in many places only be assured if forests can be successfully rehabilitated. Downstream water quality and flows, biodiversity conservation, raw material supply and forest-based income for the poor will depend on it. CIFOR has since its beginning undertaken research programs and projects that address forest rehabilitation.

This report is one of six emerging from the study 'Review of forest rehabilitation: Lessons from the past'. This study attempted to capture the rich but under-utilised experiences of many years of forest rehabilitation in Brazil, China, Indonesia, Peru, Philippines and Vietnam, and make this information available to guide ongoing and future rehabilitation efforts. The study was carried out with generous contributions from the Government of Japan.

We present this and the other five study reports in the hope that the lessons they contain will be relevant for people who are concerned about tropical forests, and that as a result societies will continue to enjoy the benefits that tropical forests can provide.

Markku Kanninen

Director Environmental Services and Sustainable Use of Forests Programme

CIFOR

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Our gratitude to the numerous people in CIFOR, World Agroforestry Centre (ICRAF), The World Conservation Union (IUCN), Food and Agriculture Organization of the United Nations (FAO), German Technical Cooperation (GTZ), World Wide Fund for Nature (WWF) and elsewhere who helped develop the original project design and survey questions across the six study countries — Philippines, China, Vietnam, Indonesia, Peru and Brazil. We are grateful to

all the individuals and agencies in China who responded to CIFOR's preliminary questionnaires or shared their insights during our initial visit and via e-mails. Last but not least, our sincere thanks to WWF China for their support at the start of this study.

Glossary

AVHRR	Advanced Very High Resolution Radiometer
CCICED	China Council for International Cooperation on Environment & Development
CIFOR	Center for International Forestry Research
FAO	Food and Agriculture Organization of the United Nations
FSDIGD	Forest Survey and Design Institute of Guangdong
GAF	Guangdong Academy of Forestry
GAS	Guangdong Academy of Science
GCEB	Guangdong Chorography Editing Board
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFB	Guangdong Forestry Bureau
GFEB	Guangdong Forestry Editing Board
GIS	Geographic Information System
GPS	Global Positioning System
GTZ	German Technical Cooperation
ICRAF	World Agroforestry Centre
ITTO	International Tropical Timber Organisation
IUCN	The World Conservation Union
LPG	Liquid petroleum gas
LRDGP	Land and Resources Department of Guangdong Province
MIST	Mountain Integrated Survey Team
MOF	Ministry of Forestry
NAPOGP	National Afforestation Project Office of Guangdong Province
POSFA	Propaganda Office of State Forestry Administration
RITF	Research Institute of Tropical Forestry
RMB	Chinese Yuan Renminbi
SCAU	South China Agriculture University
SDASFB	Survey and Design Academy of the State Forestry Bureau

SFA	State Forestry Administration
SMD	Silviculture Management Department of Guangdong Forestry Bureau
UNDP	United Nations Development Program
USD	United States Dollar
WOSMOC	Website of Science Museums of China
WTO	World Trade Organisation
WWF	World Wide Fund for Nature
ZFB	Zhongshan Forestry Bureau
<i>Afforestation</i>	In China, it refers to forest establishment through planting trees, aerial seeding or <i>mountain closure</i> on barren mountains, barren sandy land, <i>sparse forests</i> , burnt-over and logged-over forest areas, and some shrublands and grasslands. It also includes planting trees along roads and rivers, around houses and villages and as shelterbelts in farms. The term “ <i>afforestation</i> ” as used in China includes regreening recently deforested areas.
<i>Ecological forest</i>	Non-commercial forests for the purpose of maintaining and improving the ecological balance and the environment, conserving biodiversity, and providing non-timber forest products.
<i>Economic forests or plantations</i>	Forests for non-wood products such as fruits, edible oils, beverages, fodder, medicines, spices and industrial materials like rubber for cash income.
<i>Greening</i>	Increasing forest canopy cover to a certain percentage or above, and is expected to result from <i>afforestation</i> .
<i>mu</i>	Land area equal to 1/15 th of a hectare.
<i>Mountain closure</i>	Closing public access to degraded forests and forest land with natural regeneration capacity to enable natural forest recovery.
<i>Non-public system</i>	<i>Afforestation</i> and management of forest land by any individuals or agencies for income with their own investment through lease, tenure transfer, contract, <i>stock-sharing</i> or joint management mode.
<i>Sparse forests</i>	Areas with less than 20 percent tree canopy cover (< 30 percent prior to 1996).
<i>Stock-sharing</i>	Farm households contribute land, and companies contribute funds and establish, manage and harvest the timber plantations in a <i>stock-sharing</i> system. Benefit-sharing arrangements would generally be in the ratio 70:30, company to farm households. Fruits and other non-timber products are often included as additional incentives for farmers.

Chapter I

Introduction

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Forest cover is decreasing or very low in many tropical landscapes following decades of logging, fire and other human disturbances. At the same time, there are large and growing areas of degraded forest lands¹ that need to be rehabilitated to again provide forest goods and services and meet local livelihood needs. National, international, local and private agencies have invested in innumerable rehabilitation initiatives in the tropics. Some countries such as China and the Philippines started earlier than others. Some countries are winding up large programs and others are initiating them. The initiatives have differed in scale, objectives, costs, implementation strategies, and in how much they considered socio-economic and institutional aspects. Lots of money has been spent, but have these efforts actually increased forest cover, helped local communities, enhanced biodiversity and environmental services, or contributed to meeting timber needs? Did they address the underlying degradation causes and were the rehabilitated areas maintained in the long term? What are the most promising approaches and what enabling factors are required to sustain the efforts?

¹ There is no official term “degraded forest land” in China. We calculated degraded forest land to be the sum of five categories of forest land cover in the national inventory: barren land suitable for planting trees, burnt-over forest areas, logged-over areas, barren sandy land suitable for planting trees and *sparse forest*. Forest land in addition includes forests, shrub land (natural cover in parts of northern China), young plantations and seedling nurseries.

This report reviewing forest rehabilitation in China is part of a larger study by the Center for International Forestry Research (CIFOR) and national partners to assess efforts across six countries to try and answer the above questions and derive lessons for planning and guiding future efforts. The countries are Peru, Brazil, Indonesia, Vietnam, China and the Philippines. The study aimed to increase the chances of success for future rehabilitation efforts by identifying the approaches that contributed to longer-term sustainability and positive outcomes for different stakeholders. The CIFOR team designed and used common methods to be able to compare approaches, outcomes and influencing factors across the study countries. The methods were modified as necessary to fit the specific country contexts.

Rehabilitation of degraded forest lands has been ongoing in China for centuries. Efforts intensified late last century, starting from the 1980s. In 1998, China had about 64.2 million ha of degraded forest lands, with high livelihood pressures on these lands and remaining forests, particularly in the western regions. China's rapid economic development and construction activity since its 1978 policy reform has further increased the domestic demand for forest products, including sawn timber, plywood, panels, pulp and paper, furniture, bamboo and other non-timber products (Shi *et al.* 1997, Sun *et al.* 2004). Exports of China's cheap end products (most importantly furniture, paper and plywood) have also risen dramatically since the 1990s (Sun *et al.* 2004) and China has become the world's largest wood workshop (White *et al.* 2006). The country now faces a massive shortage of wood resources to feed its industries, and meet local consumption and international demand (Yin 1998, Bull and Nilsson 2004).

At the same time, continuing and expanding environmental problems have been attributed to deforestation and have generated concerns for forest conservation and rehabilitation (Shi *et al.* 1997, Li 2004, Liu and Diamond 2005). These include major flooding events as in 1998, the 200-day drought in 1997, severe soil erosion affecting 38 percent of the land area, desertification and sandstorms in the north and coastal typhoon damage. Increasing demand for environmental protection and national economic growth as well as development of the poorer western region, is at present driving massive forest rehabilitation efforts throughout the country. These efforts are accompanied by a logging ban or reduced allowable cuts in state-owned forest regions.

What has been the nature of these rehabilitation efforts and their outcomes? Did they meet or are they likely to meet their environmental, economic and social objectives? What are the constraints faced? It is imperative that China succeeds in its rehabilitation efforts in order to meet its growing demand for timber and environmental services. Failure on this front will not only affect China but also have global impacts due to continued imports of raw material (often unsustainably

or illegally sourced) and environmental degradation elsewhere (Katsigris *et al.* 2004). Additionally, could forest rehabilitation and management contribute to China's western region development plan and help alleviate poverty in that region as proposed?

This report presents the results of the China study which had two components:

- a) A national-level review of forest rehabilitation using the literature and inventory data.
- b) Review of forest rehabilitation in Guangdong Province
 - Using the literature and inventory data
 - Detailed characterisation and analysis of 22 cases, their outcomes and influencing factors using technical, socio-economic, financial and other parameters
 - Consultative workshop to understand the perspectives of key actors involved in rehabilitation projects.

The main objective of the study and this volume is to enhance the success and sustainability of forest rehabilitation efforts in Guangdong Province and China by:

- Assessing the characteristics and outcomes of past rehabilitation efforts,
- Assessing the main constraints and challenges faced, and
- Identifying and disseminating the most promising approaches and incentives that could lead to positive outcomes and long-term sustainability.

Guangdong is one of China's most economically-developed provinces, with many rehabilitation experiences, policy incentives and achievements to draw lessons from. Lessons learnt from China's and Guangdong's long rehabilitation history and diversity of approaches and institutional arrangements will be useful for other countries across the tropical and subtropical zone as well. Underlying concerns and motivations driving rehabilitation efforts are often similar.

1. Terminology and scope of the review

Numerous terms have been used in the literature to refer to regrowing trees on formerly forested lands: rehabilitation, restoration, reclamation, reforestation and afforestation. Scientists, policy makers, practitioners and the public media tend to use these terms loosely and interchangeably. However, different authors define the terms relatively consistently based on the objectives, approaches used and the type of land targeted (www.cifor.cgiar.org/rehab/_ref/glossary). Accordingly:

- Reclamation aims to enhance productivity and little of the original biodiversity. Exotic species are commonly used.

4 | Learning lessons from China's forest rehabilitation efforts

- Restoration tries to recreate the original forest diversity, structure and function.
- Rehabilitation attempts to return the forest to a stable and productive condition, but not necessarily the original diversity, structure and function. It could include native and exotic species. The protective function and many of the ecological services of the original forest may be re-established.
- Afforestation refers to establishing a forest on land without forest cover in the recent past. Some authors suggest that afforestation includes only artificial means while others include planting, seeding and assisted natural regeneration.
- Reforestation refers to establishing a forest on recently deforested lands. Some authors qualify “recent” as < 10 years and others as < 50 years.

The generic term “rehabilitation” is used in the six-country study and in this volume to cover all activities designed to bring back trees on formerly-forested grasslands, brushlands, scrublands or barren areas for productive, livelihood and/or environmental purposes (www.cifor.cgiar.org/rehab/_ref/study/index.htm). It includes forest establishment via planting, seeding, assisted natural regeneration and agroforestry. In China the term “*afforestation*”² covers all such activities and includes forest establishment through planting trees, aerial seeding or “*mountain closure*”³ on barren mountains, barren sandy land, *sparse forests*⁴, *burnt-over and logged-over forest areas*, and some *shrublands*⁵ and *grasslands*⁶. It also includes planting trees along roads and rivers, around houses and villages and as shelterbelts in farms. Thus, the terms “rehabilitation” and “afforestation” are used interchangeably in this volume. The term “*greening*” commonly used in China refers to increasing forest canopy cover to a certain percentage or above, and is expected to result from *afforestation*.

Based on their end uses, the forest established could be classified as timber, fuelwood, protective, special use or economic forests (People's Congress 1998). Protective forests are intended to help safeguard other forests, shrublands, roads, farmland, pasture land, riverbanks and coastal areas from soil erosion, wind and fire; stabilise sand dunes; and conserve watersheds. Special-use forests are for memorial, defence, research, environmental protection, scenic landscape or nature

2 The term “*afforestation*” as used in China includes regreening recently deforested areas.

3 “*Mountain closure*” means closing public access to degraded forests and forest land with natural regeneration capacity to enable natural forest recovery.

4 *Sparse forests* are areas with less than 20 percent tree canopy cover (< 30 % prior to 1996).

5 Some natural shrublands exist in parts of China. In Guangdong, shrublands are mostly degraded vegetation types and identified as suitable for planting trees.

6 Large areas of natural grasslands/pasture lands exist in northern China. Grasslands in China are managed by the agricultural sector and some are identified as suitable for planting trees.

reserve purposes. *Economic forests or plantations* are for non-wood products such as fruits, edible oils, beverages, fodder, medicines, spices and industrial materials like rubber for cash income. Official forest cover in China thus includes more than in other countries: natural forests; commercial timber plantations; *economic plantations*; bamboo groves; some shrub lands specially prescribed by the State; farmland and coastal shelterbelts; and trees planted around villages, rivers, roads and houses (Rozelle *et al.* 2003).

This review covers initiatives with diverse scales, actors and approaches, but excludes rehabilitation of wetlands and mined areas. The original intention in this study was to assess forest rehabilitation initiatives on degraded forest lands or cleared forest lands with grass, shrub or barren cover. However, once the degraded forest lands were planted, the projects also cleared and planted low-yielding or degraded plantations which formed a percentage of land cover on most sites. It was difficult to separate out rehabilitation of degraded forest land from rehabilitation of low-yielding or degraded plantations and therefore both are included in this study. The degraded plantations often arose from earlier unsuccessful *afforestation* efforts.

2. Structure of this volume

Chapter II traces the development of forest rehabilitation in China since 1949, describing the actors, objectives, funding sources, driving forces, outcomes and key challenges as could be inferred from the secondary data and literature.

Chapter III looks more in detail at forest rehabilitation in Guangdong Province, using the literature, secondary data and a range of case studies to explore different aspects of interest such as project implementation activities, incentives, institutional arrangements and ensuing outcomes. It identifies the most promising approaches and incentives for long-term sustainability and positive outcomes for different stakeholders.

Chapter IV presents the stakeholders' perspectives on key rehabilitation constraints in Guangdong Province, and their recommendations for overcoming them.

Chapter V concludes the volume by highlighting the main findings from the study and providing key recommendations for the relevant stakeholders to support, plan, implement and sustain forest rehabilitation in Guangdong and China overall.

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Chapter II

National overview

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1. Introduction

China has a long history of forest degradation and rehabilitation¹. In 1949, the year the People's Republic of China was founded, forests covered roughly 120 million ha or 12.5 percent of the national land area (MOF 1949-1993). At the time, deforestation and land degradation were largely the legacy of agricultural and pastoral expansion, over-cutting for construction and fuelwood and repeated wars (Shen 2003). Over the last 56 years, China has made continuous efforts to rehabilitate its degraded forest lands².

Most activities have been carried out by governments at various levels. Since 1998, six key national programs have steered China's forestry development. Five of these programs mainly involve forest rehabilitation. Provincial and local governments have launched their own independent rehabilitation activities in addition to participating in the national programs. Since the 1980s, the private sector³ and foreign investments have also been increasingly involved. The private

1 See Chapter I for details on rehabilitation terminology.

2 There is no official term "degraded forest land" in China. We calculated degraded forest land to be the sum of five categories of forest land cover in the national inventory: barren land suitable for planting trees, burnt-over forest areas, logged-over areas, barren sandy land suitable for planting trees and *sparse forest*.

3 Private sector here refers to farmers afforesting and managing their allocated lands, and individual investors and private enterprises afforesting and managing leased or subcontracted forest land for their own income. There is no strict recognised definition of private sector in China and many mixed public-private sector institutional arrangements exist in practice.

sector rehabilitates degraded forest lands for commercial purposes, particularly in South China, with enhanced opportunities and policy support through liberalised timber markets and land reforms (Lu *et al.* 2002).

Rehabilitation activities have thus differed widely in the actors involved, their objectives, scale, and funding sources. They have also differed in approaches, institutional arrangements and incentives offered. This chapter provides an historical review of forest rehabilitation in China over the last 56 years based on an assessment of the literature and national forest resource inventories. We look at the development and outcomes of past rehabilitation efforts, the factors driving degradation and rehabilitation including the main policies and identify some key constraints and challenges that China faces to ensure the sustainability of its ongoing and future efforts.

2. Biophysical and socio-economic characteristics

China has a land area of 960 million ha and is administratively divided into 23 provinces, five autonomous regions, four centrally administered municipalities, and two special administrative regions. Within each province are prefectures and cities that are in turn made up of counties, towns and villages. High mountains (with elevations of > 2000 m), plateaus and deserts in the west give way to hills, plains and deltas in the east (Zhang *et al.* 1992). China's population in 2000 was 1.29533 billion, 64 percent of which was rural and 36 percent urban. Average population density was 132 per km² in 2000, but distribution is uneven with more people in the east (> 300 people per km²) and fewer in the west (about 40 people per km²). The population growth rate is 0.758 percent. Han Chinese make up 91.59 percent of the population and the remaining 8.41 percent is made up of 55 ethnic minority groups. Ethnic minorities occupy some 66 percent of the country's land area, mainly the remote upland forest areas.

The climate is extremely diverse. Most of the country falls within the temperate and subtropical zones with a small tropical zone in the south (Figure 1) (Zhang *et al.* 1992). Minimum winter temperatures range from -27°C in northern Manchuria to 4°C along the middle and lower valleys of the Yangtze River and 16°C farther south. Summer temperatures are more uniform in southern and central China, with a July mean of about 27°C, but northern China has a shorter hot period and the nights are much cooler. Annual precipitation also varies greatly from as high as 1500 mm in the south and southeast, to 600 mm in the north and < 50 mm in northwest China. Approximately 31 percent of the total land area is classified as arid, 22 percent as semiarid, 15 percent as subhumid, and 32 percent as humid.

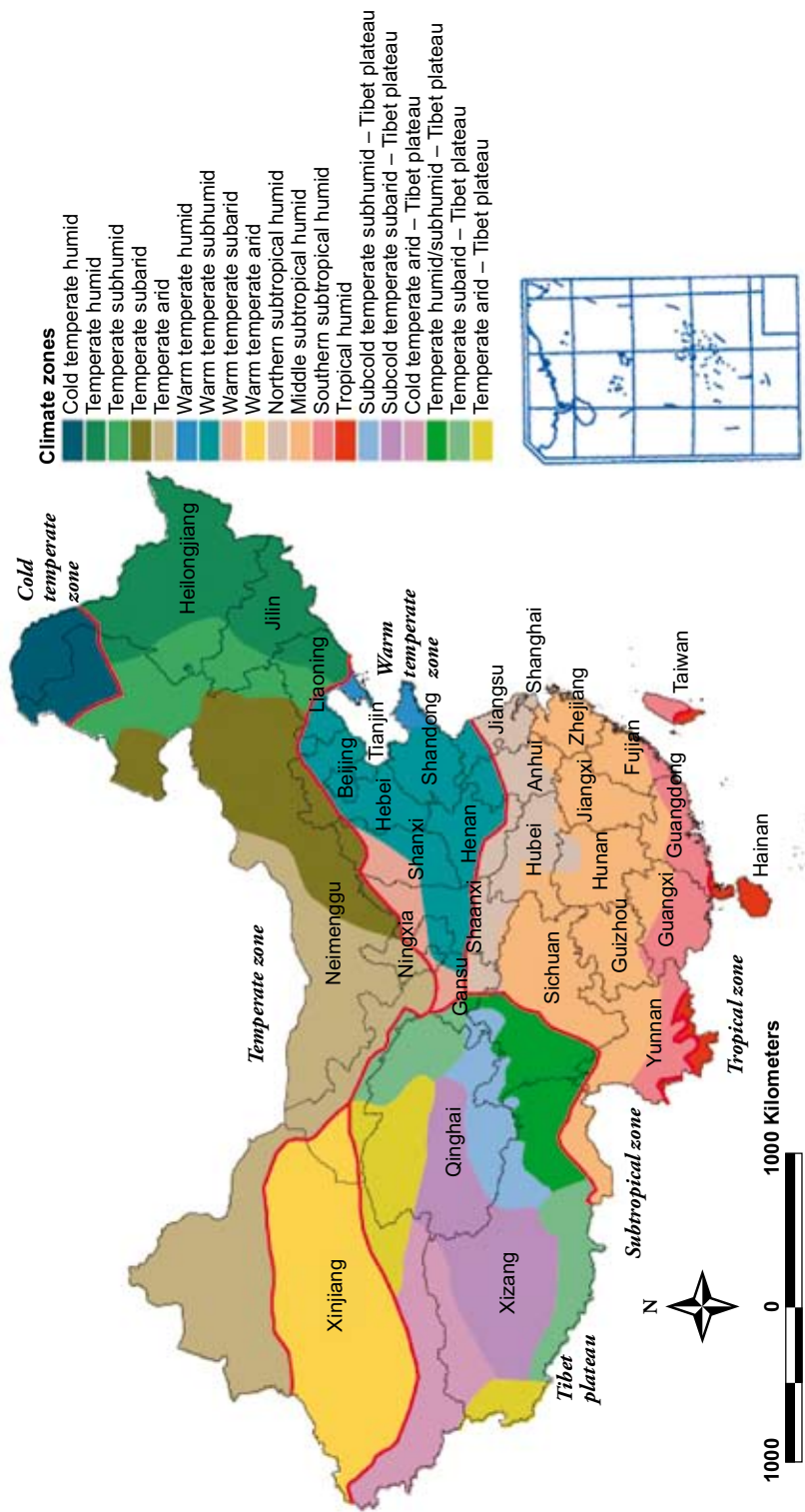


Figure 1. Climatic zones and provinces of China. Source: Geographical Sciences and Natural Resources Research Institute, Chinese Academy of Science, Beijing.

The Chinese economy has been growing rapidly since the reform policy was implemented and the nation opened up to the outside world in 1978; in recent times, the Gross Domestic Product (GDP) has grown 8-9 percent per year. GDP has risen from RMB⁴ 362.4 billion in 1978 to RMB 13.7 trillion in 2004 (both figures at current prices) (National Bureau of Statistics 2004). Annual GDP per capita has also risen from RMB 379 to RMB 10,502. The relative GDP contribution of the agriculture, industry and service sectors was transformed from 28:48:24 in 1978 to 15:53:32 in 2004. Forestry is a part of the agricultural sector and an important income source in poor regions. According to Xu *et al.* (2004), forestry accounts for less than one percent of the GDP but meets 40 percent of rural energy needs and provides almost all the timber for construction. It also provides other important commercial products such as bamboo, fruits, spices, resins, edible oils and medicines.

The forest products industry has expanded rapidly since the 1980s with market liberalisation and private investment. Much of the wood (about 44 percent in 2003) is imported due to timber shortages and logging restrictions within the country (Sun *et al.* 2004). Ten percent of forest product consumption and 50 percent of all timber imports by volume were exported as finished products in 2003. Furniture, paper and plywood were the main forest product exports.

Economic conditions are, however, disparate across the country with eastern China and particularly the coastal areas being well-developed with good transport infrastructure, industry, and intensive agriculture. The southeastern provinces rank among the richest in China. The western region with its high mountains and vast arid areas, rich in natural resources and home to a large share of China's minority cultures, is less developed (Glantz *et al.* 2001). The area has large environmental concerns related to water and soil conservation, desertification and sandstorms. The last Five-Year plan (2001-05) focused on developing the western region and included both infrastructure development and improving the ecological environment (Hou *et al.* 2002). The area is the target of two major forestry programs at present – the natural forest protection program and the sloping land conversion program (Glantz *et al.* 2001).

The general regional land use plan officially designates 257 million ha or 27 percent of the national land area for forestry (Table 1). In 1994-98, forest land was composed of 153.7 million ha of forest, 64.2 million ha of degraded forest land, and the remaining area in shrub land, young plantations and seedling nurseries. Collectives hold and manage 58 percent of the forest land while the state manages the rest through state forest farms and enterprises. From 1981 to 1983, collective

4 Roughly 8.27 Chinese Yuan Renminbi (RMB) per US dollar (USD) in June 2005. The exchange rate was 100 USD to 153 RMB prior to 1981, 100 USD to 320 RMB from 1981 to 1985, 100 USD to 370 RMB from 1986 to 1989, 100 USD to 870 RMB in 1994, and 100 USD to 828 RMB after 1995.



Household forest farm in Guizhou Province.
(Photo by Alexander Hinrichs)

forest land was partially reallocated to local farmers or village households to manage and use the resources for roughly 50-70 years. More than half the forest area and 75 percent of the standing timber volume are in the state-owned forest provinces/regions in the northeast and southwest, mainly Heilongjiang, Jilin, Inner Mongolia, Yunnan and Sichuan (Yin 1998). Another 31 percent of the forest area and 15 percent of the timber volume are found in 10 collective-managed forest provinces in the south: Zhejiang, Anhui, Hubei, Jiangxi, Fujian, Hunan, Guizhou, Guangxi, Guangdong and Hainan.

State forests mostly in the northeast and southwest supplied most timber in the past but the yields declined with over-cutting in what were primarily natural forests (Sun *et al.* 2004, Xu *et al.* 2004). Collective forests mainly in the south have increasingly contributed to timber supplies since the 1980s by developing plantations. Of the 7.8 million ha of plantations established in 2002, 81.3 percent were on collective land; overall, 73.6 percent of all China's plantations are on collective land (Miao and West

Table 1. Forest land and ownership in China (Fifth national forest resource inventory 1994-1998, SFA 1994-1998).

Tenure	Forest Land ¹ million ha	Total forest ²	Standing timber volume million m ³
State	105.9	63.9	7641.0
Collective	151.1	89.7	3665.3
Total	257.0	153.6	11,306.3

¹ Forest land is the sum of forest, sparse forest, shrub land, young plantations, seedling nurseries, logged-over and burnt-over forest areas, and all other land suitable for planting trees as designated by the different levels of government (Regulations for implementation of the State Forest Law issued in 2000). The total area varies due to forest cover outside state and collective forest lands being included, such as planting along roads and in farm land shelterbelts.

² Actual forest cover includes natural and artificial forest with more than 20 percent tree canopy cover (> 30 % prior to 1996). It includes timber, shelterbelt, fuelwood, *economic* (non-wood products) and special purpose forests, as well as bamboo groves and some shrub lands specially prescribed by the State. It also includes tree shelterbelts in farms and trees planted around roads, rivers, houses and villages. Artificial forest is formed through planting and aerial seeding.

2004). In 2002, household forest farms in the south and north plain regions accounted for 43 percent of total timber production, collective forest farms in the south for five percent and state forest farms and enterprises for 52 percent (Sun *et al.* 2004). Many non-timber products (dominated by fruit) and much of the fuelwood also come from collective forests (Miao and West 2004).

China is very rich in biodiversity given its large land area and wide range of climate conditions. There are 599 terrestrial ecosystem types and 32,800 higher plant species, of which, 17,300 are unique to China. This includes more than a 1000 valuable native tree species suitable for timber production and other economic purposes. China has a wide range of forest types stretching from the north to the south (MOF 1949-1993):

- Conifer and mixed conifer and broadleaved forests with tree species such as Faber fir (*Abies fabri*), Chinese spruce (*Picea asperata*), pine (*Pinus*), larch (*Larix*) and Chinese fir (*Cunninghamia lanceolata*) are found in the Da xing an ling to Himalayan mountains and from Taiwan to Artai mountains in the Xinjiang Uigur region.
- Deciduous broadleaved forests with *Fagaceae*, *Betulaceae*, willows (*Salix*), *Corylaceae*, *Ulmaceae*, *Aceraceae* and *Tilia* species are found in the middle to high mountains and sub-alpine zones of the temperate and subtropical regions.
- Evergreen broadleaved forests with genus such as *Cyclobalanopsis*, *Castanopsis* and *Lithocarpus* are mostly found in lower hills and middle-high mountains of the mid-subtropical region.
- Monsoon evergreen broadleaved forests with *Lauraceae*, *Magnolia*, *Theaceae*, *Myrtaceae* and *Caesalpiniaaceae* as well as *Cyclobalanopsis*, *Castanopsis* and *Lithocarpus* species are mainly found in the lower hills in the southern subtropical region.
- Sclerophyllous forests with species such as *Quercus semicarpifolia* and *Quercus aquifolioides* are found in middle-high mountains, the sub-alpine zone and dry and hot river valleys of the western subtropical region.
- Monsoon rain forests and rain forests with species in the families *Dipterocarpaceae*, *Moraceae*, *Sterculiaceae*, *Guttiferae*, *Meliaceae* and *Anacardiaceae* are found in the tropical region in southwestern and southern China as well as Taiwan.
- The tropical coasts in the far south have mangrove forests with tree species such as *Kandelia candel*, *Rhizophora* and *Bruguiera gymnorhiza*.
- The coral islands of Hainan province also have evergreen forests with species such as *Guettarda speciosa* and *Jatropha curcas*.
- Bamboo forests with 40 genus and more than 400 species are mostly found in the subtropical region. The most common bamboo species is *Phyllostachys pubescens*.

3. Historical review of forest rehabilitation

3.1 Early efforts (1949-1980)

In general, over the past 50 years, China has put in substantial effort to rehabilitate its forest lands. In the early 1950s, wood production was the forestry department's priority; forest rehabilitation was limited and had little funding support. The limited rehabilitation activity from 1949 to 1952 established 889,333 ha of shelterbelt forest in northern China. The focus was on some key areas in northern Shannxi, north to central Hebei, eastern Henan, the western part of the northeastern region and the northern coast of Jiansu Province that were affected by severe runoff, soil erosion, drought and sandstorms. After 1954, timber development was prioritised, and plantations were established in the southeastern provinces. For example, in 1955, a total 1.71 million ha of forest land was rehabilitated, of which timber forest accounted for 55 percent (MOF 1949-1986).

In the 1960s, along with the continued establishment of shelterbelt forests, timber plantation development was accelerated. Shelterbelt forests were located in northeastern and northwestern China, the loess plateau, and some coastal areas suffering from typhoons and flooding from torrential rain. In 1964, a regulation was issued to fund regeneration in the collective forest region and the Ministry of Forestry planned to establish 240 patches of timber plantations primarily in the southeastern provinces. Provinces in southern China responded by establishing Chinese fir plantations. However, during the Cultural Revolution from 1966 to 1976, most forest management agencies functioned poorly and plantation establishment almost stopped. At the same time during the 1960s, aerial seeding proved effective after many trials and helped to speed up forest rehabilitation in Guangdong, Sichuan and then parts of central and northern China (Li 1985).

In the early 1970s, timber plantation establishment was prioritised over protection forest, especially in the subtropical region, to meet increasing wood demand for national economic development. In 1974, the Central Government planned to establish 6.67 million ha of timber plantations within 10 years, with Chinese fir as the dominant species. From 1976, the Government invested 20 million RMB annually in collective-owned forest farms in southern China for this purpose. A total 6.53 million ha of timber plantations were established in 528 counties across 13 provinces in the south from 1973 to 1980, almost reaching the national 10-year target in just seven years (Li 1985).

In 1971, the plain regreening project was also launched with shelterbelts established around farmland, water canals, roads, villages and houses to alleviate

frequent sandstorms and dry hot winds. By the end of 1985, a shelterbelt network of about 7.2 billion trees protected 1.07 million ha of croplands on the plains. In 1978, when the Cultural Revolution ended and the forestry administration was revived, a shelterbelt forest program in the Three-North region was initiated and integrated into the national economic development plan (MOF 1949-1986).

Overall from the 1950s to the 1970s, 23.69 million ha were afforested as shelterbelts to alleviate sandstorms, runoff and soil erosion; or for timber production. Rehabilitation was primarily funded through government subsidies and compulsory labour from local people (Li 1985). Species planted in shelterbelts included willows, poplar (*Populus*), elm (*Ulmus*), ash (*Fraxinus*), Mongolian Scots pine (*Pinus sylvestris*), Chinese arbor (*Platycladus orientalis*), black locust (*Robinia pseudoacacia*), horsetail beefwood (*Casuarina equisetifolia*), Japanese black pine (*Pinus thunbergiana*), water larch (*Metasequoia glyptostroboides*), pond cypress (*Taxodium ascendens*) and various shrubs.

Species planted in timber forests included Korean pine (*Pinus korariensis*), Chinese pine (*Pinus tobulaformic*), Chinese fir, Masson pine (*Pinus massoniana*), *Paulownia*, larch and bamboo. Exotic tree species such as *Eucalyptus*, slash pine (*Pinus elliottii*), loblolly pine (*Pinus taeda*), Caribbean pine (*Pinus caribaea*), Italian poplar (*Populus canadensis*) and teak (*Tectona grandis*) were introduced from Australia, Italy, America, Cuba and India, and planted for timber in the southeastern provinces, mainly Hunan, Hubei, Jiangxi, Fujian, Guangdong, Guangxi, Sichuan, Yunnan and Hainan.

3.2 Large national forestry programs from the 1980s

In the 1980s, the launching of a series of nationwide programs accelerated forest rehabilitation. In 1980, the Government enhanced cooperation between the Ministry of Forestry and the local provinces to strengthen timber plantation development. A national compulsory tree-planting campaign was initiated in 1981 requiring all citizens over 11 years old to plant 3-5 trees annually. From 1981 to 2005, a cumulative total of more than 9.9 billion people participated and more than 47.1 billion trees were planted across China under this campaign. From 1984 to 1989, four key programs were launched: the Taihang Mountain greening program; coastal shelterbelt forest program; the national plan to establish 6.67 million ha of fast-growing, high-yielding forest plantations; and the shelterbelt forest program along the upper and middle reaches of the Yangtze River valley. The plain regreening program was also accelerated in 1988 through a new targeted national plan.

In 1989, the first national plan on *afforestation*⁵ and greening from 1989 to 2000 was approved, and this plan integrated all rehabilitation activities. A nationwide campaign to regreen barren mountains followed, with provincial and local governments encouraged to take responsibility for greening barren mountains in their administrative regions. Guangdong Province was the first to totally regreen barren mountains where trees could be planted. Subsequently 11 other provinces — Fujian, Hunan, Jiangxi, Anhui, Jiansu, Guanxi, Zhejiang, Shandong, Hubei, Hainan and Jilin — also fulfilled their *afforestation* and greening targets. The campaign greatly increased forest cover within a short period but most of the new forests had very poor timber quality and were vulnerable to pests and fire. During this period, rehabilitation for both timber and environmental purposes was important (MOF 1999).

In the early 1990s, five additional national programs were initiated: the program on combating national desertification; and the development of shelterbelt forests in the Huaihe River and Taihu Lake basin, and the Yellow, Liaohe and Pearl River valleys. The average annual area afforested was four million ha during the 1990s. Ten of the 11 national forest rehabilitation programs launched since 1978 were aimed at environmental security in response to frequent floods, drought, sandstorms, typhoons, water runoff and soil erosion; and one program was aimed at supplying timber. The key rehabilitation programs from 1978 to 1998 are described in Annex 1.

In 1998, the Government implemented the policy to stimulate national economic growth through enhanced government fiscal investment in infrastructure and ecosystem recovery projects. Such projects they believed could ultimately support sustainable industrial development and resource exploitation. The focus was particularly on western China where environmental and economic conditions were fragile. The original 11 forestry programs were regrouped into six key programs covering 97 percent of the country's counties and integrated into the national plan for social and economic development. Of the six programs, five focus mainly on forest rehabilitation, with plans to build 92 million ha of plantations between 2001 and 2010 with a total investment of billions of RMB. These include the natural forest protection program, the sloping land conversion program, the desertification control project, the key shelterbelt project along the Three-North region and the Yangtze River valley as well as other regions, and the forest industrial base project. The high investment level and large scale and scope of the projects are unprecedented. In recent years, approximately 6.7 million ha

5 *Afforestation* includes forest establishment through planting trees, aerial seeding or *mountain closure* on barren mountains, barren sandy land, *sparse forests*, burnt-over and logged-over forest areas, and some shrublands and grasslands. It also includes planting trees along roads and rivers, around houses and villages and as shelterbelts in farms. The term "*afforestation*" as used in China includes greening recently deforested areas.



Area newly planted for sand control in Hebei Province. (Photo by Lu Shaobo)

have been rehabilitated to forest annually. Again, ecosystem recovery was a key driver, with five of the six programs aimed at environmental improvement and the last on establishing a forest industrial base. The five rehabilitation-related programs are detailed in Annex 2.

The national programs were each spread out over many counties and provinces (Table 2). Programs prior to 1998 had *afforestation* targets of less than four



Young mixed plantation of Poplar and Japanese pagoda trees for sand control in Hebei Province. (Photo by Lu Shaobo)

Table 2. Scale and duration of the national forest rehabilitation programs since 1978. (Sources: Zhang 1997, SFA 1998, Zhou 2001)

No	Programs/ Projects	Duration (years)	No. of counties	No. of provinces	Afforestation target (million ha)
Early programs: 1978-1998*					
1	Three-North shelterbelt (1978-2050)	73	551	13	35.6
2	Yangtze River shelterbelt (1989-2010)	20	271	12	20.0
3	Coastal shelterbelt (1988-2010)	22	195	11	3.5
4	Pearl River shelterbelt (1995-2000)	5	177	4	1.2
5	Combating national desertification(1991-2050)	59	598	27	47.1
6	Taihang Mountain greening (1986-2000)	14	110	4	3.9
7	Yellow River shelterbelt (1996-2010)	15	177	6	3.1
8	Huaihe River & Taihu Lake shelterbelt (1995-2005)	10	208	7	1.0
9	Liaohe River shelterbelt (1995- 2005)	10	77	4	1.2
10	Plain regreening (1987-2000)	23	918	26	No exact figure
11	National Afforestation Project (1990-1997)	7	306	16	1.0
Consolidated programs: 1998 onwards**					
1	Natural forest protection (2000-2010)	10	799 counties/ forest farms +102 state enterprises	17	12.7
2	Sloping land conversion (2001-2010)	10	1596	30	32 (of which, 15.3 is in Phase 1)
3	Desertification control - Beijing & Tianjing city (2001-2010)	10	75	5	7.57
4	Key shelterbelt along the Three-North region and the Yangtze River valley as well as other regions (2001-2010)	10			27.0
5	Forest industrial base (2001-2015)	15	886 + 114 forest farms or enterprises	18	13.3

* The figures are based on the original plans.

** The programs from 1978-98 were integrated into the current six programs/projects. Only the five rehabilitation-related programs are included here. These figures are based on revised plans.

million ha with three exceptions. The consolidated programs from 1998 onwards have higher *afforestation* targets ranging from 8-32 million ha. The current forest industrial base development project extends beyond the subtropical to tropical provinces with their favourable site and economic conditions, to the northern plain and the state-owned forest regions of inner Mongolia and the northeast. *Afforestation* programs aimed at protecting against natural disasters and improving environmental conditions are in the major river valleys and plains scattered throughout China, along the coastline and in the steep western mountains. Desertification and sandstorm control projects are mainly located in the northwest. The natural forest protection program (with a logging ban and a rehabilitation component) covers the remaining natural forest areas in China; including the upper reaches of the Yangtze River; the upper to middle reaches of the Yellow River; and the state-owned forest regions of inner Mongolia, the northeast, and the northern part of Xinjiang Uygur Autonomous Region.

Tree planting, *mountain closure*⁶ and aerial seeding all appear to be important revegetation techniques considered in the large national programs (Figure 2). Aerial seeding is suitable for rough terrain and remote areas in regions with >

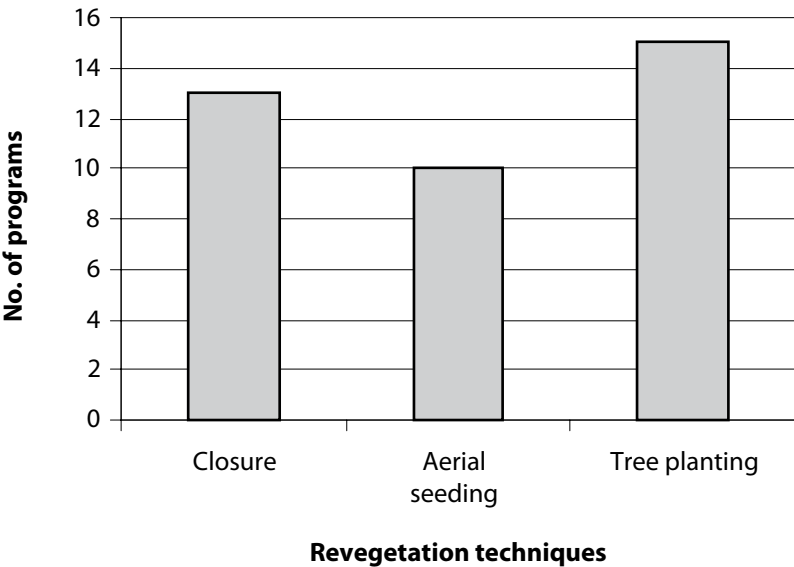


Figure 2. Revegetation techniques used by 10 national programs from 1978-98 (excluding the earlier combating national desertification program) and five consolidated programs since 1998. Sources: (Zhang 1997, Zhou 2001)

⁶ “Mountain closure” means closing public access to degraded forests and forest land with natural regeneration capacity to enable natural forest recovery.

300 mm rainfall. *Mountain closure* is an inexpensive, low-labour demanding and efficient technique of forest regeneration practiced in China since ancient times.

Pines and poplars were the most common candidate tree species spanning a range of locations. The Yangtze River shelterbelt program also included Chinese fir, broadleaf species and a mix of bamboo and cash crop trees. The coastal shelterbelt forest program, learning from experience since the 1950s, also considered hardy species such as horsetail, beefwood, mangrove and shrubs as well as commercial coconut and agroforestry species for local people. A mix of candidate species was listed for five programs in the northern and northeastern plains, river valleys and mountains, including cypress (*Cupressaceae*), black locust, sea buckthorn (*Hippophae rhamnoides*), shrubby amorphia (*Amorpha fruticosa*) and apricot (*Prunus armeniaca*), besides the pines and poplars. The National Afforestation Project focused on timber production with candidate species such as pines, poplars, Chinese fir, larch, black locust, *Eucalyptus* and other broadleaf species. Species like larch, *Eucalyptus* and *Acacia* are also considered in the forest industrial base project. However, listing candidate tree species does not mean that they were all planted. Only a few species are actually used in any given rehabilitation project for various reasons such as high seedling prices, lack of technical knowledge, mismanagement and limited suitable tree species for some areas with poor site conditions.

3.3 The evolution of local, private sector and foreign-funded efforts

Besides the national level programs, some provinces also adopted their own independent initiatives for ecosystem restoration and city greening with local government funding. For example, in 1998 the Yunnan Government decided to construct a shelterbelt forest along the upper and middle reaches of the Nan Ting He River in Lin Cang county with 58.6 million RMB of planned investment. The project aims to establish 13,000 ha of new forest, protect 20,000 ha of current forest, and thus increase forest cover in the project area from 28.9 percent to more than 50 percent (SFA 1999-2000). As two special economic zones, the governments of Shenzhen and Zhuhai cities in Guangdong Province actively initiated city-greening projects for environmental purposes and aesthetics (MOF 1999, Chapter III).

Forest development and utilisation have been shifting more and more from the state sector to the private sector since the 1980s with liberalised markets, investment support, technical assistance, opportunities to lease land for tree planting, longer leases and contracts, and liberty to trade and auction use rights (Lu *et al.* 2002, Xu *et al.* 2004). Different provinces and counties have adopted their own approaches based on the national reform framework. In the southeast



(Left) Small-scale timber production in Anhui Province (Photo by Alexander Hinrichs), (Right) Fragrant pear grown in Xinjiang Uighur autonomous region (Photo by Yu Yanling)

collective region, which has been traditionally favoured for wood production, private forest rehabilitation efforts are being accelerated by company-community partnerships, more flexible management allowed by governments, and reduced timber taxes and fees. However, non-timber sectors such as *economic forests* and bamboo plantations experienced greater success and expanded rapidly given less restrictive regulations, shorter-term returns and faster market development than for timber (Xu *et al.* 2000, Xu and White 2001, Cai *et al.* 2003). With economic reform and the Central Government's opening-up policy, China and particularly the southeast collective region have been the focus of international investment in commercial plantation development by some transnational corporations such as the Singapore-based Asia Pulp and Paper Co. Ltd. and Finland-based Storaenso Co. (Lu *et al.* 2002).

In the 1998 Forestry Law, the Government announced its intention to set up the forest environmental benefit compensation fund⁷. Forest lands were then classified into “ecological” and “commercial” based on their location and site characteristics. Roughly 30 percent or 57.3 million ha, were to be set aside as *ecological forests*⁸ and would be rehabilitated and managed as such. Based on national financial reform and classified forestry management policies, rehabilitation for environmental purposes was to be mainly funded through government budgets,

⁷ The forest environmental benefit compensation fund is equivalent to the term “Payment for Environmental (or Ecosystem) Services” used elsewhere.

⁸ *Ecological forests* or non-commercial forests are for the purpose of maintaining and improving the ecological balance and the environment, conserving biodiversity, and providing non-timber forest products.

while commercial forests were to be developed more and more by the private sector through market mechanisms. Discussions are also ongoing regarding ways to fund *ecological forest* management through market mechanisms. End users of forest services such as water, biodiversity, carbon, tourism and hydropower and other actors could possibly share the costs. Several *afforestation* projects under the Clean Development Mechanism are under preparation and one will be registered soon.

Also since 1978, more than 20 foreign countries and international organisations have set up cooperative relationships with Chinese national and provincial forestry departments. The partners include Italy, Australia, America, Canada, Germany, France, Japan, South Korea, Sweden, Finland, Netherlands, United Nations Development Program (UNDP), Food and Agriculture Organization of the United Nations (FAO), International Tropical Timber Organisation (ITTO), Global Environment Facility (GEF), World Bank and World Wide Fund for Nature (WWF). Besides the World Bank loan for the National Afforestation Project from 1990 to 1997, by 2003, 822 million USD (6.8 billion RMB in 2005) in foreign grants had flowed via various channels to support Chinese forestry development (Liu 2004). At present, 122 projects with 230 million USD (1.9 billion RMB in 2005) in foreign grants are being implemented. Of the 122 million USD (450 million RMB in 1986) in foreign grants from 1981 to 1986, around 78 percent was used in forest rehabilitation activities (i.e. *afforestation* and forest cash crop development) (Table 3) (MOF 1949-1986).

Table 3. Focus of foreign grants for forestry from 1981 to 1986 (MOF 1949-1986).

Focus of foreign grants	Funding amount (USD)	Percentage
<i>Afforestation</i>	78,982,480	64.7
Forest for special use (fruits, nuts, etc.)	15,859,000	13.0
Forest resource management	7,691,000	6.3
Forest protection	6,314,880	5.2
Comprehensive wood utilisation	5,061,903	4.1
Study of main tree species planted	3,567,117	2.9
Management and protection of wildlife	2,912,000	2.4
Study and application of new techniques	794,116	0.7
Other	881,816	0.7
Total	122,064,362	100.0

Two examples of foreign-funded rehabilitation projects are described in the boxes below. Most foreign-aided projects were managed independently, although some were implemented in domestic project areas.

Forest rehabilitation projects funded by the German Government

The German Government has supported Chinese forest rehabilitation since the start of the Sino-German forest rehabilitation program in 1993. The program covered some 90 counties in 14 provinces (autonomous regions and municipalities) in the Yangtze and Yellow River valleys which are less developed and suffer from poverty and severe environmental problems such as runoff and soil erosion. Ten of these provinces are currently implementing the project's first phase while four have moved into the second phase. Project durations average eight to 10 years, with forest rehabilitation activities being completed within four to five years. The total budget is 2.012 billion RMB, with 1.173 billion RMB in German grants and 839 million RMB in Chinese matching funds. Local farmers' labour inputs account for 218 million RMB. To date, the German Government has allocated 534.77 million RMB, the Chinese Government 490 million RMB with 174 million RMB from local farmers' labour. Up to now, 381,780 ha of forest have been established (Su *et al.* 2003).

FAO-funded forest rehabilitation project

The Chinese Government set up six forest rehabilitation projects with the help of FAO from 1982 to 1987, involving 11 counties in Ningxia, Shandong, Sichuan, Hunan, Liaoning and Hebei provinces and one nature reserve in Sichuan Province. The total investment was roughly 91.6 million USD (338.9 million RMB in 1986). The project aimed to afforest 572,900 ha, plant grass on 68,450 ha, improve and regenerate 16,000 ha of degraded *Oiltea Camellia* (*Camellia oleifera*) stands, build up 202 km of roads and a small scale hydropower station and 29,876 check dams for water and soil conservation (MOF 1949-1986). The seeds of the shrub *Oiltea Camellia* are extracted for high-value edible oil used for cooking and in making cosmetics in the mountains of the subtropical region. When the project ended, 43,000 ha of shelterbelt forest, 11,500 ha of fast-growing plantations, 45,500 ha of grassland and 16,000 ha of *Oiltea Camellia* had been planted and improved. Forest cover in Xiji county of NingXiaHui autonomous region had increased from 3.3 to 21.8 percent, and in Gongxian county of Sichuan Province, from 19.7 to 26.4 percent. The newly established forests protected more than 14,000 ha of agricultural land (Li 1985).

4. Achievements and impacts

4.1 Rehabilitation targets and forest cover change

Efforts from the 1950s to 1970s (23.69 million ha rehabilitated as shelterbelts or for timber production) were not visible on the ground as a net increase in forest cover (Figure 3: MOF 1949-1993, SFA 1994-1998). Considerable deforestation continued during the same period, and not much attention was paid to long-term sustainability of the rehabilitated areas. Forest cover actually declined by

6.64 million ha between 1950-62 due to improper forest management and over-cutting during the industrialisation period or Great Leap Forward movement which started in 1958 (Shen 2003). Forest cover declined again from 121.86 million ha in 1973-76 to 115.28 million ha in 1977-81 due to the Cultural Revolution (1966-76), which affected forests on a national scale.

Forest cover has been on the rise since the 1980s, mostly through rehabilitation of degraded forest land. From 1978 to 2000, roughly 41.3 million ha were rehabilitated through the 11 national rehabilitation programs according to SFA (2004) (Table 4). Project reports had higher figures for area afforested but national

Table 4. Area planted as compared to *afforestation* target in national programs since 1978 (SFA 2004).

No	Programs	Afforestation target (million ha)*	Area rehabilitated (million ha)**
Early programs: 1978-1998			
1	Three-North shelterbelt (1978-2050)	35.6	27.6 (1978-2000)
2	Yangtze River shelterbelt (1989-2010)	20.0	5.0 (1989-2000)
3	Coastal shelterbelt (1988-2010)	3.5	1.1 (1988-2000)
4	Pearl River shelterbelt (1995-2000)	1.2	0.16 (1995-2000)
5	Combating national desertification (1991-2050)	47.1	1.1 (1993-2000)
6	Taihang Mountain greening(1986-2000)	3.9	3.6 (1984-2000)
7	Yellow River shelterbelt (1996-2010)	3.1	0.5 (1996-99)
8	Huaihe River & Taihu Lake shelterbelt (1995-2005)	1.0	0.2 (1995-99)
9	Liaoh River shelterbelt (1995- 2005)	1.2	0.22 (1995-99)
10	Plain regreening (1987-2000)	No exact figure	0.42 (1993-2000)
11	National Afforestation Project (1990-1997)	1.0	1.4 (1990-97)
Consolidated programs: 1998 onwards***			
1	Natural forest protection (2000-2010)	12.7	3.68 (1998-2003)
2	Sloping land conversion (2001-2010)	(15.3 1 st phase)	12.2 (2000-03)
3	Desertification control - Beijing & Tianjing city (2001-2010)	7.5	2.16 (2001-03)
4	Key shelterbelt along the Three-North region, the Yangtze River valley and other regions (2001-2010)	27	8.2 (2001-03)
5	Forest industrial base (2001-2015)	13.3	0.65 (1998-03)

* The figures are based on the original plans.

** Also includes area rehabilitated in pilot phases prior to official commencement of projects.

***Only the five rehabilitation-related programs are included here.

statistics from a single report have been used here for consistency. Degraded forest land decreased from 101.5 to 64.2 million ha between 1973-76 and 1994-98 (Figure 3). Annually afforested area in the 1990s as a result of the national and provincial programs reached four million ha on average (MOF 1999) and a 38.35 million ha increase in forest cover was registered from 1977-81 and 1994-98. However, over-logging and degradation have continued at the same time in mature natural forests and state-run logging enterprises faced financial crises as timber volumes declined (Weyerhaeuser *et al.* 2005).

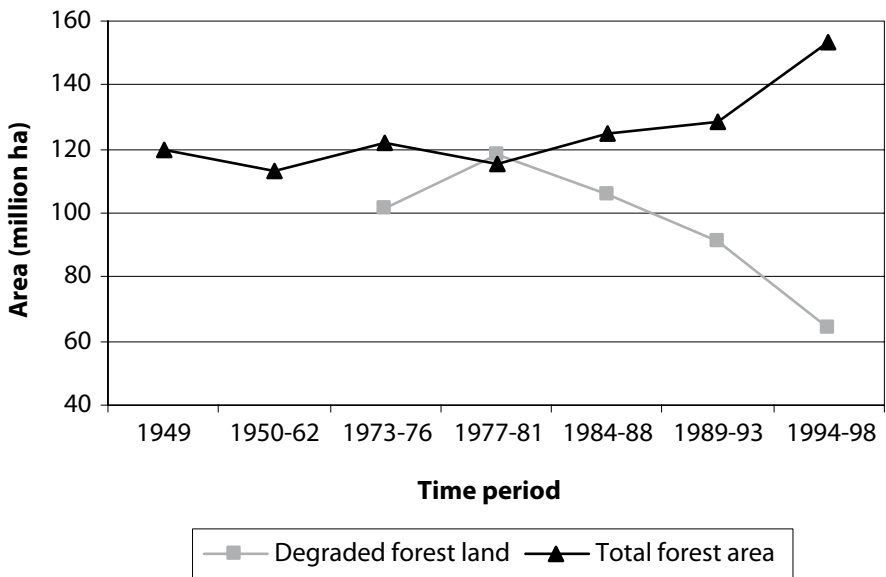


Figure 3. Trends in forest area and degraded forest land in China (MOF 1949-1993, SFA 1994-1998).

Note: The definition of forest was changed from 30 percent to 20 percent tree canopy cover in 1996 and thus the rise in forest cover from 1989-93 to 1994-98 is slightly inflated.

Rozelle *et al.* (2003) estimated that 27 million ha were rehabilitated to forest from 1980-93: timber and protection forest (14 million ha), shelterbelt (six million ha), *economic plantations*⁹ (five million ha) and fuelwood forest (two million ha). However, nine million ha of natural forest were lost in the same period and seven million ha logged and converted to plantations.

However, most of the 11 programs from 1978-2000 were not on track in terms of meeting their *afforestation* targets on time (Table 4, details in Annex 1). Exceptions were the Three North shelterbelt program, the National Afforestation Project and

⁹ *Economic forests or plantations* are for non-wood products such as fruits, edible oils, beverages, fodder, medicines, spices and industrial materials like rubber for cash income.

possibly the Taihang Mountain greening and plain regreening programs. Detailed feasibility analysis was not undertaken at the planning stage to set realistic targets and plans were changed frequently. The Pearl River shelterbelt program was constrained by a three-year delay and low investment. Only pilot trials were implemented in the Huaihe River and Taihu Lake shelterbelt program. But as part of the nationwide campaign to regreen barren mountains launched in 1989, 12 provinces fulfilled their tasks.

The five consolidated national programs since 2000 have resulted in 6.7 million ha being rehabilitated annually (SFA 2000, 2001a, 2002, 2003 and 2004). Four programs were on track and possibly the fifth as well in terms of achieving their *afforestation* targets within the time planned (Table 4). The forest industrial base project reports a rehabilitated area of only 0.65 million ha but this is probably a vast underestimate due to data from private sector plantations not being readily available.

4.2 Survival, forest type and condition

Nationwide average survival rates one year after planting has improved from 55 percent before 1985, to 87 percent in the mid 1990's and higher than 90 percent in 2003, due to the strict quality checks undertaken since 1988. Average survival rate three years after planting was 75-80 percent in the 1990s (Xu 2003). A 40 percent survival rate of planted trees was sufficient for the area to be counted as successful *afforestation* in the national statistics prior to 1985. Now survival rates of more than 85 percent (in high rainfall areas) and 70 percent (< 400 mm rainfall areas) are required to be included.

Most of the forest area increase was in artificial forest (through planting and aerial seeding) which rose from 23.69 million ha in 1973-76 to 46.66 million ha in 1994-98 (MOF 1949-1993, SFA 1994-1998) (Figure 4). Artificial forests made up 30 percent of China's total forests in 1994-98 and China has the largest artificial forest area in the world. Natural forest showed an overall decline from 1973 to 1993, indicating that overlogging was continuing. Natural forest area increased from 1993 to 1998 with protection of existing natural forest areas and attention paid to natural regeneration.

Although rehabilitation over the past several decades has succeeded in increasing forest cover, the quality of forest resources and age structure shows a general declining trend. First, substantial areas have poor growth and timber volumes as well as stem deformities. Growth increments in planted forests are 3-3.5 m³ per ha per annum (Bull and Nilsson 2004). Declines in yield with subsequent rotations are evident. Standing timber volume per hectare of forest and total timber growing stock was decreasing up to the late 1970s but increased thereafter,

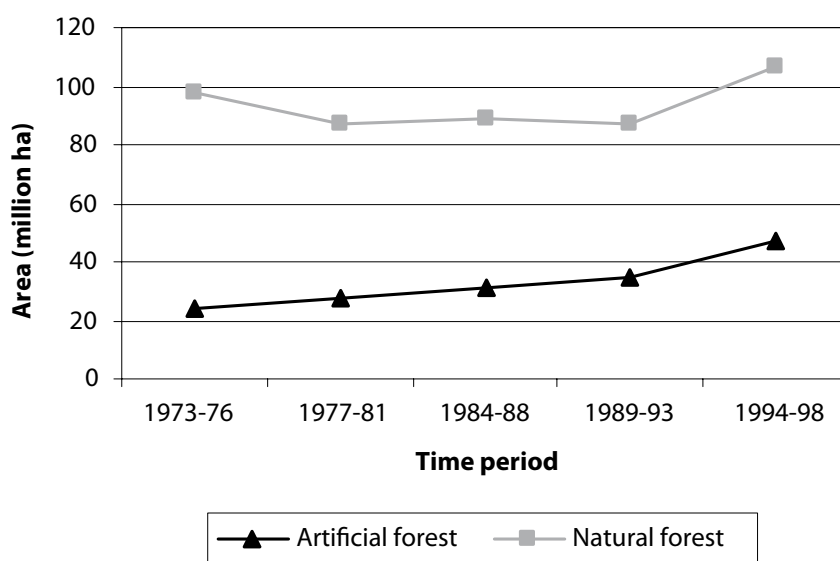


Figure 4. Trends in artificial and natural forest area from 1973-76 to 1994-98 (MOF 1949-1993, SFA 1994-1998).

though total timber growing stock declined again in 1994-98 (Table 5). Available mature forest resources for timber production continued to decrease despite an increase in forest cover. Most of the forest was very young. In 1994-98, standing timber volume was only 35 m³/ha in artificial forest and 91 m³/ha in natural forest.

Second, the structure and composition of the forest stands was also very simple with more conifers and fast growing species, and fewer broadleaved and high value timber species (Li 2004). The proportion of mixed forest was low and diversity

Table 5. Standing timber volume per hectare of forest, total timber growing stock and area in mature forest.

Period	1949	1950-62	1973-76	1977-81	1984-88	1989-93	1994-98
¹ Standing timber volume (m ³ /ha)	90	90.12	71.03	69.21	73.3	75.8	78.06*
² Total timber growing stock (billion m ³)	11.6	11.0	9.5	10.3	10.6	11.8	11.3*
³ Mature and over-mature forest area (million ha)	~ 48	42	28	22	14	13	13*

¹ Growing stock on forest land divided by forest land area. MOF (1949-1993), SFA (1994-1998).

² MOF (1949-1993), SFA (1994-1998).

³ Shen (2003)

* Based on new definition of forested area (> 20 percent canopy cover). Before, it was > 30 percent.



Chinese fir plantation in Hunan Province. (Photo by Li Xiquan)

was reduced. For example, from the 1970s to 1980s, Chinese fir and Masson pine were widely selected as dominant species for timber plantations in the subtropical region, resulting in trends towards more coniferous forest in some areas (Sheng 1997). Table 6 provides statistics on artificial forest composition in five typical subtropical provinces.

Plantations with single species and simple structures were not effective in watershed protection and soil conservation. It is very common in the subtropical region that canopy cover is high but soil erosion below is still very severe. In recent years, large-scale clearing of secondary forests took place in the southern provinces to establish fast-growing and high-yielding forest plantations as well as *economic plantations*

Table 6. Artificial forest composition in six typical subtropical provinces in 1989-1993 (Sheng 1997). Unit: 100ha.

Provinces	Total artificial forest area	Conifer forest area	Broadleaf forest area	Broadleaf (%)/Total
Fujian	13143	12591	552	4.2
Zhejiang	8077	7981	96	1.2
Jiangxi	8300	8156	144	1.7
Guangdong	14682	12571	211	4.4
Guangxi	8544	8208	336	3.9
Hunan	11957	11303	672	5.6

(Sun 2004). Site preparation activities, species planted and the presence and nature of ground vegetation and litter could have an important effect on soil properties and erodability (Huang *et al.* 2004, Jia *et al.* 2005, Wang *et al.* 2005, Yang *et al.* 2005, Zheng *et al.* 2005). For example, a lack of ground vegetation and litter could increase soil erosion (Jia *et al.* 2005) while soil compaction during land preparation could increase surface runoff (Yang *et al.* 2005). A survey in Fujian Province shows that without rotational cultivation, soil nutrients decrease by 10-20 percent in second-generation Chinese fir plantations and by 40-50 percent in third-generation plantations (Sheng 1997). Shelterbelt forests, however, did help to check soil erosion where established (Rozelle *et al.* 2003).

Monocultures also tend to be less resistant to pests and diseases and natural disasters. Poplar trees planted in the Three-North shelterbelt program were devastated by beetles and insects while diseases caused severe damage in the coastal shelterbelt forest program. Insect infestations have damaged more than 9.3 million ha of forest annually (Li 2004).

4.3 Forest production and socio-economic impacts

Rehabilitation projects have had both positive and negative impacts on production and socio-economic aspects though studies are needed to clearly identify the effects. Reviews of social impact are currently being undertaken on sample sites for the five consolidated rehabilitation projects. Specific program outcomes mentioned in the following three paragraphs are taken from project reports (details in Annex 1).

The Three-North shelterbelt program was able to harvest 5.47 million tons of fuelwood annually from 911,752 ha of fuelwood forest, and from tending and pruning. It could provide six million farmer households with fuelwood, as well as business opportunities and jobs from the forest products generated. In the coastal shelterbelt program, the output value from timber and *economic plantations* rose from 1.334 billion RMB to 8.881 billion RMB from 1987 to 1999. In the plain greening program, timber demand eased and local incomes increased. *Economic plantations* contributed to increased household income in some areas in the Taihang Mountain greening program. In 2000, overall production from *economic plantations* in China reached more than 67 million tons, with fruit alone making up 62.25 million tons (SFA 2001a). The total output value was 12.752 billion RMB.

Besides the above, improvement in local income was also stated in the reports of the Yangtze and Yellow River shelterbelt programs, the sloping land conversion, the National Afforestation and the Pearl River shelterbelt programs. However, local incomes improved mainly through job opportunities in the rehabilitation

process in the Yellow River shelterbelt and the National Afforestation programs, and through fixed-term grain and cash subsidies for farmers participating in the sloping land conversion program. Income from the job opportunities is also limited and wages vary among regions, though wages have generally increased with increased investment in rehabilitation.

In general, many programs (Yangtze River shelterbelt, Three-North shelterbelt, plain regreening) have faced problems with rehabilitated areas being destroyed due to lack of genuine participation and stake, local needs not being considered, unstable tenure and poor economic incentives, and limited and unstable funding that impedes long-term protection and maintenance. In the desertification control project, continued over-grazing, reclaiming arable land, over-cutting for fuelwood and over-collecting herbal medicines resulted in severe damage. Some recent programs such as the desertification control and natural forest protection programs also involve relocating people from the area to be rehabilitated.

Numerous reviews suggest that the sloping land conversion program, often in combination with the natural forest protection program, is already running into many implementation and sustainability problems (Lele and Shen 2001, Colchester 2002, Xu 2002a, Shen 2003, Weyerhaeuser *et al.* 2005). The program has had some negative impacts on livelihoods of mountain communities in some regions. The program aimed to improve the natural environment while increasing farmers' income, and farmers' participation was to be solicited. However, local forestry administrations find it difficult to meet the high targets with the low funding and short time available, let alone be sensitive to local farmers' needs. With tight local government budgets, they cannot provide the counterpart funds to match the Central Government investment. The target-driven approach has been imposed without considering local farmers' interests and views. Farmers have lost their current income opportunities, and compensation levels are low and only available for 5-8 years. Alternative livelihoods are not provided for beyond the compensation period and farmers are unsure about the survival and marketability of the species planted. Technical support is limited. The risk is high that farmers will revert to former land use practices once the program ends.

4.4 Protection functions

According to project reports¹⁰, the plain regreening, Three-North and coastal shelterbelt programs have respectively protected some 32.5 million ha, 21.3 million ha and 400,000 ha of farmland (details in Annex 1). The program on combating national desertification helped improve 472,000 ha of arable land.

¹⁰ Environmental outcomes provided in project reports are based on expert evaluations in some instances but may not be very formal scientific reviews. The level of seriousness varies from province to province.

Soil erosion was reduced by 21.96 million and 0.1 billion tons per annum in the Yellow River shelterbelt and the National Afforestation programs respectively, and by 390 million tons/ha/annum in the Huaihe River and Taihu Lake shelterbelt program. However, Yin (1998) indicates that the gains in these areas were more than offset by increased erosion elsewhere, such as in the Yangtze and Haihe River basins.

According to the project report, the Yangtze River shelterbelt program enhanced dramatically the capacity to resist natural disasters such as floods and improved the functioning of the watershed infrastructure such as dams and irrigation systems (Zhang 1997). However, the reported flooding outcomes are not supported by detailed investigations.

Increases in grain yield were reported in the Three-North, Yellow River and coastal shelterbelt programs as a result of the shelterbelt protection and reduced soil erosion. In the National Afforestation Project, water shortages in some local rivers were resolved. Other authors suggest the overall environment continued to deteriorate despite the rehabilitation efforts (Shen 2003). Apparently planted forest structure was simple and often followed by degradation through grazing, agriculture and other pressures in the Yangtze River area.

According to the project reports, increased wildlife species were observed in the sloping land conversion and the Yangtze River shelterbelt programs. Sayer and Sun (2003) suggest that the natural forest losses and conversion to plantations reduce biodiversity, but beyond that the impacts of the rehabilitation efforts on wildlife habitat and biodiversity are unclear. New forests are often created on open barren land, potentially having a positive impact.

Weyerhaeuser *et al.* (2005) indicates that the sloping land conversion program may fail to mitigate soil erosion and surface runoff in some areas because the lands planted are not usually the worst affected. Local administrative staff has to fulfil their allocated targets and have little time to select the areas for optimal benefit. Besides, highly-diverse landscape mosaics were converted to large-scale plantations containing few species. Monitoring was not linked to program objectives, but to the target area planted.

5. Factors driving forest land degradation and rehabilitation

The factors driving forest land degradation and its rehabilitation need to be well understood to ensure long-term sustainability of the rehabilitation efforts and prevent the recurrence of degradation and wasted money and effort. The major

deforestation episodes and expansion of degraded forest lands that followed the founding of the Peoples' Republic of China were closely linked to several political movements and transformation of forest ownership. Besides, high wood demand for economic development, subsistence needs of the rural population, fires, pests and acid rain were also important reasons for the expansion of degraded forest lands. Up to 1998, forest was still being converted to bush or barren land at the rate of 1.65 million ha per year, and forest land to other land uses such as urban development at roughly 0.44 million ha per year (Wang 1998).

Strong political resolve has driven rehabilitation of degraded forest lands to deal with environmental concerns, and timber and fuelwood shortages. In recent times, efforts to facilitate private enterprise and the opportunities for economic profit are also driving tree planting. The factors driving degradation and rehabilitation are described in detail below:

5.1 Political movements and resolve

Over the past 50 years in China, major political movements such as the Great Leap Forward and the Cultural Revolution have been responsible for substantial deforestation and expansion of degraded forest lands. The Great Leap Forward, which started in 1958, focused on rapid industrial development to keep pace with America and Britain, and resulted in forest resources being over-exploited to fuel steel and iron production. In Hubei Province, standing timber volume was reduced from 41.2 million m³ in 1957 (not including Sheng longjia nature reserve) to 27.3 million m³ by 1960. In Guangxizhuang autonomous region, 17.5 million m³ of timber was harvested for steel and iron production, 10 times more than stipulated in the region's 1958 timber supply plan (Li 1985).

During the Cultural Revolution from 1966 to 1976, forest management agencies at various levels were dismissed and forestry administration was weakened nationwide. At this time, 110,000 forest fires were recorded, burning 670,000 ha of forest annually. Uncontrolled logging and forest fire reduced national forest cover by 6.6 million ha. In Fujian, Guangdong, Guangxi, Hunan and Jiangxi provinces, forests in the lower hills were completely cleared (Li 1985).

In recent decades, faced with insufficient forest resources and widespread barren areas, the political will to rehabilitate degraded forest land has strengthened, greatly speeding up rehabilitation efforts. Large national programs with billions of RMB invested have been ongoing since 1978. Political pressure was brought to bear on provincial and local governments and the masses to fulfil allocated rehabilitation tasks decided at the national or provincial level.

5.2 Tenure security

The agricultural cooperative movement from 1953 to 1958 and later the Peoples' Commune Movement which started in 1958 led to privately-owned forests being totally eradicated. Farmers lost their rights to use and manage forests. Open-access led to severe deforestation in some areas. Some forest land was allocated to local farmers under land ownership reform from 1981 to 1983 and wood markets were opened up to promote forest rehabilitation. However, open markets and experience with frequent tenure changes and unstable forestry policies in previous decades led to farmers rapidly exploiting the forest in the southern collective region for fear the policies might change again (Cai *et al.* 2003). Subsequently, over time, tenure security and rights to transfer tenure were strengthened, which did lead to substantial interest and investment in rehabilitation for commercial purposes by the private sector.

However tenure over the land does not automatically guarantee tenure over the forest resources on the land; these resources are still government-controlled. Tenure rights are often curtailed by policy initiatives and changes such as the recent logging ban under the natural forest protection program; the ban was extended to collective forest areas, even planted areas (Lele and Shen 2001, Shen 2003, Miao and West 2004). In some extreme cases, local communities' access to non-timber forest products was also cut off along with timber harvest rights. Such changes negatively affect the development and management of forest resources on collective land and increase illegal activities leading to resource degradation.

5.3 High wood demand and timber shortage

High wood demand for economic development led to heavy logging and a dramatic decrease in forest cover in many areas. In the early 1950s, the forestry department was responsible for harvesting as much wood as possible and most of the 138 state-owned forest industrial enterprises were established for this purpose. They were also responsible for rehabilitation after logging but this was rarely done. Annual timber harvests rose steadily from 1949 to 1997, and then declined when the logging ban was implemented in natural forest areas in 1998 (Figure 5). Shi and Xu (2004) based on national forestry statistics, estimate that an annual average of 19 million m³ of wood was over-logged between the first national forest inventory (1973-1976) and the second. This had increased to 28 million m³ by the third inventory (1984-1988). In Yunnan Province, over-logging reduced forest cover from 50 percent in the early 1950s to 24 percent in 1980 and in Hainan Province from 35 to seven percent (Zhang 1996).

On the other hand, timber shortages and increasing wood demand have driven plantation programs since the 1960s, particularly in the southeastern provinces. Earlier efforts were by the government alone but now involve the government

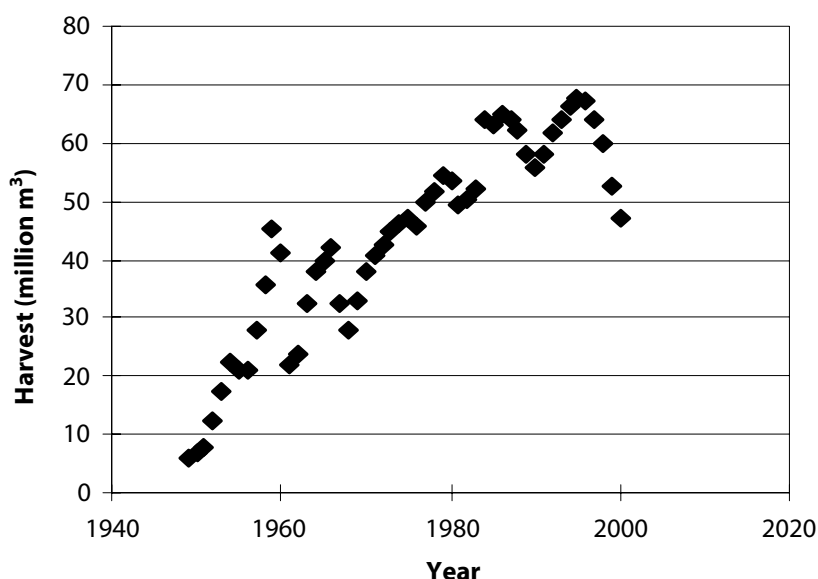


Figure 5. Annual timber harvest (million m³) from 1949 to 2000 (SFA 2000).

and private sector. The annual gap between timber demand and supply increased at the rate of 15.9 percent from 1981 to 1990 and stood at 54.26 million m³ in 2000 (Hong 1997). In recent years, timber demand from the wood-processing and construction industries is increasing dramatically with rapid economic development. Experts project that timber demand will continue to increase for a long time, with domestic wood demand of 345.9-350 million m³ by the end of 2005 and 437.8-442.8 million m³ by the end of 2015 (Table 7) (Yao 2000). At the same time, projected domestic wood supply based on present forest resources is 169 million m³ in 2005 and 195 million m³ in 2015, leaving shortages of 60-70 million m³ in 2005 and 140-150 million m³ in 2015 respectively; this does not even include fuelwood.

Table 7. Projected wood demand in 2005 and 2015 (Yao 2000). Unit: million m³.

Items	2005	2015
1. Production and construction	235.9-240	337.8-342.8
• construction	64.4	72
• paper	28-30	63-68
• decoration	24	33
• furniture	21	37
• panels	29-31	39
• other	69.5	93.8
2. Fuelwood	110	100
Total	345.9-350	437.8-442.8

5.4 Population growth and subsistence needs

Rapid population growth from the 1960s to 1970s increased the pressure on forest land. Even steep slopes were cultivated for food crops and the demand for fuelwood and other forest resources was high. Cultivation and overuse of these marginal lands led to severe degradation and environmental problems in the subtropical region. Population pressures also arose in the state-owned forest regions where roughly 1.3 million forestry employees were located and pressed to depend on over-logging for their basic living needs (Tang *et al.* 1998). In southern China, local villagers relied heavily on forest products for both cash income and domestic use (Cai *et al.* 2003). Fuelwood extraction often included removing all branches, logging residues and understory shrubs thus denuding hillsides, altering soil properties and increasing erosion and surface runoff (Yin 1998).

Increasing population in Karst region of Guizhou Province worsened degradation

The population growth rate was 2-3 percent per annum in the Karst region of Guizhou Province, and the province's population density was 200 people per km² in 1993. Both the growth rate and population density were much higher than the national averages of 1.14 percent per annum and 124 persons per km² in the same year. Reclaiming steep forested land for cultivation led to severe soil erosion and exposure of the underlying rock. Further cultivation or rehabilitation is difficult. The area of such degraded Karst land increased by 62,400 ha from 1974 to 1979, and is expected to expand further (Lan 2002).



(Left) Household fuelwood stock for pigfeed in Xinfu village, Guizhou, (Right) A day's fodder collection, Xifeng village, Guizhou. (Photos by Alexander Hinrichs)

The same high dependence on forest resources is stimulating local governments to rehabilitate forests for fuelwood. People in many rural areas rely mainly on fuelwood for their daily cooking and heating needs. Official statistics indicated that national fuelwood consumption was 8.84 million m³ in 1993 (Zhang 1996) while Hou and Wang (1998) estimate that it was closer to 173 million m³. Annual fuelwood consumption decreased by 3.7 percent from 1988 to 1993 due to improved cooking equipment; the development of methane gas, mini hydropower and wind energy in rural areas; and decreasing rural population. However, fuelwood demand is still expected to equal 110 and 100 million m³ in 2005 and 2015 respectively (Yao 2000).

5.5 Forest fires, pests and acid rain

Forest fires result in substantial deforestation in China, with 947,242 ha being severely burnt annually from 1950 to 1987. Fires were particularly frequent and widespread during the Cultural Revolution when forestry management was weak. The largest forest fire occurred in Daxinanling region of Heilongjiang Province in 1987, burning 890,000 ha, with 23,300 ha completely deforested (SFA 2001b). With a strengthened fire control system, fires declined drastically in the 1980s. In 1998, fire totally destroyed 27,424 ha of forest nationwide.

Since the 1980s, pest incidence has been increasing with 6.67 million ha of forest severely infested annually. At present, some native and exotic forest pests such as pine caterpillars, fall webworm, spring cankerworm, nematodes, pine greedy scale and rodents destroy large areas of plantations. These plantations, the result of past rehabilitation efforts, are mostly monocultures and often composed of exotic species. They are often poorly matched to site conditions and very vulnerable to pest and disease outbreaks. In 1998, 7.01 million ha were badly infested, with pine caterpillars damaging 695,000 ha and rodents 719,000 ha. By the end of 1999, nematodes had infected 72,400 ha of pine plantations and killed about 15 million trees (Li 2002).

Acid rain also degrades forests in certain areas, including in Sichuan, Guizhou, Hunan, Hubei, Jiangxi and the coastal areas of Fujian and Guangdong provinces. Field investigation shows that acid rain with pH < 4.5 greatly affects the growth of Masson pine, Huashan pine (*Pinus armandii*) and firs, and can ultimately kill such forests. The most severely affected area is in the Sichuan basin where approximately 280,000 ha is damaged annually, of which roughly 15,000 ha was totally destroyed and then clear-cut in the province (WOSMOC website).

5.6 Frequent natural disasters and deteriorating environment

Large natural disasters such as floods, droughts and sandstorms have been occurring with increasing frequency in many areas and have been associated with

deforestation and forest land degradation in China (Zhou 1997, Liu and Diamond 2005). For example, in the Yangtze River valley, forest cover of 22 percent in 1957 dropped to 10 percent after 30 years of exploitation. The area affected by runoff and soil erosion increased from 36 million ha in the 1950s to 73.4 million ha in the 1980s, covering 41 percent of the valley's land area. Annual soil loss reached 2.26 billion tons with 530 million tons ending up directly in the Yangtze River (Zhang 1997). Such natural disasters and environmental objectives have driven the bulk of the national programs, particularly since 1978.

The key environmental objectives of the programs were:

- Reduce runoff and soil loss in some river valleys and mountains.
- Reduce desertification, sandstorms and direct onslaught of dry hot winds on crops growing on plains, the northern dry zone and some river valleys.
- Avoid severe flooding and landslides in the mountains, lake basins and river valleys.
- Reduce typhoon and storm damage and stabilise shifting dunes along the coast.

The type of rehabilitation and management activities adopted could well influence local soil properties, surface flow and flooding on a small-scale. However, it should be noted that the influence of forests and tree planting activities on massive flood and landslide events is increasingly questioned (FAO and CIFOR 2005).

5.7 Facilitation of private enterprise and pursuit of economic profit

In recent years, the policy to develop private forestry has encouraged rural farmers and some private enterprises to invest in forest rehabilitation, especially in fast-growing and high-yielding timber plantations and *economic plantations* for profit. In 2003, the private sector rehabilitated approximately 5.317 million ha or 58.3 percent of the total national *afforestation* area. Government incentives for private investment include lowering timber taxes and fees and liberalising markets.

In conclusion, political pressures and demand for timber and fuelwood are common driving factors in both directions. They could promote forest land degradation or rehabilitation, and care should be taken in devising policies and programs to be sure they inhibit degradation while promoting rehabilitation and sustainable management for timber production. Additional factors driving rehabilitation efforts are frequent natural disasters and pursuit of private profit particularly after 1998. Socio-economic and technical causes of degradation such as insecure tenure, local livelihood needs and pest susceptibility will have to be addressed to ensure long-term sustainability of the rehabilitation efforts for both environmental and commercial objectives.

6. Overview of policies influencing forest land rehabilitation

During the past 50 years, under the centrally-planned economic system, governments at all levels played a leading role in facilitating forest land rehabilitation. Policies influencing rehabilitation in that time can be summarised as follows:

6.1 Financial policies

The forest rehabilitation funding system was adopted in some state-owned forest regions in the northeast and inner Mongolia in the 1950s, and extended to collective forests in the south later. In the 1960s, the Central Government formally enacted the system, which was then amended several times up to 1981. In the state-owned forest regions, 26 percent of the income from sale of timber is collected towards the forest rehabilitation fund, whereas in the collective forest region, 20 percent of the income is collected. The fee is directly levied and managed by local governmental forestry agencies to regenerate the forest.

Besides the specific income from local timber sales which provided bulk of the investments, the Central Government provided some funding for national programs and local people provided free labour. A certain percentage of the Central Government's fiscal budget has been allocated for forest rehabilitation through a financial subsidy and capital investment since 1949 (Zhao and Gao 1999) (Table 8 and Figure 6). An estimated 24.3 billion RMB of Central Government funds have been invested in forest rehabilitation from 1950 to 1999 (Zhou 2001). In general, over the past decades, the Central Governmental investment only served to subsidise seedling and seed costs, with few additional incentives. Besides, the Central Government's financial allocation for forestry was much lower than for water conservation and agriculture (Table 8). Also, capital investment declined year by year from 1980 to 1995 as a proportion of the total government budget

Table 8. Financial allocation (from Ministry of Finance) for forestry, agriculture and water conservation from the 4th to the 8th Five-Year plans in China (Zhao and Gao 1999). Unit: billion RMB (%).

Sectors	Five-Year plan periods					Total
	1971-75	1976-80	1981-85	1986-90	1991-95	
Forestry	2.48 (0.6)	3.46 (0.6)	5.53 (0.8)	9.82 (0.7)	18.03 (0.7)	39.35 (0.7)
Water conservation	18.85 (4.8)	30.05 (5.7)	23.67 (3.4)	35.35 (2.5)	63.58 (2.4)	146.51 (2.6)
Agriculture	-	11.08 (2.1)	20.77 (3.0)	36.29 (2.6)	112.30 (4.2)	180.45 (3.2)
National total	391.94	527.35	695.19	1397.82	2689.57	5699.26

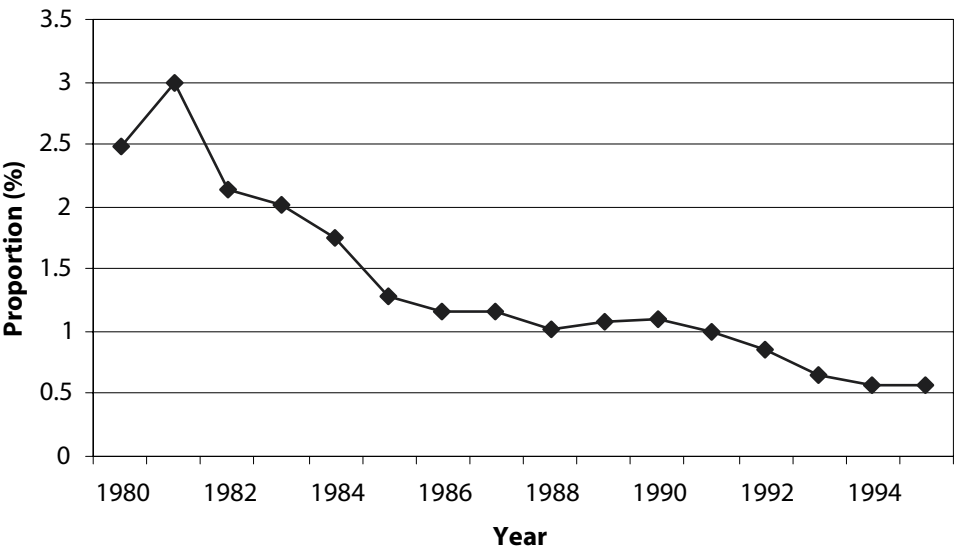


Figure 6. Proportion (%) of national capital investment allocated to forest rehabilitation from 1980-1995 (Zhao and Gao 1999).

(Figure 6) with a shift to loan-based financing of private sector and local initiatives (Xu *et al.* 2004).

In the early programs prior to 1998, much of the rehabilitation costs were borne by local governments and through free labour, with the Central Government contributing a small proportion (see Annex 1). Four consolidated large programs launched in 1998 are to be mainly funded by the Central Government with a little local government counterpart funding. The fifth program — the forest industrial base project — is to be supported through low-interest commercial loans made available to individual investors, farmers and private companies to establish *economic plantations* and fast-growing and high-yielding forest plantations. Planned investment for afforesting 92 million ha¹¹ through the five programs in 10-15 years is roughly 573 billion RMB: 23.13 billion RMB for the natural forest protection program, 358.43 billion RMB for the sloping land conversion program, 57.7 for the desertification control project, 70 billion RMB for the key shelterbelt project and 63.8 billion RMB for the forest industrial base project.

Investment standards have been established for the different revegetation techniques (1050 RMB/ha for *mountain closure*, 1800 RMB/ha for aerial seeding and 3000-4500 RMB/ha for planting) and for producing different types of

11 This is larger than the 64.2 m ha of degraded forest land since the programs also target areas outside the designated forest lands such as sloping cultivation lands, grasslands, lowland farms, roadsides and riverbanks for *afforestation*.

wood products (6000-7000 RMB/ha for pulp and artificial boards and 7000-8000 RMB/ha for large-diameter timber) (Zhou 2001). Under the sloping land conversion and desertification control programs, farmers are to be given cash and grain subsidies for converting their steep or poor farmlands as well as barren mountains and sandy lands into forests and grasslands. The compensation is to be paid for five and eight years respectively for conversion to *economic forests* planted with fruit trees and *ecological forests* planted with timber trees. These subsidies account for a sizeable proportion of the total 573 billion RMB estimated costs of the rehabilitation-related components of these five programs.

But how much is actually spent and achieved depends on the Central Government's budget situation and the local counterpart funding which varies from region to region and year to year. Sustaining such large Central Government investment will depend on the general economic situation of the country and the formulation of effective income generation and re-investment mechanisms by Chinese forestry agencies. Local governments are finding it difficult to raise the necessary counterpart funds given tight budgets and reduced revenues in natural forest areas arising from the logging ban. Free labour is also not forthcoming anymore.

6.2 Forest ownership

Before 1949, three major categories of forest ownership existed: national, public and private. Private forestland was owned by millions of landlords and a few feudal clans. In 1950, the land law of the People's Republic of China was enacted and forest lands were seized and distributed to local farmers. In 1953, the cooperative movement of agriculture regrouped the forest lands into elementary agricultural producers' cooperatives at first and then into advanced agricultural producers' cooperatives. In 1958, the Peoples' Commune Movement further increased the degree of public ownership with total eradication of private forest. This resulted in just two ownership types: a) state-owned forest (central or local government) located mainly in northeastern, northwestern and southwestern China; and b) collective-owned forest (local township, administrative village or natural village). In the southern and southeastern provinces, most forest land is collective-owned.

Under this system, individuals and private entities had no real tenure rights despite the stipulation that whoever planted the trees also owned them. Land ownership reform from 1981 to 1983 allowed some collective and state-owned forest lands to be partially reallocated to local farmers to manage and use the forest resources. Up to 1984, a total of 71.3 million ha of collective forest land was reallocated to more than 57 million households nationwide (MOF 1949-1986).

In the 1980s, wood markets were opened up to promote forest rehabilitation by farmers. Under a new policy in 1992, barren mountains and sandy areas were

auctioned to local farmers and private entities for *afforestation* and long-term management and use (Miao and West 2004). The Forestry Law of 1998 made use rights over timber, economic and fuelwood forest lands transferable. Farmers and collectives were allowed to transfer, lease or contract their land holdings but conversion to non-forest use was prohibited. The Law further extended use rights for up to 70 years and made them renewable. These improved tenure rights along with other financial incentives are resulting in more and more civil and private sector actors rehabilitating degraded forest land for commercial purposes. However, private ownership rights still need clarifying and strengthening to ensure sustainable rehabilitation.

6.3 Forest taxation and fee structures

Taxation and fee structures were not entirely favourable to forest rehabilitation in the past, particularly for establishing timber plantations. About 40 percent of the harvest earnings were to be paid directly in taxes and fees, although it varied widely between provinces and counties. In Fujian Province, the taxes and fees levied were more than 50 percent on average, rising to more than 70 percent in certain areas (MOF 1999). Taxes for forestry products were higher than taxes in other sectors (Sun 2002a). Foreign investors had more favourable terms than domestic companies.

Many provinces gradually abolished agricultural taxes (including timber harvesting taxes) to speed up agricultural and rural area development and improve farmers' livelihoods. In 2004, the Central Government announced that all taxes paid by rural farmers on special agricultural products including timber will be gradually repealed within five years, thus reducing the financial burden on farmers (Wen 2004). Forest product processing industries still have to pay taxes on value added and for their overall business operations. Timber producers still have to pay some fees to forestry agencies at the county level for the forest rehabilitation fund and related activities such as road building and fire control. It is expected that the abolition of taxes for timber producers will be a big incentive for commercial forest development.

6.4 Classified forest management policy

The classified forest management policy zoned forest land into "commercial" and "ecological" based on the main functions the forest was to play. Southeastern China was mainly classified for developing commercial forest plantations, while western China is mainly oriented towards ecosystem restoration. The policy influences rehabilitation greatly with funding for *ecological forests* arising primarily from the Central Government, and the investment for commercial forest rehabilitation depending on markets or commercial loans in most situations.

Ecological forest tenure holders were to be economically compensated to conserve the environment while combating poverty. Besides central and provincial government contributions, money was raised from local sources including part revenues from utility bill payments to cover the shortfall in compensation (Wang and Dan 2004). Numerous problems were apparent in some ongoing initial programs with compensation schemes, such as the sloping land conversion program and the Eco-fund program (Sun 2002b, Xu 2002a, Regional Development Research Centre Yunnan University 2004, Weyerhaeuser *et al.* 2005). Governments at all levels were the major funding sources and the payments were inadequate at roughly five RMB per *mu*¹² and were far below the opportunity costs.

Market, local and other mechanisms for rewarding environmental services need to be explored further. Better appraisal of the services provided, and information and technical support for the providers and buyers are also needed. Currently, there is just a single compensation rate irrespective of local situations, forest quality or contribution to environmental services; and the system is not concerned with local farmers' needs or views. Lost income opportunities and inadequate compensation may act as disincentives to landholders to rehabilitate and sustainably manage their forest land, and may impoverish farmers in some cases.

6.5 Harvesting regulations

Forest resource management policies were mainly focused on protecting the remaining forest resources, with all harvesting regulated by annual quotas. The Government invested a large amount in forest resources in the past and feared rapid deforestation, hence quotas were continued despite market liberalisation and private forestry being encouraged (Xu 2002b). However, quotas do constrain tree planting because people do not have the right to dispose of the trees planted. Quotas are also insensitive to plantation conditions and market signals and do not allow for efficient resource allocation (Xu 2002b).

Bill Hyde states in Zhu (2002) that harvest regulations, with a logging ban at the extreme, have not helped to protect the environment nor succeeded financially. The private sector has been more successful in commercial forestry except where constrained by the Government. For example, Yin (1998) states that timber forestry grew rapidly in the Three-North farm forest region before 1998 compared with the state farm and southern collective regions, because this area had no harvesting quotas, timber could be sold in the open market and taxes were low. This calls for improving regulations to help the private sector practise sustainable forest management and efficient use of timber resources, while using public mechanisms to protect environmental values.

12 Fifteen *mu* = One ha

Forest resource management policy reform discussions have been ongoing since 2003 and policy reform aims to support commercial forestry development while protecting *ecological forests*. Timber logging is banned in *ecological forests* though non-timber forest products can be harvested. Since 2004, commercial foresters have been allowed to freely time their harvesting activities to suit market conditions. Further, the Central Government has decided to liberalise timber harvesting quotas for commercial plantations within the 11th national five-year plan (2006-2010) to enable tree planters to respond to market situations, particularly in southern China (http://www.forestry.gov.cn/DB1/news/content.asp?table_type=news&id=9715&pgid=1).

7. Key constraints and challenges to sustainable rehabilitation

Rehabilitating large areas in a short time has been possible in the past but there have been problems with long-term sustainability of the efforts. Concerted efforts have increased forest cover since the 1980s but the nature and quality of the forests regenerated was poor. Growth, stocking, and forest composition and structure need much improvement. There were documented production and livelihood benefits arising from the different programs. However, negative socio-economic impacts have been noted as well. Projects report improvements in soil erosion and grain yields as a result of the rehabilitation efforts while others claim that environmental conditions continue to deteriorate.

Strong political resolve has driven rehabilitation of degraded forest lands to deal with environmental concerns, and timber and fuelwood shortages. There is good experience in government programs, planning and management systems to draw from. The private and civil sectors are playing an increasing role with tenure reform and market liberalisation. Incentives offered to them at national and/or local levels include priority rights for logging licences and quotas, reduced timber taxes and fees, open timber markets, credit facilities with lower interest rates, secure and longer-term tenure, allowing tenure transfer and lease arrangements, pilot environmental service payments to landholders of *ecological forest* areas, and allowing *economic forests* or cash crop species in forest lands.

The review of past experiences suggests that the key constraints and challenges to sustainable forest rehabilitation lie in future program planning and financing; paying attention to long-term management; technical considerations; improving incentives further for private forestry; identifying effective mechanisms for enhancing environmental services; addressing timber and livelihood needs and concerns; ensuring local participation and stake; and further strengthening tenure over the land and resources.

7.1 Policy and program level

The first major challenge lies in adequately planning for and mobilising the institutional and financial resources needed for implementing the current large-scale national programs. From the mid-1980s, the Central Government adopted the responsibility system for achieving rehabilitation tasks, compelling governments at all levels to meet their respective targets in the planned period, or else the leaders stood to lose their positions. This system led to previous rehabilitation objectives being achieved. However, the system shows signs of losing its effectiveness since late 1990s with new rehabilitation tasks not being enacted in a timely manner and the Government losing its driving role in the new market economy situation. The forestry administration is stretched and funding is limited. In the 1990s, the policy requiring obligatory labour of farmers in public affairs such as forest rehabilitation and construction of irrigation facilities without pay was cancelled in order to reduce the farmers' burdens. People increasingly expect to receive direct incomes or subsidies for their efforts and it is increasingly difficult to coerce voluntary participation in forest rehabilitation projects.

Secondly, the current forestry management system was formulated under a planned economic system with governments at all levels playing dominant roles in implementing the plans. Plans often fail to reflect ground realities due to insufficient information for planning. Also the planned economic system makes managing the forest rehabilitation process less flexible. For example, in the sloping land conversion program, plans often do not suit local needs, site and market conditions. It is difficult to alter the plans handed down by higher forestry agencies, even if the weather and other conditions are unfavourable. Besides, bureaucratic procedures could mean delaying implementation and forfeiting planting at the appropriate time, which leads to poor survival rates.

Thirdly, the focus in the past was mainly on meeting targets, rather than on quality. Although a complete system to evaluate and control the quality of forest rehabilitation has been formulated since the end of the 1980s, the system focuses more on checking results and neglects guidance through the process. The quality of the forest rehabilitation process needs to be controlled, so that managers can identify, adapt to and rectify problems as and when they occur.

Fourthly, little attention was paid to managing the rehabilitated areas in the long term. The areas may be degraded after meeting afforestation targets due to fires, pests and diseases, poor survival and growth, grazing and local harvesting for domestic needs. General guidelines, concrete criteria and indicators, funding and institutional arrangements are required to sustainably manage these young and middle-aged forest stands.

Fifthly, governmental forestry agencies at different levels implemented most programs in the past, but funds and institutions are stretched and there is a new market-based economic system that could be used to mobilise more social capital for forest rehabilitation. Now, different entities such as the private sector could undertake rehabilitation using funds from the government and elsewhere. Through plantation development since the 1980s, the collective and private forestry sectors have contributed greatly to the expansion of forest cover in China. Zhou (2002) suggests that the government could focus on funding and managing *ecological forests* while commercial forestry could be left to the private sector and market-based mechanisms.

Sustaining and promoting private forestry would require that existing constraints, such as high taxes and fees and harvesting and transport controls, are addressed to make commercial forestry viable and allow the investors to manage their resources freely in response to forest conditions and market signals. However, some safeguards may be required to ensure sustainable management without land degradation and depletion of ecosystem services. Also, taxes and fees are often the main revenue source in villages and counties, especially in forest regions, and lowering these charges requires finding other funding sources to cover basic administrative expenses (Sun 2002a). The private sector would also need more technical support backed by research information and supplies of superior and diverse planting stock.

Ecological forests have more restrictions on management and use since they are meant primarily for improving environmental services. Logging is usually not allowed and landholders are to be paid economic compensation for lost opportunities. However, implementing and monitoring this scheme appropriately and providing adequate compensation over the long-term and nationwide is a serious challenge. Problems were already apparent in some early attempts. Richer provinces could afford to pay more. It is also unclear whether this strategy will actually improve environmental conditions given the choice of lands, rehabilitation techniques, consequent loss of management interest in the resources and heavy informal extraction. Alternative strategies could also be considered, such as sustainable forest management for products and services by communities or the private sector with adequate tenure security.

7.2 Socio-economic considerations

Local peoples' livelihoods and community development were hardly considered in the forest rehabilitation processes before the 1980s. Rehabilitation plans and stipulations were largely based on governmental motivations and targets. Neglecting the daily necessities of local communities and households often led to rehabilitation efforts failing and created hardships for people. For example, strict

closure of mountains without considering local farmers' basic needs for fuelwood and grazing is not implementable. Livelihood needs have to be balanced with environmental and production needs, else it ends up being a lose-lose situation.

Second, local farmers' voices remain unheard and rehabilitation processes are largely top-down and may actually harm local interests. Many programs such as the shelterbelt programs were intended to improve the local environment and enhance fuelwood, water, fodder and other resource availability. However, local people were hardly consulted and were forced to provide compulsory and mostly free labour in most past government programs. Past experiences suggest it would be wise to ensure genuine participation and consider the needs and perspectives of all stakeholders, including local communities, in designing and implementing projects. The shelterbelt program in the Three-North region was forced to integrate multiple forest types with multiple tree species and combine trees, shrubs and grasses during program implementation to cater for local livelihood needs. Participatory methods are employed in foreign-assisted projects, but they tend to bypass existing institutional structures (Liu 1999). They could more usefully try to work with the existing institutions and build their capacity for working more directly with local people.

Third, little attention is paid to program evaluation during and after project completion, particularly on the socio-economic impacts. Initial assessments suggest socio-economic problems arising from the natural forest protection and the sloping land conversion programs. Systematic methods and procedures to carry out such evaluation and synthesise the experiences and lessons would be useful. Long-term sustainability and impacts on local livelihoods should be assessed before the program is launched and after it ends.

Fourth, long-term tenure security over both the land and resources is critical for sustainable rehabilitation and management. It is important to speed up reform on tenure policies and ensure that they permit local farmers and other stakeholders to have full rights to manage their forests and dispose of any products arising from them. Any new programs and policies should be consistent and build on existing rights in order to build trust and confidence.

7.3 Technical aspects

Many technical problems continue to plague rehabilitation efforts. First, species-site matching was not effectively implemented. Some conifers or exotic species were introduced imprudently in many areas without considering the site or objectives. For example, with the boom in fast-growing, high-yielding forest plantations in southern China, *Eucalyptus* species are being introduced even in more temperate latitudes without long-term trials. If the introduced species fail to

survive extreme climatic conditions including frost, much effort and money will be wasted, and local forestry agencies who advocated the species will lose their credibility. Loblolly pine and slash pine, which were introduced in the 1960s, show weak resistance to diseases and pests. In contrast, some promising native tree species have not been given much attention. Also native species such as Chinese fir and bamboos were planted on a large scale on inappropriate sites leading to low productivity (Cai *et al.* 2003). Improper site preparation practices such as burning of the ground vegetation and not using fallows and species mixtures lead to declining soil fertility in fir plantations. Forest rehabilitation for economic purposes should be based on market trends and economic considerations, but also requires technical and social risk assessments. More natural regeneration through *mountain closure* could be used in rehabilitating forests for ecosystem services where possible, a technique that is not only cost effective but also functional.

Secondly, techniques for improving the survival and growth of trees planted in dry, sandy regions present a major challenge. This is especially important now with the rehabilitation focus moving towards dry western China with development plans for the region. Here, areas suitable for planting trees need to be identified first, as opposed to areas that should be planted to shrubs or allowed to recover naturally into forests or grasslands. Suitable tree species for the site and local needs need to be assessed before undertaking any rehabilitation action. Project implementers also need to consider the balance of water resources in site and tree species selection.

Thirdly, supplying adequate technical extension support from the top to grass-root levels is a problem due to a shortage of funds. As a result, the quality of forest rehabilitation tends to be poor. Traditional knowledge is not sufficiently used, and farmers usually only participate with their labour rather than being involved in selecting sites, tree species, and other such issues.

Fourthly, persistent and aggravated environmental problems and concerns continue to drive rehabilitation efforts, despite large increases in forest cover. The plans and techniques adopted in any program should also be based on the objectives of rehabilitation such as reducing soil erosion, while balancing other needs. A system for monitoring and evaluating progress according to the objectives should be put in place from the start.

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Annex 1. The key forest rehabilitation programs from 1978 to 1998 (Zhang 1997, Zhou 2001, SFA 2004). Planned targets and durations underwent numerous changes so initial figures are presented below.

1. Shelterbelt forest program in Three-North region

The Three-North region — namely, northern, northwestern and northeastern China — contained five percent of China's forest cover and more than 60 percent of its poor counties in 1977. With annual average rainfall less than 400 mm, the region is prone to drought and desertification. The shelterbelt program was initiated in 1978 primarily to improve the environmental conditions for agriculture and local people, and also provide timber, forage, and fuelwood. The driving forces behind this program were severe top soil loss, low soil fertility, and shortages of timber, forage and fuelwood. The program covered 407 million ha or 42.6 percent of the nation's land area, and originally involved 551 counties across 13 provinces. The program was subdivided into three stages with eight phases lasting from 1978 to 2050, and an *afforestation* target of 35.6 million ha with a planned forest cover increase from 5.05 percent in 1978 to 15 percent in 2050. Revegetation techniques involved planting, closure of mountains and sandy areas to promote natural regeneration, and aerial seeding. Main species to be planted were poplars, willows, elm, pines; and shrubs such as seabuckthorn, peashrub (*Caragana*) and shrubby amorpha. Work in the first three phases was primarily done by local people providing obligatory labour (equivalent to 86 percent of the cost) with seven percent funding from the Central Government, four percent from the local government and three percent from other sources (POSFA 2001).

Area rehabilitated from 1978 to 2000 totals 27.6 million ha (SFA 2004). Shelterbelt networks have brought 21.3 million ha of farmland under protection, steadily increasing grain yield. The forest cover in priority sandy areas such as Maowusu and Keerqin has reached more than 15 percent and 20 percent respectively. Fuelwood forest of 911,752 ha has been established yielding 5.47 million tons annually. In addition, tending and pruning have provided supplementary fuelwood to meet the demand from six million farmer households. Moreover, the program has altered the rural industrial structure in some areas. More than 2600 forest products, including seabuckthorn, apricot, dates (*Phoenix*), walnut (*Juglans*), littleleaf peashrub (*Caragana microphylla*) and Mongolia willow (*Salix mongolica*), have resulted in diversified business opportunities, created 63,000 jobs and generated revenue of more than 600 million RMB (POSFA 2001).

However, beetles have damaged the shelterbelt forest network, in which poplar was the dominant tree species. Beetles almost totally destroyed the poplars in Ningxia autonomous region prior to 1994. Meanwhile, farmers are losing interest in participating in the program due to insufficient investment and insecure ownership over the resources. This program has now been integrated with the new national forestry programs from 2000 and is in its fourth ten-year phase. This phase is being implemented in 590 counties in 13 provinces, and has an *afforestation* target of 9.5 million ha (Zhou 2001).

2. Shelterbelt forest program along the upper and middle reaches of the Yangtze River

The Yangtze River valley is 6300 km long and covers 18.8 percent (180 million ha) of China's land area and contains 33 percent of its population. Most of the valley is in the subtropical region. Intensive farming and fuelwood and timber extraction over a long period have led to vegetation removal, severe soil erosion, flooding and adverse socio-economic impacts.

To reverse this trend as rapidly as possible, the national Seventh Five-Year Plan (1986-1990) proposed establishing soil and water conservation forests in the Yangtze River's middle and upper reaches. The 20-year plan started in 1989 was designed to establish 20 million ha of forest in two phases in 271 counties across 12 provinces (Zhang 1997). Forest cover was to be increased from 20 percent to 40 percent, and runoff and soil erosion was to be controlled on an affected 7.4 million ha. Revegetation techniques involved planting, *mountain closure* and aerial seeding. Pines, Chinese fir, broadleaf species, bamboo, commercial fruit trees and shrubs were to be planted. The planned investment in the first phase was 3.3 billion RMB, 27.3 percent from the Central Government, 20 percent from local government and 52.7 percent as equivalent labour cost. Materialised investment equalled 38.2 percent from the Central Government and 61.8 percent from the local government and other sources.

Five million ha were rehabilitated in the first phase from 1989-2000 with forest cover in the program area increasing from 19.9 to 29.5 percent (SFA 2004). Zhang (1997) stated that the capacity to resist natural disasters such as drought, floods and sandstorms has been enhanced dramatically, watershed infrastructure such as dams and irrigation systems were functioning better, and some wildlife including the giant panda were increasing in abundance. The rehabilitation quality was high with 90 percent of the area meeting the national standards. A survey in Sichuan Province showed that local incomes had risen by 80 percent since 1989. However, limited funding meant the

forests could not be protected and rehabilitation was often followed by degradation through grazing, agriculture and other pressures. The structure and functionality of the rehabilitated forests was lower than in the natural forests.

This program was readjusted to focus on the valley's middle and lower reaches in 2001 following the launch of the natural forest protection program and the sloping land conversion program along the upper reaches of the Yangtze and Yellow River valleys (Zhang 1997). The second 10-year phase of the program is being implemented in 1039 counties in 17 provinces, and has an *afforestation* target of 6.87 million ha (Zhou 2001).

3. Coastal shelterbelt forest program

China has a long coastline of 18,000 km, stretching across 195 counties in 11 provinces. The coastal shelterbelt forest program covers 25.1 million ha of land, equalling 2.6 percent of China's land area. The region's ecological health has deteriorated following deforestation and it was very vulnerable to natural disasters such as typhoons, storms, droughts, strong winds and shifting sand dunes. These disasters caused direct economic losses of about 2.95 billion RMB per year on average and also threatened national environmental security. The coastal shelterbelt program was started in 1988 to protect against natural disasters and solve the severe local fuelwood shortage problem. It was divided into two phases, from 1988 to 2000, and from 2001 to 2010, with *afforestation* targets of 2.49 and 1.07 million ha respectively.

The program has sought to improve forest cover from 24.9 to 39.1 percent of the project area; the target for the first phase was an increase in cover to 34.8 percent. Regeneration techniques involved planting, *mountain closure*, aerial seeding, and agroforestry. Horsetail beefwood, pines, poplars, coconut, mangrove, and shrub species were to be planted. The original planned investment was 3.2 billion RMB, 22 percent from the Central Government, and 78 percent from the local government and as equivalent labour cost (Zhang 1997). Materialised investment was 2.953 billion RMB, four percent from the Central Government, 71 percent from the local government and 25 percent as equivalent labour cost (Zhang 1997).

According to SFA (2004), 1.1 million ha was rehabilitated by 2000. The project report however gives a higher estimate of area rehabilitated (Zhang 1997). According to the project report, 1.9 million ha of barren mountain land was rehabilitated in the first phase, with forest cover increasing from 24.9 percent to 35.45 percent. Shelterbelt forest covering 18,000 ha was established, which helped protect 387,100 ha of cultivated land and the total

grain output in the program area rose from 69.53 billion kg to 125.12 billion kg. With 203,600 ha of timber forest and 799,200 ha of *economic plantations* established, forestry output value increased from 1.334 billion RMB in 1987 to 8.881 billion RMB in 1999. Although a basic shelterbelt forest system has been formed along the coastal area, the forest structure is simple and some difficult planting sites need further investment.

In 2000, the program was regrouped into the key shelterbelt program along the Three-North region, the Yangtze River valley and other regions. The second 10-year phase of the program is being implemented in 220 counties in 11 provinces, and has an *afforestation* target of 1.36 million ha (Zhou 2001).

4. Pearl River valley shelterbelt forest program

This program covered the zone around the three major tributaries of the Pearl River. This zone plays an important role in the national economy. Forest cover in the valley decreased greatly with overexploitation, and the area affected by runoff and soil erosion increased from 4.1 million ha in the 1950s to 7.6 million ha in the 1990s. The land area with exposed rock surfaces following vegetation and soil removal increased at an annual rate of 3-6 percent, posing a severe threat to local people and their livelihoods.

The program was initiated in 1995 for watershed protection and for alleviating natural disasters such as drought, flood and debris flows. The program covered 40.9 million ha, about 92.6 percent of the total area of the Pearl River valley. It stretched across 177 counties of four provinces, namely Yunnan, Guizhou, Guangxi and Guangdong. Planned *afforestation* totalled 1.2 million ha with a total planned investment of 1.08 billion RMB: 12.1 percent from the Central Government, 29.3 percent from local governments and 58.6 percent being the equivalent labour cost. Targeted increase in forest cover at the end of the program is from 35.01 percent to 37.94 percent. Shelterbelt forest in particular is to be increased from 11 to 38.16 percent while timber forest is to be decreased from 72.55 to 43.88 percent. Revegetation techniques involved planting, *mountain closure* and aerial seeding (Zhang 1997). Total materialised investment in the first stage was 833 million RMB with 155 million RMB from the Central Government, 250 million RMB from the local governments and 428 million RMB as equivalent labour cost (Zhou 2001, SFA 2002).

By the end of the program's first stage in 2000, 160,000 ha were rehabilitated to forest, accounting for 13 percent of the planned task (SFA 2004). The program was constrained by a three-year delay and low investment, but

forest cover was increased in the areas where the program was implemented, improving the local environment and livelihoods in certain regions. However, severe runoff and soil erosion problems remain uncontrolled in much of the valley. The stony land needs more technical and financial inputs to speed up its recovery.

In 2000, the program was regrouped into the key shelterbelt program along the Three-North region, the Yangtze River valley and other regions. The second 10-year phase of the program is being implemented in 187 counties and 34 forest farms and nature reserves in six provinces, and has an *afforestation* target of 2.27 million ha (Zhou 2001).

5. The program on combating national desertification

The program was launched in 1991 and aimed to protect cropland and grassland from desertification and regenerate grassland for animal husbandry, as well as improve the livelihoods of local people. It covered 264 million ha of land susceptible to desertification or 27.5 percent of the national land area, and is spread across 598 counties in 27 provinces. During the first 10-year phase, the program planned to control the desertification process on 7.18 million ha through recovering 1.32 million ha of grassland, improving 376,700 ha of low-productivity cropland and increasing forest cover by 5.24 million ha. The last will involve planting 1.74 million ha, closing off 2.83 million ha for natural regeneration, and aerial seeding 673,400 ha. By the end of the program in 2050, 47.1 million ha total would be afforested, forest cover is estimated to increase to 7.6 percent, and forests will protect 3.17 million ha of cropland and 6.86 million ha of grassland. The materialised investment was 1.4 billion RMB, of which, 436 million RMB was from the Central Government (SFA 2001a).

The area rehabilitated from 1993 to 2000 was 1.1 million ha according to SFA (2004). According to the project report, from 1991 to 1995, the program established 1.42 million ha of artificial forest, aurally seeded 313,000 ha and closed 1.216 million ha of sandy land for forest and grass recovery (Zhang 1997). The report also states that 472,000 ha with low agricultural output was improved, medicinal herbs were planted on 238,000 ha, and more than 600 projects aiming at comprehensive development of the sandy region through grain and medicinal plant production, animal husbandry and tourism were established. In 2000, this program was replaced by the program "Desertification control in the vicinity of Beijing and Tianjin cities" (Zhou 2001).

6. Taihang Mountain greening program

Taihang Mountain is a natural protective barrier for Beijing and Tianjing as well as for the plains of northern China. Deliberate logging and burning during the Japanese invasion and other historical wars resulted in scant forest cover. The area was affected by severe water runoff, soil loss, and flood and mud-rock flows caused by torrential rain. The greening program was initiated in 1986 to protect the capital city and the neighbouring area. The aim was to increase the forest cover from 1.4 to 5.35 million ha, or 15.3 to 43.6 percent through rehabilitation activities from 1986-2000. The program covered 12 million ha across 110 counties in Shanxi, Henan, Henei and Beijin provinces (Zhang 1997). Revegetation techniques included tree planting, *mountain closure* and planting grass. Tree species to be planted were pines, cypress, black locust, seabuckthorn, shrubby amorpha, apricot and elm.

By the end of 2000, 3.6 million ha were rehabilitated, accounting for 92 percent of the planned task in the first phase (SFA 2004). According to the project report (Zhang 1997), survival rate was more than 90 percent. Confronted with poor site conditions, many new planting techniques were explored. In some areas, household income improved when *economic plantations* were established. However, insufficient investment and difficult site conditions resulted in monoculture plantations of mainly pines and cypress. Meanwhile deforestation continued during the program period with 40 percent of forest in the area converted to shrub, *sparse forest*¹³ and non-forest by 1999 (Zhou 2001).

In 2000, the program was regrouped into the key shelterbelt program along the Three-North region, the Yangtze River valley and other regions. The second 10-year phase of the program is being implemented in 73 counties in four provinces, and has an *afforestation* target of 1.46 million ha (Zhou 2001).

7. Shelterbelt forest program along the middle reaches of the Yellow River

The middle reaches of the Yellow River face the most severe runoff and soil erosion problems in China, with 24.5 million ha or 78 percent of the whole river valley affected. In order to control soil loss and protect the region's watershed, the program was ratified in 1995 to rehabilitate the forests over 15 years up to 2010. A total of 177 counties across six provinces in the valley's middle reaches were involved. About 3.15 million ha of degraded forest land was earmarked for rehabilitation, with forest cover to increase from 14.9 percent in 1995 to 24.9 percent in 2010. The program planned to plant 2.7 million ha, aerially seed 300,000 ha, and protect 150,000 ha through

13 *Sparse forests* are areas with less than 20 percent tree canopy cover (< 30 % prior to 1996).

mountain closure. As a result, approximately 12 percent of the runoff and soil erosion problem area would be brought under control. Tree species to be planted were black locust, sea buckthorn, poplar, pines, cypress, apricot, *Vitex* and *Ailanthus altissima*.

By the end of 1999, 518,000 ha were rehabilitated (SFA 2004). According to the project report, 1.31 million part-time jobs created and soil erosion was reduced by an estimated 100 million tons per annum, increasing grain output by 10 percent on average (Zhang 1997). In 2000, the program was regrouped into the key shelterbelt program along the Three-North region, the Yangtze River valley and other regions.

8. Shelterbelt forest program in the Huaihe River and Taihu Lake basin

The valley of Huaihe River and Taihu Lake covers 2.75 percent of the national land area and 13.3 percent of its cultivated land. The valley produces one-sixth of the total national grain output and a quarter of the national cotton and oil output, making it a key base for commercial grain, cotton and oil production. It also supports one-eighth of the nation's population. However, the region is subject to severe flooding and drought. Following severe flooding in 1994, the program was initiated in 1995 to improve the natural environment in support of agricultural and industrial development. With a total program area of 26.4 million ha across 208 counties in seven provinces, the program aims to improve forest cover from 13.9 to 17.3 percent within 10 years. Planned rehabilitation area was 1.047 million ha, with shelterbelt forests increased from 15.7 to 30.5 percent and timber forest decreased from 50.9 to 40.3 percent. Revegetation techniques involve planting, *mountain closure*, and aerial seeding. Planted tree species are poplars, willows, pines, shrubby amorphia, black locust, *Ailanthus altissima*, cypress, elm, pond cypress and dawn redwood (*Metasequoia glyptostroboides*).

From the start of the program in 1995, pilot projects were implemented in 36 counties and 200,000 ha have been rehabilitated (SFA 2004). Forest cover has been increased dramatically, covering 6.5 million ha of land affected by runoff and soil erosion. Zhou (2001) states that soil loss decreased from 93,000 to 54,000 tons per ha per year, effectively improving the environment for agriculture and industry. In 2000, the program was regrouped into the key shelterbelt program along the Three-North region, the Yangtze River valley and other regions.

9. Shelterbelt forest program in Liaohe River valley

Liaohe River valley is an important base for agriculture, industry, energy and animal husbandry. However, long-term over-exploitation of forests and

grasslands led to environmental degradation, including torrential rain and flooding, severe runoff, soil loss and desertification. By end 1996, runoff and soil erosion affected 6.115 million ha, approximately 25.9 percent of the valley. The big flood of 1985 in the middle reaches of the valley destroyed 846,000 ha of cultivated land, 30 petroleum wells and 300 petroleum stations. Desertification has severely affected animal husbandry.

The 10-year shelterbelt forest program was launched in 1995 to address all these problems. The program was subdivided into two phases, from 1996 to 2000 and 2001 to 2005. Total program area was 23.57 million ha covering 77 counties of Hebei, Inner-Mongolia, Jilin and Liaoning provinces. Planned rehabilitation area was 1.2 million ha, leading to a projected increase in forest cover from 18.6 percent to 27.9 percent at the end of the program. This would potentially help control 6.115 million ha of land affected by runoff, soil erosion and desertification; and stabilise 1.33 million ha of flowing sand dunes. Revegetation techniques involve planting, *mountain closure* and aerial seeding. Tree species to be planted included pines, poplars, sea buckthorn, cypress, and elm.

Area rehabilitated by 1999 was 0.22 million ha (SFA 2004). In 2000, the program was regrouped into the key shelterbelt program along the Three-North region, the Yangtze River valley and other regions.

10. Plain regreening program

There are four plain and semi-plain areas in China, namely the northeastern plain, the northern plain, the plain along the middle and lower reaches of the Yangtze River valley and the Pearl River delta region. Scarce vegetation cover made the plains vulnerable to severe sandstorms, droughts, runoff, soil loss, hot dry winds, salinisation and alkalinisation. The people here also faced severe fuelwood shortages. After the Peoples' Republic of China was founded in 1949, the Government initiated the campaign to green the plains nationwide with compulsory participation by local people. Based on the experiences and lessons learnt, the National Planning Commission in 1988 developed and approved a plan aimed at speeding up plain greening. The program covered 918 counties in 26 provinces, involving 146.7 million ha, or 15 percent of the national land area. The program aimed to green the national plain areas by forming a forest network to protect against wind, sand and drought damage. Revegetation techniques involved tree planting and aerial seeding. Planted tree species were poplars, willows, pines, cypress, elm, black locust, Chinese ash (*Fraxinus chinensis*), *Paulownia*, *Tamarix*, Pond cypress, *Ailanthus*, Chinese wingnut (*Pterocarya stenoptera*), dawn redwood, common camptotheca (*Camptotheca acuminata*), London plane tree (*Platanus acerifolia*), Chinese

spruce, camphor tree (*Cinnamomum camphora*), and Mongolian Scots pine. The program was mainly carried out by local people's voluntary participation. When a county has reached the nationally-set criteria for plain greening, it will receive 100,000 RMB as a kind of bonus for the local government units and individuals who contributed (Zhou 2001).

By the end of 1998, of the 920 counties in the plain and semi-plain areas, 850 counties achieved the national *greening*¹⁴ target, placing 32.56 million ha of arable land (70 percent of the national total) under the protection of a shelterbelt forest network. The four sides of canals, roads, rivers and villages were regreened at the rate of more than 85 percent. Forest cover in the plains increased from less than two percent in the early 1950s to 19.2 percent. The program also brought about a variety of environmental, economic and social benefits to local communities and households. Zhou (2001) states that severe problems related to sandstorms, dry hot winds, floods, salinisation and alkalisation gradually reduced. The pressure of timber demand in the plains eased and local incomes as well as the natural environment improved. However, *greening* levels were still low, even in counties that had achieved the national criteria. Farmers did not take the program seriously in some places and investment was low. Between 1998 and 2000, approximately five million ha of arable land lost its shelterbelt protection and severe insect and disease outbreaks caused great damage to established shelterbelts.

In 2000, the program was regrouped into the key shelterbelt program along the Three-North region, the Yangtze River valley and other regions. The second 10-year phase of the program has an *afforestation* target of 5.52 million ha (Zhou 2001).

11. Timber plantation establishment program

Apart from the above-mentioned programs oriented towards ecosystem recovery, China also accelerated the development of its commercial forest base to meet the increasing demand for wood. In 1988, the State Council ratified the plan to establish 6.667 million ha of fast-growing and high-yielding forest plantation from 1989 to 2000. Targeted locations were in the Da xin an ling and Xiao xin an ling mountain regions, Yunnan and Guizhou provinces, as well as southeastern China where site and socio-economic conditions, local knowledge and rehabilitation practices are superior. The first phase of the plan from 1989 to 2000 covered 297 counties and 82 forest industrial bureaus. By the planned harvest time around 2010, 370,000 ha were expected to be harvested yearly on a rotational basis with annual wood output reaching 43.8 million m³ (State Council 1990).

¹⁴ Increasing forest canopy cover to a certain percentage or above, and is expected to result from *afforestation*.

The Chinese Government applied for a World Bank loan to accelerate its timber plantation establishment program and this led to the National Afforestation Project from 1990 to 1997. The project covered 306 counties in 16 provinces in the subtropical to tropical region and central and eastern China. A total of 1.385 million ha of plantations were established by 1997 against a planned target of 985,000 ha. The main tree species planted included Chinese fir, Masson pine, slash pine, torch pine (*Pinus taeda*), larch, poplars, *Eucalyptus*, *Robinia*, *Paulownia* and other broadleaf species. Materialised investment was 557 million USD (3.763 billion RMB), 59 percent through the World Bank loan and 41% in Chinese matching funds (SFA 1998). The World Bank loan was to be repaid in 20 years with a grace period of eight years and a four percent interest rate.

At the end of the program, 1.3849 million ha of timber plantation was established, accounting for 140.7 percent of the planned rehabilitation area. The achievement exceeded the targeted area due to favourable currency exchange rates providing additional funds and previous plans being readjusted. Average survival rate was 95.8 percent (SFA 1998). Predicted production during the project's management cycle was 0.211 billion m³ of timber and 16.96 billion tons of fuelwood. During project implementation, 192 million job opportunities were provided to participating farmers. Forest cover in targeted counties increased by 2-3 percent on average and soil loss is expected to decline by 21.96 million tons annually. Moreover, the project also provided important technical and management expertise that have since become national models. The rehabilitation quality was higher than in other domestic projects due to strict quality control.

An example of social benefits from the National Afforestation Project (SFA 1998)

In Hubei Province, 105,000 ha of timber plantations established through the National Afforestation Project were expected to help retain 19.129 million tons of water (SFA 1998). In Lenshui township of Zhongxiang city, 200 households in two administrative villages suffered from potable water shortages and had to travel up to seven km to procure supplies. After the National Afforestation Project was implemented in the two villages, 486.7 ha was rehabilitated to forest, and forest cover increased by 60 percent. One outcome was that a stream running through the village that had been dry for many years began flowing again and the local water shortage problem was resolved.

Annex 2. Five consolidated rehabilitation-related forestry programs since 1998.

1. The natural forest protection program

Natural forests covered 106.96 million ha in 1994-98 with 9.072 billion m³ of standing timber, and have been the country's primary timber source since 1949. However, the natural forests have been over-exploited and severe environmental crises such as the 1998 flood event were attributed at least partly to their degradation. After a pilot phase from 1998 to 1999, the natural forest protection program was formally launched in 2000 to rehabilitate the deteriorating resource by 2010.

The first part of the two-part program was located along the upper reaches of the Yangtze River and middle and upper reaches of the Yellow River. It aims to stop logging in 30.38 million ha of natural forest by reducing commercial timber output by 12.39 million m³, protecting 30.8 million ha of other forest and scrub, and relocating 256,000 redundant forest workers. Meanwhile, 12.73 million ha of forest is to be newly rehabilitated from 2000 to 2010, increasing forest cover from 25.87 to 32.26 percent.

The program's second part was located in the state-owned forest region of Inner-Mongolia, Jilin, Heilongjiang, Hainan and Xinjiang, and covers 34.179 million ha. Of this area, 14.09 and 12.06 million ha will be subject to a strict logging ban and limited logging per ha respectively, reducing timber output from 18.532 million m³ in 1997 to 11.017 million m³ in 2003. Meanwhile, 484,000 redundant workers will be relocated and the remaining 8.029 million ha will be developed into commercial timber forest through timber stand improvement.

During the pilot phase from 1998 to 1999, 10.17 billion RMB was invested in this program as a whole. The planned investment for *afforestation* was 23.1 billion RMB, with 80 percent from the Central Government's budget and 20 percent from local governments (Zhou 2001). Investment standards established were 1050 RMB/ha for *mountain closure*, 1800 RMB/ha for aerial seeding and 3000-4500 RMB/ha for planting. However actual investments depend on the Central Government's budget situation and could vary widely.

Under the program, commercial logging in natural forests was completely stopped in 13 provinces in the Yangtze River's middle reaches and the Yellow River's middle and upper reaches. By the end of 2003, 3.68 million ha had been afforested (SFA 2004).

2. The sloping land conversion program

More than 360 million ha or 37.5 percent of China's land area is affected by severe runoff and soil loss caused mainly by long-term cultivation and over-grazing on steep lands. It is estimated that two-thirds of the two billion tons of mud and sand flowing into the Yangtze and Yellow Rivers annually come from steep land along the river valleys. Severe desertification affects a further 174 million ha, or 18.2 percent of China's land area. To address these problems, the sloping land conversion program was formally initiated in 2002, after a pilot phase from 1999-2001. It involves 30 provinces and is to be executed in two phases from 2001 to 2005 and 2006 to 2010.

In the first phase, 6.67 million ha of cropland (of which 3.33 million ha has steep slopes $>25^\circ$ and two million ha are sandy land) will be converted to forest land, and 8.67 million ha of barren mountain will also be rehabilitated. In the second phase, 14.67 million ha of cultivated land including 2.67 million ha of sandy land, will be converted to forest land, and 17.33 million ha of barren mountains will also be rehabilitated. Forest cover in the program area will increase by an estimated 2.4 and five percent by the end of the first and second phases respectively. Revegetation techniques include planting trees and *mountain closure*. Although there are many candidate tree species, local people preferred planting species with high economic value such as poplar, *Eucalyptus*, bamboo, mulberry (*Morus*), *Ziziphus jujuba*, walnut, chestnut (*Castanea*), wild apricot, *Toona sinensis*, seabuckthorn, peashrub, Chinese fir, pines, *Robinia* and *Tamarix chinensis*.

Farmers who converted steep cropland into forest land in the Yellow and Yangtze River valleys were to receive 1500 kg and 2250 kg grain per hectare converted respectively, 300 RMB per hectare for their children's education and public health care, and 750 RMB per hectare for buying seedlings. The compensation is to last for five years for conversion to *economic forests* planted with fruit trees and eight years for *ecological forests* planted with timber trees. These farmers will also have to rehabilitate an equivalent area of barren mountains and will receive 750 RMB per hectare for this task.

Total planned investment in the whole project period is 358.43 billion RMB, 92 percent of it to come from the Central Government. This includes 298.5 billion RMB for grains, 34.01 billion RMB cash subsidy for education and health care, 24 billion RMB for buying seedlings, and 1.92 billion RMB for technical support and project preparation (Zhou 2001). Provincial governments will shoulder the expenses of grain transportation and other local costs amounting to roughly eight percent.

By the end of 2002, 13 million households with 53 million farmers obtained cash and grain subsidies. By the end of 2003, 5.86 million ha of sloping cultivated land and 6.34 million ha of barren land had been forested (SFA 2004). Field investigation from 1999 to 2002 indicated that various wildlife species had reappeared and increased gradually in the program area (Zhou 2001).

3. Desertification control project in the vicinity of Beijing and Tianjin

Increasingly severe sandstorms have affected the capital city of Beijing in recent years. Following up on the program on combating national desertification (1991 to 2000), this desertification control project was launched in 2001 to reduce the sandstorms and halt desertification encroaching on Beijing and Tianjin. It covers 75 counties in the Inner-Mongolia autonomous region, Hebei and Shanxi provinces, Beijing and Tianjing municipality.

The project is scheduled for 10 years, with two phases from 2001 to 2005, and 2006 to 2010. It aims to convert 2.629 million ha of cultivated land into forest land by the end of 2006, rehabilitate 4.944 million ha of barren mountains and sandy lands, improve 10.63 million ha of grassland, control runoff and soil loss on 2.34 million ha, and relocate 80,000 people living in the area who are affected by the deteriorating environmental conditions including drinking water shortages. Techniques include tree planting, aerial seeding, mountain and grassland closure and relocating local people. Species to be planted were poplars, pines, larch, *Robinia*, cypress and shrubs.

The total investment was to be about 57.703 billion RMB and includes costs of *afforestation*, establishing seedling nurseries and small-scale water conservation systems, pasture management, farmer relocation, technical support and operations (Zhou 2001). Farmers who converted poor cropland into forest land or afforest barren mountains or sandy land would receive 1500 kg grain per hectare converted, 300 RMB per hectare for children's education and public health care, and 750 RMB per hectare for buying seedlings. Investment standards established were 1050 RMB/ha for *mountain closure*, 1800 RMB/ha for aerial seeding and 4500 RMB/ha for planting.

About 2.16 million ha were afforested through this program from 2001-03, 28% of the area targeted over ten years (SFA 2004). However, over-grazing, reclamation of arable land, over-cutting for fuelwood and over-collecting of herbal medicines continue to cause severe damage.

4. Key shelterbelt development project in the Three-North region, the middle and lower reaches of the Yangtze River, and other areas

This program from 2001 to 2010 integrates the fourth phase of the shelterbelt program in the Three-North region; the second phase of the shelterbelt program along the middle and lower reaches of the Yangtze River valley; and the second phases of the coastal shelterbelt, the Pearl River valley shelterbelt, Taihang Mountain greening and plain regreening programs. Some counties from the earlier Liaohe River valley, and Huaihe River and Taihu Lake basin shelterbelt programs were also recombined into this shelterbelt development project.

The total targeted *afforestation* area is 26.98 million ha for the 10 years. Planned investment is 70 billion RMB, of which more than 50 percent comes from the Central Government (Zhou 2001). Investment standards established were 1050 RMB/ha for *mountain closure*, 1800 RMB/ha for aerial seeding and 3000 RMB/ha for planting. About 8.2 million ha were afforested through this program from 2001-03, 30% of the area targeted over ten years (SFA 2004).

5. Forest industrial base development project in key regions

China is facing increasing wood demand due to rapid economic development. Total domestic wood demand will reach 340-350 million m³ in 2005 and 430-440 million m³ in 2015, but projected wood supply based on current national forest resources will be only 169 million m³ and 195 million m³ respectively. Even excluding fuelwood requirements, domestic timber shortage for construction and wood-processing industries will be as high as 60-70 million m³ in 2005 and 140-150 million m³ in 2015. In the past, the wood supply came mainly from natural forests, and the natural forest protection program has increased the domestic pressure caused by wood shortages.

Following up on the earlier timber plantation programs, the 15-year forest industrial base development project was initiated in 2001 with the aim of meeting 40 percent of the domestic industrial wood demand by 2015. The project area is 13.326 million ha spread across 886 counties and 114 forest farms or enterprises in 18 provinces. The key areas are in the southern provinces of Guangdong, Fujian, Hainan and Guansi; the middle and lower reaches of the Yangtze River; the middle and lower reaches of the Yellow River; and the northeastern and Inner Mongolian regions. The project is subdivided into two stages, the first stage from 2001 to 2005, and the second (with two five-year phases) from 2006-2015.

The project plans to establish 10.83 million ha of plantations for paper and panel-making industries and 2.497 million ha of plantations for large-diameter timber for furniture and construction. About 4.691 million ha, 4.511 million ha and 4.124 million ha of fast-growing and high-yielding plantations will be established in each of the three phases respectively. Of the total project area, 6.18 million ha will be newly afforested and the remaining 7.146 million ha will be formed by improving current forest stands.

Revegetation techniques include tree planting and improving low-yield forests. Species to be planted include poplars, *Eucalyptus*, pines, bamboo, *Acacia*, *Paulownia*, larch, mahogany (*Swietenia*), teak, camphor, birch (*Betula*), ash, *Phellodendron amurense*, *Tilia tuan*, and oak (*Quercus*). Total planned investment for *afforestation* is 63.8 billion RMB of which 20 percent is a subsidy (mainly for seedlings) from the Central Government, 70 percent from low-interest bank loans and 10 percent from other sources (Zhou 2001). Investment standards for new plantations were 6000-7000 RMB/ha for pulp and artificial boards and 7000-8000 RMB/ha for larger-diameter timber.

Chapter III

Success and sustainability: Lessons from Guangdong Province

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1. Introduction

Guangdong Province, in southern China, had 6.67 million ha of degraded forested land¹ in 1935 (GFB 1994). In 1949, forests² covered only 3.36 million ha, or 18.7 percent of the province, while degraded forest land equalled 7.67 million ha. Heavy logging, use for farming, war and forest fire led to severe forest destruction and degradation. Since 1949, the province has made continuous efforts to rehabilitate³ its degraded areas, driven by national and regional policy initiatives, concerns over deteriorating environmental conditions and timber shortages. The extent and nature of these rehabilitation efforts have changed over time in response to political changes, economic development and land tenure reform.

The province proclaims great successes in its rehabilitation efforts, particularly since 1985. Under the project ‘Rehabilitating degraded forest land in five years,

1 There is no official term “degraded forest land” in China. We estimated degraded forest land in Guangdong as the area with *non-forest* (barren, logged-over and burnt-over forest areas), shrub and *sparse forest* cover which represent degraded vegetation types in the province. *Sparse forests* are areas with less than 20 percent tree canopy cover (< 30 percent prior to 1996).

2 Forest includes area with greater than 20 percent (> 30 percent prior to 1996) tree canopy cover, bamboo groves, some shrub lands specially prescribed by the State, farmland shelterbelts, and trees planted around villages, rivers, roads and houses (Regulations for implementation of the State Forest Law issued in 2000). It includes timber, shelterbelt, fuelwood, economic (non-timber products) and special purpose forests.

3 See Chapter I for details on rehabilitation terminology.

and greening Guangdong in 10 years' started in 1985, the province achieved its target two years ahead of schedule. Degraded forest land was reduced to 1.19 million ha and forest cover increased to 57 percent of the land area in 2003. Guangdong has won a number of national titles and recognition such as "The first province to rehabilitate and green its degraded forest lands" in 1991 and "The advanced province in greening its plains" in 1993. In 1995, Zhongshan city was awarded the title of "Advanced Greening City" and in 1996 was declared one of China's eight garden cities. Guangdong took a leading role in developing private sector forestry⁴, both in policy formulation and implementation. It has successfully tried and developed many innovative socio-economic incentives and institutional arrangements, such as jointly-managed⁵ or *stock-shared*⁶ forest farms; these have been recommended and extended to other provinces (SFA 1999).

However, the picture is not all positive. Guangdong's forest rehabilitation efforts, as elsewhere in China, have resulted in vast monoculture landscapes with simple stand structures, low forest quality and productivity, and high vulnerability to pests and diseases (Deng 2001, GFEB 2001). Forest lands⁷ have also not been regenerated well after logging and fire damage. Besides, heavy soil erosion, surface water runoff, and droughts and floods continued unabated in Guangdong, despite the large areas rehabilitated and most projects having soil and water conservation objectives. It is necessary to monitor and evaluate the effects of the revegetation, management and use practices on water and soil properties in line with the stated goals.

In this chapter, we assess in detail the characteristics of rehabilitation efforts in Guangdong Province, and their outcomes and influencing factors using the literature and 22 case studies across eight types of rehabilitation initiatives identified. The case studies help to elucidate implementation activities and

4 Private sector here refers to farmers afforesting and managing their allocated lands, and individual investors and private enterprises afforesting and managing leased or subcontracted forest land for their own income. There is no strict recognised definition and many mixed public-private sector institutional arrangements exist in practice. The term "*non-public system*" is commonly used in China and refers to *afforestation* and management of forest land by any individuals or agencies for income with their own investment through lease, tenure transfer, contract, *stock-sharing* or joint management mode.

5 Joint management refers to cooperative efforts between institutions — such as forestry departments with other government departments, state forest farms with village committees, village committees with individuals and foreign enterprises — with sharing of land, techniques, management and benefits.

6 Farm households contribute land, and companies contribute funds and establish, manage and harvest the timber plantations in a *stock-sharing* system. Benefit-sharing arrangements would generally be in the ratio 70:30, company to farm households. Fruits and other non-timber products are often included as additional incentives for farmers.

7 "Forest land" includes forests, *sparse forests*, shrub land, young plantations, seedling nurseries, *logged-over and burnt-over* forest areas, and all land suitable for planting trees as designated by the different levels of government (Regulations for implementation of the State Forest Law issued in 2000).

outcomes on the ground. Our main objective is to draw strategic lessons for sustaining and guiding current and future efforts both within Guangdong and elsewhere by identifying the:

- Most promising technical, financial, socio-economic and institutional approaches and incentives that have contributed to longer-term sustainability and positive outcomes for different stakeholders.
- Problem areas, constraints and issues needing resolution.
- Gaps in information.

Guangdong's experiences, over the past 20 years in particular, provide opportunities for learning many useful lessons to guide and sustain future rehabilitation efforts in China and elsewhere. This study can feed into the key policy processes related to forest rehabilitation and management in China, and particularly southern China given common biophysical conditions, land use history and tenure regimes. However the specific conditions of Guangdong — a relatively rich, economically developed area with good market access — will have to be borne in mind when considering the transferability of the lessons learnt.

We present below some relevant background information for the province followed by the methods used in this study. Then we provide a historical review of forest degradation and rehabilitation in the province, assess the characteristics and outcomes of the major initiatives, and finally present the lessons learnt from the analysis.

2. Background information on Guangdong Province

2.1 *Biophysical conditions*

Guangdong is a southern province on the Chinese mainland, next to Hong Kong and Macao (Figure 1). It covers 17.977 million ha or 1.9 percent of China's total land area. The provincial mainland coastline is 3368 km, the longest in China (GCEB 1998). The Tropic of Cancer passes through the centre of the province, dividing it into tropical and subtropical zones. Mountains (> 400 m altitude), hills and plateaus comprise 77 percent of the total area (Figure 2). Mountains higher than 1500 m in the north give way to hills and plateaus, and then plains in the south. Major rivers include the Pearl, the Hanjiang, the Dongjiang, the Jianjiang and the Moyangjiang.

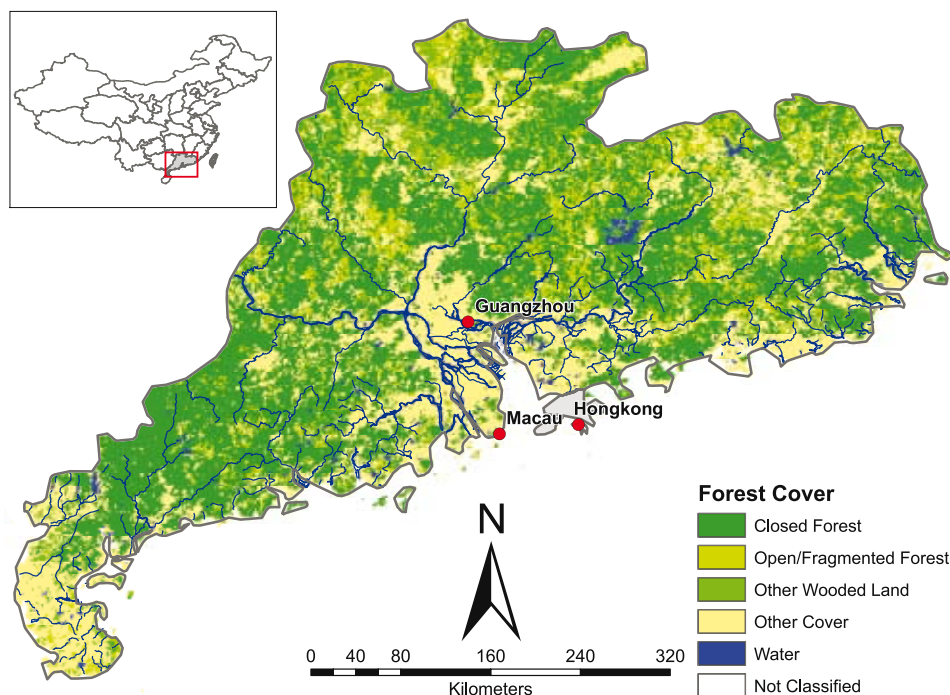


Figure 1. Location and forest cover of Guangdong.

World Forest Cover map based on 1992-93 and 1995-96 Advanced Very High Resolution Radiometer (AVHRR) data. Source: Forestry Department, Food and Agriculture Organization of the United Nations (FAO), Rome.

FAO's standard classification

- Closed forest: Trees with > 40% canopy cover and > 5 m height, includes natural forests and forest plantations
- Open/fragmented forest: Trees with 10 to 40% canopy cover and > 5 m height (open forest), or mosaics of forest and non-forest land (fragmented forest), includes natural forests and forest plantations
- Other wooded land: Land either with a 5 to 10 % canopy cover of trees > 5 m height, or with a shrub or bush cover of more than 10 percent and height < 5 m
- Other cover: All other land, including grassland, agricultural land, barren land, urban areas.

The region has a long summer and warm winter with average annual temperatures of 19°C in the north and 23.5°C in the south. Average minimum temperature in January is 9-16°C. Annual mean sunlight hours range from 1750 to 2200 hours. Average annual rainfall ranges from 1400 mm in the north to 2200 mm in the south, with most falling from April to September. Tropical windstorms buffet the province from May to October.

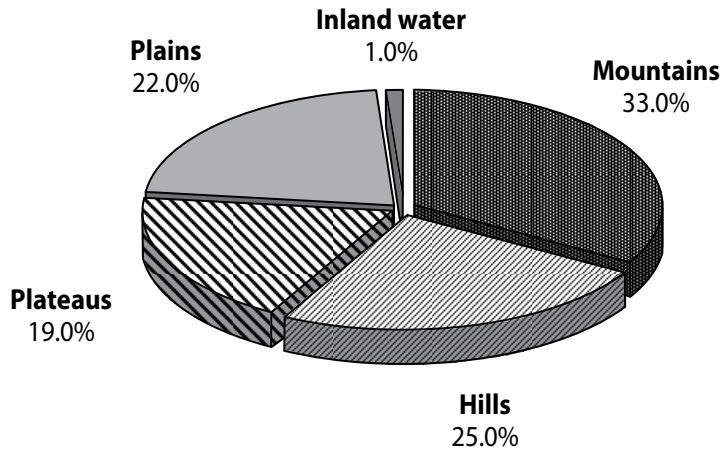


Figure 2. Landform distribution in Guangdong (GCEB 1998).

The southern part of Guangdong is in the tropical monsoon climate zone, while the northern part is on the southern edge of China's subtropical monsoon zone. Evergreen monsoon rainforests once dominated the south, with species such as *Endospermum chinense*, *Choerospondias axillaris*, *Ficus altissima*, *Cinnamomum camphora*, *Cryptocarya chinensis*, and *Altingia chinensis*. South-subtropical monsoon evergreen forests with *Castanopsis* species, *Elaeocarpus sylvestris*, *Garcinia multiflora*, *Machilus velutina*, *Cryptocarya chinensis*, *Schefflera octophylla*, *Bischofia javanica*, *Sterculia lanceolata*, *Ilex purpurea* and *Symplocos* spp. dominated the province's middle areas. Mid-subtropical, evergreen, broad-leaved forests composed of *Castanopsis hystrix*, *Schima superba*, *Altingia chinensis*, *Cinnamomum camphora*, *Castanopsis fissa*, *Choerospondias axillaris* and *Liquidambar formosana* dominated the northern section (GFEB 1990). However, long-term human intervention has made the original forest vegetation types rare.

The main soil types in Guangdong include lateritic red soil (39% of the area), laterite (15%), red earth (15%), paddy soil (14%) and yellow earth (6%) (GCEB 1998). There are small areas of purple soil, dry red soil, meadow soil, limestone, coastal saline and sandy soils and tidal mud (GCEB 1998, GAS 1991). Lateritic red soil is typical in the south-subtropical area and suitable for growing tropical and subtropical fruit trees and other *economic plantations*⁸, agricultural crops, and some valuable timber trees such as teak (*Tectona grandis*), *Castanopsis hystrix*, *Pterocarpus indicus*, *Betula alnoides*, *Cinnamomum camphora* and *Swietenia macrophylla*. The favourable water, heat and soil conditions in the south subtropical area provide high potential land productivity as compared to the rest of China.

⁸ *Economic forests or plantations* are for non-wood products such as fruits, edible oils, beverages, fodder, medicines, spices and industrial materials like rubber for cash income.

Laterite is typical of the tropical area and suitable for growing tropical fruits and crops. Red earth is typical of the mid-subtropical area in the northern mountains, and is good for growing Chinese fir (*Cunninghamia lanceolata*), Masson pine (*Pinus massoniana*), some valuable broad-leaved timber plantations such as *Castanopsis fargesii*, *Altingia chinensis*, *Choerospondias axillaris*, *Betula alnoides* and *Castanopsis carlesii*, and economic plantations. Yellow earth is suitable for developing commercial timber and *ecological forests*⁹.

2.2 Socio-economic conditions

In 2000, agricultural land constituted 83.5 percent of all land use, construction nine percent and other uses 7.5 percent (LRDGP 2000). Of the agricultural land, arable areas comprised 20.44 percent, gardens 5.72 percent, forest land 67.96 percent or 10.2 million ha, grassland 0.19 percent and other agricultural land 5.69 percent.

2.2.1 Population density and composition

The Han ethnic group makes up 98.6 percent of Guangdong's population, with the rest comprising 53 minority groups, mainly the Zhuang, Yao, She, Hui and Man. The population in 2000 was almost triple that in 1949 (Table 1), with the density rising from 155 to 417 people per km² in 2000. Guangdong's population is still largely agricultural (69%), but the rural growth rate has been declining due to increasing urbanisation. From 1990 to 2000, the non-agricultural population increased on average by 5.83 percent per annum while the agricultural population increased by only 0.82 percent. A sample survey suggested that Guangdong's permanent residents totalled 78.58 million by the end of 2002, making it the third most populated province in China.

Table 1. Population distribution in Guangdong Province.

Year	Total population (million)	Non-agricultural population (million)	Agricultural population (million)	Population density (People/km ²)
1949	27.82	4.37	23.45	155
1970	43.82	6.93	36.89	244
1980	52.27	9.09	43.18	291
1990	62.46	14.77	47.69	347
2000	74.98	23.38	51.60	417

Source: Guangdong Population Information Centre.

2.2.2 Economy and development

Since China implemented its reform policy and began opening up to the outside world in 1978, Guangdong has enjoyed substantial, sustained economic growth

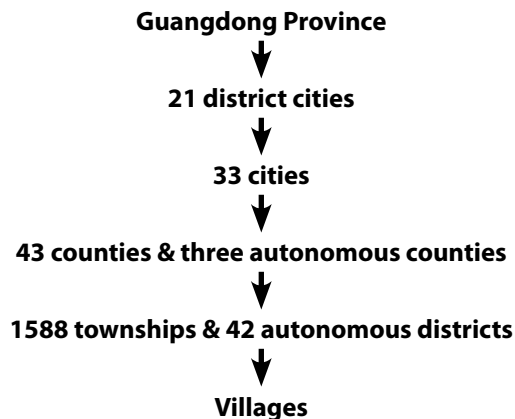
⁹ *Ecological forests* or non-commercial forests are for the purpose of maintaining and improving the ecological balance and the environment, conserving biodiversity, and providing non-timber forest products.

that has made it the nation's strongest economic province. Guangdong ranks the highest in total investment in fixed assets, value of retail sales, value of imports and exports, government revenue and numerous other economic indicators. From 1978 to 2002, the Gross Domestic Product (GDP) grew an average 12.7 percent a year, reaching 1176.97 billion RMB¹⁰. The service sector has been expanding with its relative contribution to the GDP increasing from 35 percent in 1995 to 41 percent in 2002 (Lu 2003). However, economic development is not uniform across the province. The coastal region, especially the Pearl River delta, has developed rapidly while the mountain region has lagged behind. Forestry is considered a part of the agricultural sector and its specific contribution to the GDP is unknown. However, the contribution of the agricultural sector overall to the GDP has decreased from 15 percent in 1995 to nine percent in 2002 (Lu 2003). People depend on forestry for subsistence more in the mountain region as compared to the coastal areas. Guangdong is one of several provinces with the best infrastructure and transport development in China. It has sea and air connections to many countries and regions across the world. Internal air, road and water transport routes and communication networks are well developed.

2.3 Institutional conditions

Current administrative structure

Source: LRDGP 1997, 99.



2.3.1 Forestry Administration

The Guangdong Forestry Bureau is the province's highest forestry authority. It is tasked with implementing national forestry policies, laws and regulations;

¹⁰ Roughly 8.27 Chinese Yuan Renminbi (RMB) per US dollar (USD) in June 2005. The exchange rate was 100 USD to 153 RMB prior to 1981, 100 USD to 320 RMB from 1981 to 1985, 100 USD to 370 RMB from 1986 to 1989, 100 USD to 870 RMB in 1994, and 100 USD to 828 RMB after 1995.

drafting forestry development plans; developing local forestry policies and regulations; guiding forest production and development; mobilising the citizens to participate in *afforestation*¹¹ activities; and protecting and rationally utilising the forest resources.

Each district city, city and county government has a forestry administration authority, usually named the Forestry Bureau or Greening Committee. These authorities are responsible for implementing policies and regulations issued by higher-level government agencies; supervising and evaluating performance; conducting forest resource inventories and forest operations layout; guiding state forest farms, collective forest farms, and local farmers; and mediating land tenure conflicts. The capacity of local forestry bureaus or greening committees largely depends on the local government's economic status. Rich cities and counties tend to have higher capacity and better facilities.

Every town has a forestry station affiliated to the county's forestry bureau. These stations assist the township government to prepare an annual forestry plan, check *afforestation* results, verify annual logging quotas and logging sites in forests managed by collectives and local farmers, help to investigate and handle land tenure conflicts, protect forest resources, and provide technical assistance to local farmers. Most forestry stations have low capacity and are poorly maintained because of funding shortages.

2.3.2 Forest land tenure

Before 1949, most forest lands belonged to individuals and clans. After the People's Republic of China was established, tenure was changed several times. Under the land reform campaign from 1951 to 1953, most forest lands were assigned to farm households. In 1954, the Government regrouped forest lands into cooperative communes for joint management and then into larger people's communes in 1958. The Government subsequently retransferred forest lands managed by people's communes into smaller cooperative communes to prevent illegal logging and degradation and stabilise production. Since the 1960s, county and township governments combined and transferred forest lands of cooperative communes into collective forest farms.

From 1981 to 1982, Guangdong implemented the Central Government's "Three-Fix" forestry policy initiating institutional reform and stabilising use rights to forests and mountains in order to protect and better manage these lands. Much

11 *Afforestation* includes forest establishment through planting trees, aerial seeding or "*mountain closure*" on barren mountains, barren sandy land, *sparse forests*, burnt-over and logged-over forest areas, and some shrublands and grasslands. It also includes planting trees along roads and rivers, around houses and villages and as shelterbelts in farms. The term "*afforestation*" as used in China includes regreening recently deforested areas.

of the collective forest land was allocated to local households to develop, manage and use the forest resources for 30 years (Liu 2001). The farmers could plant trees for fruits and other non-wood products but were not allowed to convert the land to non-forest use. Continuing land reforms allowed farmers and collectives to transfer, lease¹² or otherwise contract out their timber, economic and fuelwood forests and forest lands; or jointly manage them in partnership with other agencies. In 1995, collectives managed 92.4 percent of Guangdong's forest lands, much of which was contracted out to local farm households (GCEB 1998). The remaining 7.6 percent was in state forest farms owned by the local district city, city or county forestry bureaus.

Forest lands were severely deforested and degraded following each policy change up to the mid-1980s, after which tenure rights were continuously strengthened. However, tenure conflicts persisted till recently over boundaries allocated to households and over land abandoned by households migrating to urban areas. In 2000, the Guangdong Government recertified forest and land tenure, clarifying the boundaries and reflecting the realities on the ground. This recertification aimed to reduce conflict, protect the landholders' legal rights and interests, and promote investment in rehabilitation (Deng¹ 2002). Household and collective tenure were made permanent if the tenure holders fulfilled their contracted responsibilities (GFEB¹ 2002). Currently, most forests in Guangdong are managed by individual households or other agencies and persons contracted by them, and tenure rights are relatively secure.

3. Methods

A review of government reports and other literature was used to trace the history and driving forces behind forest degradation and rehabilitation in Guangdong and to identify and characterise the major rehabilitation initiatives. Since the 1950s, there have been 10 major rehabilitation initiatives or types of initiatives in Guangdong (Table 2). Case studies from eight distinct initiatives provided further information on implementation activities and outcomes on the ground. Twenty two cases were investigated: roughly three sample counties (for province-wide projects), cities (for city projects) or instances (for smaller initiatives) in each of the eight initiatives (Figure 3). See Annex 1 for a list of the case study sites. Hereafter, initiatives are referred to by their abbreviated names in Table 2.

A questionnaire was developed to obtain information on the general characteristics of the 22 cases, the site conditions, implementation activities, institutional

12 Collectives or farmers lease out their forest land for fixed annual payments to the private sector and other agencies for 30-50 years.

Table 2. Major types of rehabilitation initiatives in Guangdong since the 1950s and number of cases surveyed in each type. Source: Summarised from Sections 4 and 5.

Dates	Abbreviated names	Initiatives	Number	Sample
Since 1950s	State Forest Farm	State forest farms (independent operation + part of larger national/provincial projects since the 1980s)	233 farms (by 1987)	1 (of 2 large farms ¹³)
From 1960s		Collective forest farms (independent operation + part of larger national/provincial/ city projects since 1980s)		
From 1960s, increased from 1980s	Joint Afforestation	Joint afforestation initiatives		2 cases but also part of all other initiatives below
From 1980s		Farmers/households (independent operation + part of larger national/provincial/ city projects)		
1985-95	Greening Guangdong	Rehabilitating degraded forest land in five years & greening Guangdong in 10 years (Provincial project)	1 project	3 counties
From 1980s, but increased since 1990s	Private company	Private enterprise afforestation initiatives		3 cases
From 1980s, promoted actively since 1999	Private individual	Private individual afforestation initiatives	540,000 entities	3 cases
1990-96	National Afforestation	National Afforestation Project aided by a World Bank loan	1 project	3 counties
1991-2010	Coastal	Coastal protective forest system development project (National project)	1 project	3 counties
From 1990s, increased recently	City landscape	Forest landscape rehabilitation projects by local city & county forestry bureaus	Many cities	4 main cities with landscape projects

arrangements, and results. Data were gathered on technical, socio-economic, financial and institutional parameters. Project documents or other literature available in 10 cases and interviews with the project managers were used to fill out the questionnaires. People interviewed included directors and deputy directors of

13 There are two big provincial state forest farms plus other much smaller state forest farms owned by the district city, city and county forestry bureaus.

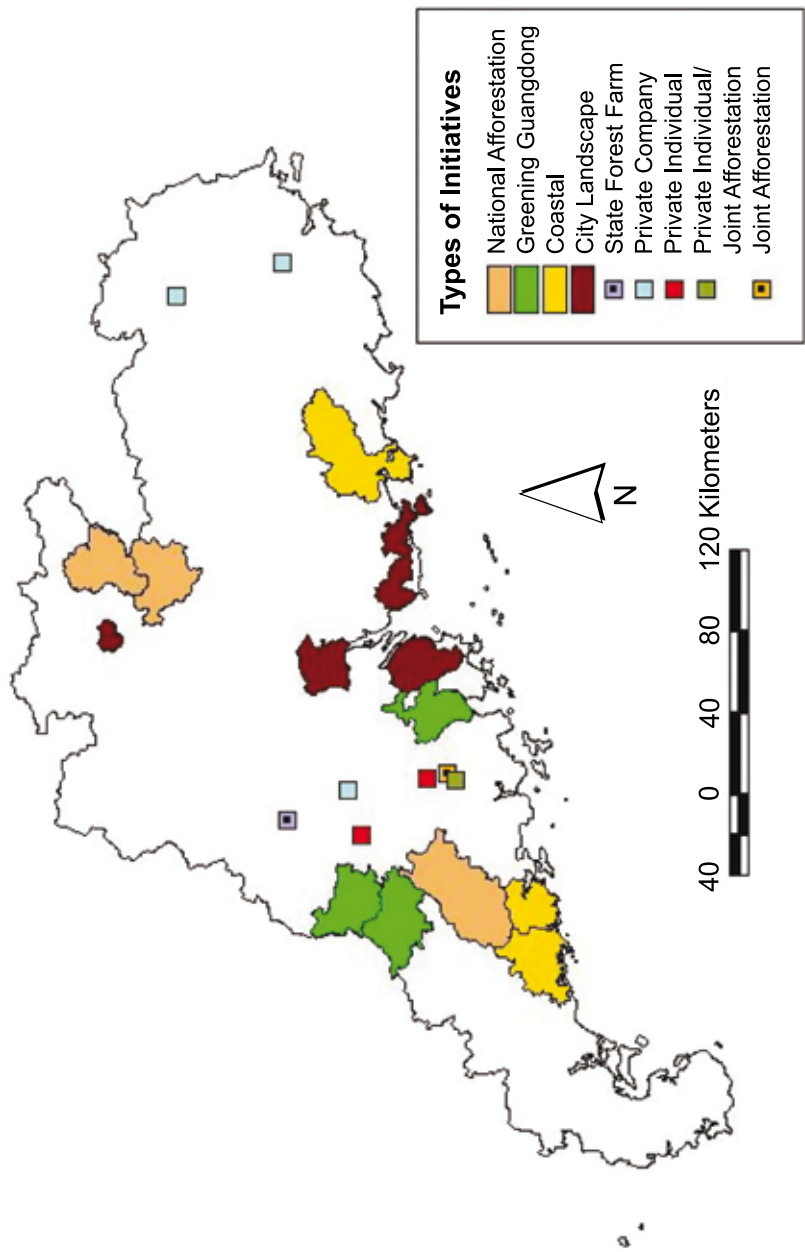


Figure 3. Forest rehabilitation study sample locations in Guangdong Province. The county was the sample unit for the larger National Afforestation, Greening Guangdong and Coastal projects. The city was the sample unit for city landscape projects. Individual cases were the sample units for the remaining four initiatives.

county or city forestry bureaus in the National Afforestation, Coastal, Greening Guangdong and City landscape cases; the deputy director of the state forest farm; senior executives of the private companies; individual investors; and leaders of the town forestry station or village committee in the Joint Afforestation cases.

We reviewed the outcomes and influencing factors within and across the different initiatives and extracted lessons for enhancing the success and sustainability of forest rehabilitation efforts in Guangdong and elsewhere. Rather than talking about absolute unqualified success or failure, this study looked across project types, separated out the different outcomes and explored different factors that contributed to them.

Assessment of outcomes is based on independent project reviews found in the literature (supplemented by government reports) and observations of the people implementing the specific cases and are indicated so. The coastal project is an exception where information comes mainly from a government project report besides case study observations. Further ground-level analysis would be needed to verify environmental outcomes. Also community perspectives may vary from those of the project managers', and community surveys would be required to clearly establish the socio-economic impacts of the different initiatives.

4. Historical overview of forest land degradation and rehabilitation

Before 1949, forestry development in Guangdong was poor due to persistent war, political corruption and economic depression. Forests in accessible areas were all logged. Few original forests were preserved. There were some limited rehabilitation efforts in this period, insignificant in comparison with the scale of deforestation and degradation. The deforestation directly led to severe wood and fuelwood shortages, and biodiversity depletion. In coastal regions, the destruction of forests left communities exposed to storms and tides. Wind-blown sand buried farmland and destroyed houses (Chen and Gan 1996). Deforestation in mountain areas is also blamed for frequent heavy flooding and droughts. However, links between landscapes and water are complex and all downstream water problems cannot be attributed simplistically to upstream logging (van Noordwijk 2006). FAO and CIFOR (2005) report that forests can affect peak river flows and floods on a small scale, but their effects on major flood events over a large basin are relatively small.

The following is an historical analysis of the changing patterns and driving forces of forest degradation and rehabilitation in different phases since 1949 (see Annex 2 for list of policies affecting degradation and forest rehabilitation in Guangdong).

4.1 The first phase (1950-1959)

After the People's Republic of China was established, large-scale *afforestation* activities were mainly conducted by the Cooperative Communes and the People's Communes with little attention paid to technical and management aspects. In 1950, the Guangdong Agricultural and Forestry Ministry issued forestry guidelines for the county level aimed at protecting the forest, logging sustainably and mobilising the public to undertake large-scale *afforestation*. In that year, 9653.3 ha were afforested. Since 1950, state forest farms have gradually been established to rehabilitate the barren hills, establish timber plantations, and guide local people in *afforestation* efforts.

In 1958, the Central Government issued a call for large-scale *afforestation* throughout the country by mobilising the public, developing existing state forest farms, and increasing and establishing new forest farms for afforesting state- and collective-owned barren hills. This led to widespread *afforestation* activities in the province with 286,667 ha planted. From 1958 to 1959, 130,000 ha were afforested in state forest farms in Guangdong.

More than 70 percent of the land area in 47 counties¹⁴ was mountainous or hilly. *Afforestation* through tree planting was difficult in these areas because of poor road access and transport, so aerial seeding was tried. First successful trials on 667 ha in Wuchuan county in Guangdong in 1956 (Deng 1999) led to nationwide adoption of aerial seeding.

However, large areas were simultaneously degraded in the 1950s-60s with over-logging and illegal logging to meet the increasing demand for timber to reconstruct the country (Chen and Hu 2000). There was a major degradation episode from 1958-1961 to meet the timber and fuelwood needs of "The Great Leap Forward" and "Iron-and-Steel Making" campaigns.

4.2 The second phase (1960-1979)

In this period, *afforestation* efforts were mainly focused on rapidly establishing high-yielding timber plantations and forest farms on degraded forest lands. In 1962, forest farms were granted cash and grain for timber plantation establishment (i.e. 10 RMB subsidy and 2.5 kg grain quota per *mu*¹⁵). In 1965, the Guangdong Government implemented a revised forestry policy "closely combining planting,

¹⁴ Administrative divisions and number of counties in the province different at that time.

¹⁵ Fifteen *mu* = One ha

tending and management” with the main focus on *afforestation* in collectives, supplemented by *afforestation* on state-owned and joint forest farms. Joint forest farms here were cooperative efforts between state forest farms and collectives sharing land, techniques, management and benefits. There was a significant increase in the quantity and quality of *afforestation* efforts. The area afforested increased from 53,900 ha in 1961 to 560,000 ha in 1966. From 1962 to 1979, 5.37 million ha were planted. From 1963-79, 2.18 million ha was aerially seeded with mainly Masson pine and some *Acacia confusa* (GCEB 1998), and 1.138 million ha were effectively afforested as a result.

Thus from 1962-79, a total of 6.51 million ha was afforested but in general most of the plantations did not survive in the long term. Most of the planting was done on degraded forest land (with a small proportion on areas following timber harvesting), yet degraded forest land decreased by only 2.13 million ha between 1957 and 1978.

There was a major degradation episode from 1966-76 “The Great Cultural Revolution” when forestry administration was in chaos. There was also heavy fuelwood collection from 1970 to 1985 due to high population growth without other fuels that could substitute such as liquefied petroleum gas (LPG). However, due to *afforestation* efforts occurring simultaneously, forest cover increased from 20.2 percent of land area in 1957 to 30.2 percent by 1978 (Figure 4). But the

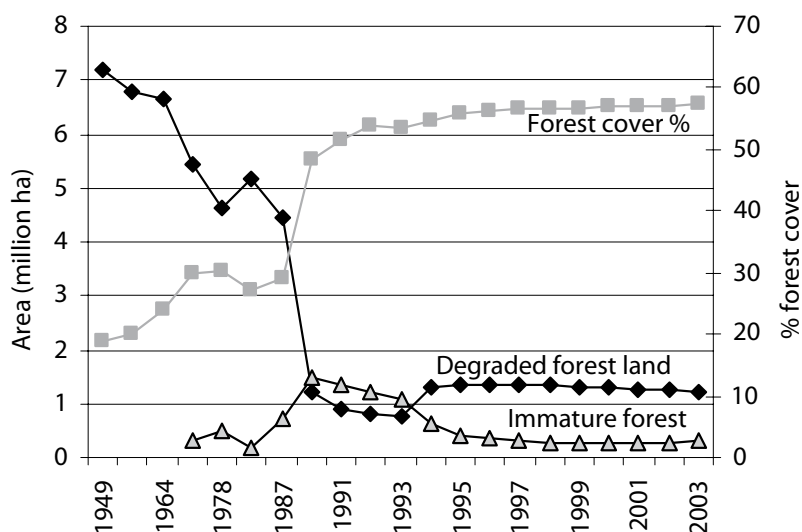


Figure 4. Trends in degraded forest land, immature forest area, and forest cover in Guangdong.

Sources: 1949-1987 (GCEB 1998), 1987-2003 (GFB 1987-2003)

Note: The definition of forest was changed from 30 percent to 20 percent tree canopy cover in 1996 and thus the rise in forest cover from thereon is slightly inflated.

afforestation efforts did not effectively control environmental deterioration. The area affected by surface water runoff and soil erosion expanded at the rate of 140 km² per year (Deng 1999). This is likely because the *afforestation* techniques and species choices did not adequately consider soil and water conservation needs in some areas, pressure on forest lands for fuel (wood, litter and ground vegetation) remained high, and areas damaged by fire and logging were not regenerated well. FAO and CIFOR (2005) also suggest that the kind of revegetation and management practices undertaken could have a beneficial or detrimental effect on local soil and water properties.

4.3 The third phase (1980-1989)

Forest land tenure rights were granted to households from 1981-83 to improve the rehabilitation success rate and improve the management of forest lands. The main dependence on collectives and state forest farms for *afforestation* and forestry production was altered. These reforms however led the new tenure holders – the farmers – to rapidly harvest the timber at first given their uncertainties over the policy's long-term stability. There was thus a brief increase in degraded forest lands and a decrease in forest cover following the 1981-82 tenure reforms (Figure 4).

China opened up its economy to the outside world in this period and implemented wide-ranging reforms resulting in rapid economic development in Guangdong. As timber markets were opened up and prices rose, the economic returns from tree-growing rose along with public interest in rehabilitating degraded forest lands. Forest and forest land tenure reform allowed transfer of use rights and diversified *afforestation* systems and institutional arrangements emerged, such as joint management, *stock-sharing*, and contract¹⁶ and lease management. In the past, much of the rehabilitation was funded through national loans at low interest rates and government agencies needed to repay this capital. The diversified arrangements helped to provide alternative financing and management mechanisms. They also significantly enhanced *afforestation* quality, allowing the different stakeholders to benefit.

There were two main issues of concern linked to forestry at this time. One related to the low volume and poor quality of forest resources and environmental services. In 1983, degraded forest lands covered 5.18 million ha. Soil erosion affecting up to 1.2 million ha in 1985 was linked to a deteriorating forest environment (Lu 2002). Resulting sedimentation in rivers reduced navigable routes by half compared to that in the 1950s. Frequent flooding was again attributed to degraded vegetation conditions.

¹⁶ The Government and others contract landholders or other agencies to afforest and manage the areas in return for payments or seedlings and other inputs.

The other concern was that economic development in the mountainous areas lagged behind that in the coastal and plain areas. In 1984, the 47 mountainous counties¹⁷ occupied half the land area and contained a third of the provincial population, but only had one-sixth of Guangdong's total Gross Domestic Product. Per capita income was only 290 RMB (MIST 1991). Forests are the major resources available in these mountainous areas. Therefore, rehabilitating the degraded vegetation and soils and developing the forest resources was surmised to be the key to alleviating poverty and enhancing economic development.

Following a Central Government edict to green the country, the Guangdong government launched a massive project in 1985 to "rehabilitate all degraded forest land in five years and green Guangdong in 10 years". By the end of 1993, 3.33 million ha of degraded forest lands were covered with trees. From 1983-1995, forest cover increased overall from 4.9 to 10 million ha, or 27.2 percent to 55.9 percent of the land area (Figure 4) (GCEB 1998, GFB 1987-2003). Only 784,500 ha of degraded land in remote and inaccessible areas were left. From 1985-95, standing timber volume¹⁸ rose from 170 million m³ to 291 million m³, the mean annual growth increment rose from 10.64 million m³ to 16.8 million m³ and mean annual consumption rose from 8.1 million m³ to 14.77 million m³ (Xu 1999). However, the degraded area rose to 1.35 million ha in 1995-96 after this initiative ended. Some major reasons for forest land degradation after the provincial program (GFEB 2001) include lack of species-site matching, forest pests and diseases, fires¹⁹ and lack of long-term management.

4.4 The fourth phase (1990-present)

The focal point gradually shifted from rehabilitating degraded forest land to protecting and enhancing the established forests to meet industrial and environmental needs. The Guangdong Government decided in 1994 "to strengthen the *afforestation* achievements and modernise forestry practices" (Li and Deng 2001). In the same year, the Guangdong Province Forest Protection Regulation was issued which stipulated that forests be classified as "commercial" or "ecological" and managed accordingly. Logging was banned in *ecological forests*. Guangdong became the first province in China to classify its forests in this manner and manage them accordingly (GFEB² 2002). It targeted establishing 3.4 million ha of *ecological forests*, equalling 30-33 percent of the total forest land. The "Development and Planning Compendium of *Ecological Forests*" identifies the categories and range of *ecological forests*. *Ecological forests* consist mainly of water source protection forests around the four major rivers and watersheds; water and soil conservation forests; coastal protection forests; farmland protection forests;

17 Administrative divisions and number of counties in the province different at that time.

18 Standing timber volume is growing stock on forest land divided by forest land area.

19 Fires were often caused by burning firecrackers for celebrations and for dead relatives

forests along roads, railways and reservoirs; nature reserves; forest parks; and landscape forests. Suggested rehabilitation methods for *ecological forests* include planting, replanting and intercropping, and “*mountain closure*”²⁰ to allow natural regeneration. In 1998, the provincial government called for both speeding up forest industry development and building high-quality *ecological forests* in Guangdong by adjusting the tree species, forest structure and type (Chen and Peng 2000).

In 1999, a regulation for “*Ecological Forest Management and Economic Compensation Measures*”²¹ was formally introduced. It was decided that funding would be allocated from the provincial budget after failing to secure finance from other sources. Such economic compensation measures have already been used to rehabilitate and protect *ecological forests* in Guangdong. Up to 2001, 536 million RMB from the provincial budget was paid out in economic compensation (GFEB² 2002). In 2002, 249 million RMB was paid out to 25.89 million people in Guangdong (Deng² 2002). An early compensation level of 2.5 RMB/*mu*/year was increased to four RMB/*mu*/year (Qu 2002). Besides, local funding was added in where possible. For example, Guangzhou city raised the compensation rate for key water conservation forests to 12 RMB/*mu*/year. With Guangdong government’s call to accelerate the development of mountainous areas in 2002, the provincial compensation rate was increased to eight RMB/*mu*/year from 2003-07 (Deng² 2002, www.szagri.gov.cn —Shenzhen agricultural information web).

In the late 1990s, the Guangdong Forestry Bureau proposed to establish 0.67 million ha (10 million *mu*) of fast-growing and high-yielding plantations by 2015 to meet the resource needs of the rapidly developing forest industry. Means of investment and timber plantation management were changed. The Government vigorously promoted and facilitated private sector involvement and foreign investment in rehabilitation and development of commercial plantations through a series of preferential policies and regulations. Diverse management options and institutional arrangements among multiple stakeholders are now being tried for commercial forests and it is difficult to find degraded forest land for lease in preferred districts.

From the 1990s to present, a wide range of rehabilitation initiatives were implemented in Guangdong, including the “National Afforestation Project” aided by a World Bank loan (1990-96); the “National coastal protective forest system development project” (1991-2010); forest landscape rehabilitation projects initiated by local city and county forestry bureaus (from the 1990s); the “Plan for

20 “*Mountain closure*” means closing public access to degraded forests and forest land with natural regeneration capacity to enable natural forest recovery.

21 The term “Economic Compensation measures or payments” for *ecological forests* used in Guangdong is equivalent to the term “Payment for Environmental (or Ecosystem) Services” used elsewhere.

rehabilitating degraded forest land within three years" (2002-2004); the *Ecological forest system development project*" (2000-2005); and afforestation projects initiated by private individuals, private (local and foreign) enterprises, collective and state forest farms. These projects were all promoted and supported by a series of national, provincial, and local policies and regulations and are closely aligned with the recent commercial and *ecological forest* land classification (see Annex 2 for details on policies).

Up to 1998, Guangdong Province had established 833,000 ha of timber and resin plantations; 333,000 ha of fast-growing *Eucalyptus* for pulpwood; 933,000 ha of *economic plantations*; 3400 km of coastal protective forest belts and 208,000 ha of protective farmland forest-networks (Deng 1999). Forestry output was double that in 1978 (Liang 2000). In 2003, total forest cover stood at 10.3 million ha, or 57.3 percent of the land area and degraded forest land at 1.19 million ha (Figure 4).

5. Description of major rehabilitation initiatives

5.1 Rehabilitating degraded forest land in five years and greening Guangdong in 10 years

In 1984, the Central Government issued an edict that the Communist party committees, governments and leaders at all levels should focus on effectively *greening*²² the country while also paying attention to the quality of *afforestation*. They would be evaluated on the basis of their performance within their prefectures. Given the condition of Guangdong's forest lands and the Central Government's call for action, Guangdong's Government and Communist Party Committee decided in December 1985 to "rehabilitate all degraded forest land in five years and green Guangdong in 10 years". Program targets were formulated as follows:

- 1) The greening rate²³ of forest land should be over 80 percent
- 2) Along provincial roads, local roads and railway tracks, over 95, 85 and 95 percent respectively of the total length suitable for greening should be covered with trees (and grass or flowers where trees cannot be planted)
- 3) In coastal protective shelterbelts and farmland protective forest networks of relevant cities and counties, over 85 percent of the total length and area should be greened with trees
- 4) The greening rate in counties and townships should be over 30 percent.

22 Increasing forest canopy cover to a certain percentage or above, and is expected to result from *afforestation*.

23 Greening rate refers to the ratio of stocked forest plus shrub to forest land



Large areas planted to *Eucalyptus urophylla* in the Greening Guangdong project, Xinhui county. (Photo by Zhong Chonglu)

The project was a top-down one with the provincial government assigning the task of funding and implementing the project as targeted to local governments and forestry agencies. Local governments contracted the collectives, local farmers and private individuals to afforest and manage their own or leased lands, while providing technical assistance and some funding for implementation. Local and provincial forestry bureaus and the Guangdong Forest Survey and Design Institute monitored and evaluated the progress during the project period. Local community participation in decision making was low. According to the project managers in the three county cases assessed, communities had low to very low influence and control over decision-making and resources. In two county cases, managers stated that indigenous knowledge and socio-cultural practices were taken into account by planting species that people were familiar with or favoured, such as pines (*Pinus*) and fruit trees. All three cases had land tenure disputes. Disputes were fully resolved in two cases through negotiation and agreement.

Planting was the dominant method of *afforestation* with aerial seeding as a supplement. Two of the three cases also had some natural regeneration. Regreening large areas rapidly was the major objective and there were no specifications on species choice as long as the area was greened. Landholders chose available exotic and native fast-growing species that could survive on the barren lands. Species-site matching was not effectively considered. Common species planted were pines (such as Masson pine and slash pine - *Pinus elliottii*) and *Eucalyptus urophylla* for timber and pulpwood. However, each case study site had planted three or more species

that included Masson pine, slash pine, Chinese fir, *Eucalyptus urophylla*, *Taxodium distichum*, *Acacia* sp. and other broadleaved trees for timber, fuelwood and fruits (see Annex 3 for tree species planted on case study sites). The planned harvest technique was mostly clearfelling. *Eucalyptus urophylla* and Chinese fir would be coppiced in subsequent rotations while other species would be replanted.

A series of measures were adopted by the provincial government to ensure the project successfully afforested the targeted areas as per schedule (GCEB 1998, Liang 2000). The main measures were as follows:

1. The provincial government held sixteen successive conferences to **raise the awareness and commitment** of the Communist party and citizens of Guangdong about the rehabilitation tasks. The provincial government also issued three subsequent directives to speed up the *afforestation*, complete the tasks on schedule and modernise forestry practices.
2. Leaders in charge at all levels were to **establish demonstration sites** for rehabilitating barren land to gain experience and to drive project implementation in their prefectures. From 1986-93, 12,500 demonstration sites were established, with the area planted to timber and fruit trees totalling 733,000 ha.
3. The province **raised funds from many different channels** given the large areas to be rehabilitated and the lack of funds particularly in poor mountain counties. A total of 25,000 million RMB was raised from seven channels: state aid, bank loans, provincial subsidies, city or county financial arrangements, funds from specific government departments, township investment and local people's self investment. Also one billion man-days of labour were used in the initiative.
4. The provincial government established a **targeted management and responsibility system** for afforesting for leaders of cities, counties, districts and townships in their prefectures and departments. For example: the transport and communication department would be in charge of afforesting local roads; the road administration department in charge of afforesting national and provincial roads; the urban construction departments in charge of afforesting built zones; and all agencies, schools, factories and mining departments in charge of afforesting their own campuses. Further in 1988, the provincial government issued a scheme to evaluate achievement of targets and assign rewards and penalties. From 1988 to 1993, they conducted eight inspections and the media circulated the results widely. The Government rewarded about 29 directors and Communist Party Committee leaders from 22 counties with increased salaries and commended 157 cities or counties, while they criticised 39 counties and issued a warning card to one city. The system of targeted management and responsibility, rewards and penalties helped to accelerate *afforestation*.

5. The Government promoted the use of LPG and other fuels to replace and **reduce charcoal and fuelwood use**. Fuelwood consumption at 7.3 million m³ in 1985 was very high and a major cause of forest degradation. According to 1991 statistics, five million m³ of wood was saved from burning in brickyards, tile and boiler plants. But there was no other information on the outcomes of this effort such as trends in fuelwood use by households.
6. In some areas, seedling survival was low and forest cover did not increase despite annual planting. Subsequently, based on YangJiang city's successful experience, the Greening administration departments across the province signed formal **contracts** with the executors who submitted *afforestation* plans, designs and operational charts. Clear responsibilities (including quality criteria and area to be afforested), rights and benefits were specified in the contracts.
7. Increased and diversified income from plantations was thought to be the key to motivating poor farmers in the mountain areas to plant trees on degraded forest lands. According to the guideline to develop **short-term benefits and a diversified economy at the local scale**, farm households were encouraged to develop small fruit orchards, bamboo, tea and herb gardens for short-term economic benefits, and in return to accelerate and promote forest restoration for long-term timber and environmental benefits. By 1991, 467,000 ha of fruit gardens had been established on degraded forest land.

By the end of 1993, almost all cities and counties had reached their scheduled *afforestation* targets and 3.33 million ha of degraded forest lands were covered with trees. Cost per ha planted was moderate at 7507 RMB plus free labour (see Table 3 for cost comparisons). Short-term survival of planted seedlings was very good; over 90 percent. However, in the long-term, 433,000 ha or 13 percent of the afforested areas were degraded (Liang 2000, case studies) due to the following reasons:

1. Once the *afforestation* tasks were fulfilled and the project was completed, the leaders tended to relax monitoring and control over the areas.
2. Species planted were not well-suited to the sites or climate in these areas; leading to poor growth, frost damage, fire, and pest and disease problems. Most of the degraded sites had exotic species (such as *Eucalyptus* or *Acacia*), or had single species planted over large areas and on unsuitable sites as well.
3. Little attention and funds were provided for long-term management after planting targets were met, and for restoration after logging or fire damage.
4. Planting and survival in remote areas were difficult to inspect, particularly without the use of remote sensing and Geographic Information System (GIS) methods.
5. Some landholders did not follow the sustainable logging instructions provided on issue of harvesting licences.

6. High timber taxes and fees and low market prices affected the landholders' motivation.

Specific environmental benefits were not measured and success was assessed only in terms of achieving planting targets. Two county cases also aimed to conserve soil and water, but used slash and burn practices of site preparation. According to Yang *et al.* (2005), slash and burn practices lead to substantial removal of nutrients, degradation of soil structure, soil exposure and increased susceptibility to erosion. However, one of the two cases established terraces and rock walls to conserve soil and water. In the third case, the manager believed that the growing ground vegetation and broadleaf trees planted would help conserve the soil and water.

With regard to socio-economic impacts, average income had increased in all three cases due to overall economic development and not specifically due to the forestry sector. Two of the three county cases were highly developed with good roads, transport, market access, and health and education facilities through government programs in the recent past. Pressure on the land for fuelwood, grazing and other subsistence activities had been reduced because of forest patrols and other protection measures, and LPG use substituting fuelwood near more developed areas. However, fire continued despite fire protection measures such as firebreaks, fire towers and fire-fighting teams. Local people's dependence on forest products for income increased or remained high in all three cases due to the production of mainly fruits and other non-timber products from the rehabilitated areas. The sites had mature timber stocks, yet little timber had been harvested to date. There was no explicit marketing strategy.

There were no long-term management, monitoring and evaluation, and financial reinvestment plans after the project ended. With respect to long-term financial outcomes, managers of one case state that the heavy timber taxes and fees will lead to low returns even though market prospects were good. Also lack of higher-level funding support led to the local forestry bureau becoming heavily indebted. In another case, declining or low timber prices provide doubtful returns. The third case indicated good market prospects but had not yet harvested the timber. Besides, problems of slow growth, damage to trees and low yields on 13 percent of the overall project area makes it difficult to generate sufficient returns to pay back the loans.

5.2 Guangdong Province "National Afforestation Project" funded by a World Bank loan

The National Afforestation Project, partly funded by a World Bank loan was implemented in Guangdong from 1990-96 in 27 counties (NAPOGP 1998).

This is another top-down project that was initiated at the national level and implemented by local governments, state and collective forest farms and households. Implementation contracts or agreements provided well-defined responsibilities, rights and benefits to contracting local farmers and collective, state or jointly-managed forest farms. Local community participation in decision making was low as confirmed by the project managers of the three county cases, though there was some negotiation over benefit-sharing in the jointly-managed forest farm case. The provincial and local forestry bureaus and governments conducted education and awareness building campaigns for forestry farmers and local communities through television and public broadcasts, distribution of propaganda materials, and meetings.

The contracted parties would afforest and manage the areas through low-interest loans, harvest and earn income from the timber and other products, and pay back the loans. The forests established by jointly-managed forest farms accounted for 75 percent of the total project area. One case study illustrates the possible institutional arrangements in a jointly-managed forest farm: The Wengyuan forestry bureau invests in, plants, manages and logs the areas. The local farmers monitor and protect the areas. The local township government provides some assistance. Ten percent of the income is to be used to pay back the World Bank loan; 16 percent reinvested; and four percent for management fees, wages, and taxes. Net profits from timber production were to be shared between the forestry bureau, the forest farmers and the township government in the ratio 57:40:3.

The main objective of the National Afforestation Project was to establish large-scale and high quality, fast-growing and high-yielding timber plantations for building material, pulp, paper and plywood, while simultaneously rehabilitating degraded forest land and low-yielding forests. After planting available degraded forest land, poor disease-impacted pine and other plantations were cut and replanted. These low-yielding plantations arose from past rehabilitation activities, where large areas were planted to pure pine, Chinese fir, *Eucalyptus* and *Acacia* with uniform stand structures and low resistance to pests and other disturbances. Fire, frost, pests, diseases and human pressures left many stands severely degraded with poor form, growth and yield, or resulted in further degeneration into scrub, grass or barren land.

The main species planted in this project were again Chinese fir and Masson pine, and short-rotation *Paraserianthes falcataria* and *Eucalyptus* for pulp and plywood. Number of species planted in each case was low, commonly just two. Natural vegetation was allowed to regenerate in the plantation understorey in two cases. Sites were prepared using slash and burn techniques and terracing for soil and water conservation in the three cases. The planned harvest technique was

clearfelling. *Eucalyptus urophylla* and *Paraserianthes falcataria* would be coppiced in subsequent rotations while Chinese fir and Masson pine would be replanted. Investment totalled 333.239 million RMB with 60 percent through a World Bank loan, 12 percent from the province, 20 percent from the counties and eight percent from self-funding by forest farmers or management entities. Cost per ha afforested was low at 2611 RMB.

Specific regulations and mechanisms were introduced to ensure seed, seedling and *afforestation* quality. Inspection arrangements were formulated to check and certify each step of the project, such as land preparation, tending and planting. This included self-inspection by project executive units, comprehensive inspection by the county project office and random inspection by the Guangdong Forest Survey and Design Institute. Forestry research findings were extended and applied to ensure *afforestation* quality. Seven extension groups provided technical assistance and training and conducted research on high quality seedling production, fertilisation, land preparation, planting density control and superior provenances and clones.

The project afforested 127,600 ha, much more than the targeted 85,000 ha (NAPOGP 1998). First, available degraded forest land was planted (equalling 50 percent of the area afforested) and then low-yielding stands were cut and replanted. Average short-term seedling survival was good at 80-95 percent on the three cases. Good growth was recorded in 23,792 ha of high-yielding and fast-growing *Eucalyptus urophylla* plantations of superior provenance (Wu 1999, Cheng 1998). In 1995, a final evaluation indicated that the area in first grade plantations was 85 percent, 12 percent higher than the national project average. The area in second and third grade plantations was 12.9 percent and 2.32 percent respectively, nine percent and three percent lower than the national average (Wu and He 1997).

Most plantations were doing well but the second and third grade plantations covering 27 percent of the area had some problems (Wu and He 1997) which were reflected in the case studies as well:

1. Species planted did not match site conditions, resulting in low survival and poor growth.
2. Uneven stand growth due to poorer quality of some seedlings.
3. Frost damage to *Eucalyptus* and *Paraserianthes falcataria*.
4. Fire and pest problems on some sites. Pines were particularly affected by pests.
5. Attempts to plant large areas with a single species for aesthetics and for operational efficiency. However, this tended to lead to site matching problems and increased vulnerability to fire, pests and diseases.

Two county cases were highly developed with good roads, transport, market access, and health and education facilities through government programs in the recent past. Transport and health facilities were still low on the third site. Local people depended on the products (resin, fruits, timber and fuelwood) from the rehabilitated areas for both income and subsistence to a moderate extent in all three cases. External pressure on the land for grazing and fuelwood had been reduced with forest patrols and other protection measures. There has only been a little timber harvesting on the sites till present because the plantations were still young. In one case, thinning was not done because of high thinning costs, inadequate funds, and problems getting logging licenses. There was no explicit marketing strategy in all cases. Average income had risen in the three counties due to overall economic development and not specifically due to the forestry sector. The project was oriented towards timber production and greening and other environmental outcomes were not assessed.

In general funding availability enabled planting targets to be met. However, the project lacked focus on and funds for long-term management (Wu and He 1997). This was true for two of our cases where individual farms or farmers were contracted, but different in the joint management case which had long-term management and financial reinvestment plans. Overall, problems of slow growth, tree damage and low yields on 27 percent of the area afforested makes it difficult to generate sufficient returns to pay back the loans. In one case, the contractor was seriously indebted and unable to repay the loan because of poor tree growth and yield, low Chinese fir prices, heavy timber taxes and fees, and loan payback time being in advance of harvest time. However, in the joint management case, the project managers expect that the loan could be paid back due to good management, anticipated high yields and good market prospects despite poor tree growth in some areas.

5.3 Private sector rehabilitation initiatives

Most counties in Guangdong, particularly the mountainous or undeveloped regions, have limited funding for forestry, comprising less than one percent of the government budgets. Promoting private sector investment is a useful way to obtain funds to rehabilitate the remaining degraded forest land and develop commercial forestry.

Private sector efforts had already started on a small-scale in the 1980s as timber markets were liberalised and prices and economic returns increased. Institutional reform contracting land to households, and allowing forest farms and households to subcontract or lease the land to other entities and agencies facilitated this process. But private sector efforts have increased in importance since the late 1990s with supportive policies, economic development and rising timber demand.

Different types of institutional arrangements characterise private sector efforts. In this volume, we focus mainly on the following:

- Farmers afforesting and managing their allocated forest lands.
- Private individuals and foreign and domestic companies afforesting, managing, logging and earning income from forest land leased or subcontracted from collectives/farmers for fixed annual payments. Lease periods tend to be 30 years for private individuals and 50 years for companies.
- Farm households contributing land, and companies contributing funds and establishing, managing and harvesting the timber plantations in a *stock-sharing* system. Costs and revenue from timber harvesting and sale would generally be shared in the ratio 70:30, company to farm households. *Economic plantations* are often included as an additional incentive for farmers. Up to 2001, 12,200 households were involved in *stock-sharing* systems with companies, leading to a 1225 RMB/ year increase in household income (Deng¹ 2003).

Many additional institutional arrangements, including mixed public-private sector arrangements, exist in practice. In China, the term “*non-public system*” is commonly used instead of private sector. “*Non-public system*” may include *afforestation* and management of forest land by any individuals or agencies (including state and collective institutions) for income with their own investment through lease, tenure transfer, contract, *stock-sharing* or joint management mode.

The case studies suggest that local communities had medium-high participation in decision-making on site identification, rights, authority, and benefit and cost sharing in private sector initiatives. Clear legal contracts were signed between the stakeholders with cost and benefit sharing arrangements, rights and responsibilities spelt out.

The Government's main measures to promote private sector initiatives were as follows:

1. *Established favourable policies*

From 1997 onwards, governments at different levels issued numerous regulations and policy incentives promoting private sector (both domestic and foreign) involvement in commercial forestry. The regulation “Administrative measures for *afforestation* through foreign business investment in Guangdong” (Wang and Hu 2002, Chen and Peng 2002) issued in 1997 provided for longer-duration forest land tenure, reduced forest tending and maintenance fees, and priority rights for obtaining logging quotas and licences. *Afforestation* implemented in mountainous areas would receive further special favourable policies. These policies attracted many foreign investors from Thailand, Singapore, Malaysia, Indonesia, Canada, and Taiwan and increased the rate of rehabilitation of degraded forest land

and establishment of fast-growing and high-yielding forests in Guangdong. As compared to other provinces in China, Guangdong attracted the most foreign capital investment in *afforestation*.

Private individuals and civil society were further encouraged to develop commercial plantations and actively invest in *afforestation* with the “Resolution to develop individual and private economy in Guangdong” in 1999. Also, the “Resolution to strengthen *afforestation* achievements, and enhance the economic, social, and ecological benefits of forestry” issued in 2000 by the Guangdong government stipulated that:

- Private forest farms holding more than 1667 ha of forest land would enjoy the same favourable privileges as state forest farms in terms of logging quotas and reduced timber taxes after approval by the Guangdong forestry and financial authorities.
- Individuals afforesting over 66.67 ha in a single instance; or state, collective and private enterprises afforesting over 666.67 ha in a single instance could enjoy the same favourable privileges as foreign investors (Deng¹ 2003).

Additionally, based on local conditions, some cities formulated more favourable policies simplifying forest land transfer and lease, providing credit facilities, and reducing taxation. All these policies speeded up the development of private commercial forestry.

2. *Established demonstration forests*

Provincial, city and county forestry authorities all paid attention to establishing fast-growing and high-yielding forest plantations. By the end of 2001, forestry authorities had set up 415 demonstration sites covering 90,000 ha in Guangdong to further encourage private investment in commercial forestry.

3. *Supported lead enterprises*

The management model of lead private enterprise plus farm households for establishing timber plantations was promoted in 2001 to encourage forest farmers to plant timber and fruit trees to alleviate poverty, maintain *afforestation* achievements and ensure sustainable rehabilitation in mountainous areas (Deng¹ 2003). Ten (domestic and foreign) forestry enterprises adopted the *stock-sharing* institutional arrangement whereby the company and farm households came together to rehabilitate degraded forest lands and develop timber and *economic* plantations. The companies included Weihua Ltd. in Meizhou city, Jiayao Ltd. (part of Sino-forest Corporation Hong Kong) in Gaoyao city, Lianxing Ltd. in Xinyi county, Shenhua Ltd. in Jiaoling county and Maoyuan Ltd. in Qingxin county.

4. *Established a technical service system*

The city and county forestry authorities were to offer private investors support in *afforestation* planning, and to provide technical guidance through each step of the process such as seedling production, land preparation and planting. Training in forestry techniques was also provided to accelerate the development of private individual and enterprise efforts and improve their chances of success. Some private companies also availed of the technical services of forest research institutes while the bigger corporations had their own research and development departments.

According to incomplete statistical data, by 2003, 540,000 private entities had invested 2300 million RMB in *afforestation* in Guangdong (Deng² 2003) and established 1.04 million ha of fast-growing and high-yielding plantations. Cost per ha on average amounted to 2211 RMB. Much of the 2300 million RMB invested was foreign capital. By the end of 2001, 10 foreign enterprises had invested 1356 million RMB and planted 50,000 ha in Guangdong (Chen and Peng 2002, Jiang 2003), incurring a much higher average cost of 27,120 RMB per ha. The leading international companies were Sino-forest Corporation from Hong Kong and Asia Pulp and Paper Co. Local companies and private individual investors also play an important role and funding is often through low interest loans available for forestry. In our case studies, a private company planting teak invested 22,760/ha, two private individual initiatives incurred 8700-9600 RMB/ha and three other private sector cases incurred < 4000 RMB/ha, showing the wide range in investments made by this sector. Higher costs reflect higher inputs, more intensive management and post-planting maintenance, and spending on research and technology.

The private sector initiatives were mainly focused on exotic timber species, primarily for pulpwood. The private company case studies evaluated had two to five mixed short- and long-rotation species per site. Dominant species were *Eucalyptus urophylla*, *Acacia mangium*, *Acacia crassicarpa*, pines and some high-value teak. Private individual cases had fewer species, mainly short-rotation *Eucalyptus urophylla* with some longer-rotation teak, *Paraserianthes falcataria* and *Betula alnoides* on one site. The company cases had fire-break forest belts that were planted with species like *Schima superba* or naturally regenerated. Natural regeneration was allowed in the understorey of two sites. Open land and degraded poor plantations were planted. Except for two company cases, others practised slash and burn techniques of land preparation. Cases on sloping land used terracing, hedgerows or rock walls for soil and water conservation. The planned harvest technique was clearcutting on all sites. *Eucalyptus* would be coppiced and the rest replanted in the second rotation.

Average short-term survival of plantings was over 90 percent in the six cases. Some pest damage occurred on at least three sites though this was not indicated as a serious problem. One company case had concerns that site productivity may degrade over time with continuous rotations of pure *Eucalyptus*. In another case, *Acacia mangium* planted was destroyed by extreme cold winds and there was fire damage too. It is relatively early to judge the long-term sustainability and production, socio-economic and environmental outcomes of these private sector efforts and information is scarce in the literature. Available knowledge from the literature and case studies is presented below.

In terms of production, Deng¹ (2003) reported that income from timber and forest products in the private forestry system totalled 7.6 billion RMB up to 2001. The private sector cases believed there were good market prospects for timber, woodchips and fuelwood and that the demand would increase with economic development. They had all done some market analyses and had some marketing strategy.

Local income increased in all cases with rapid economic development and not specifically due to the forestry sector. All case study sites were highly developed with good roads, transport, market access, and health and education facilities through government economic development. Disputes over benefit sharing (one private company), and land boundaries (in all six cases) were resolved through negotiation and agreement. Local people depended more on the forest lands for income now in all cases — obtaining rent from land leased to the private sector or a share of the timber profits in joint venture projects. Local pressures for fuelwood, grazing and other resources appear to have been reduced on three sites, while people were now using the wood available in two private individual and one private company case. Protection was minimal on these latter sites and there was high subsistence use. Developing good relations and short- and long-term local livelihood benefits through *economic plantations* were recommended for project sustainability.

Specific environmental benefits of these initiatives were not measured and success was assessed only in terms of achieving planting targets. In general, the private sector initiatives had low biodiversity potential, with mostly exotic and fast-growing species planted. However, private company sites had slightly higher diversity than private individual sites and included firebreaks of broadleaf species (Chokkalingam and Zhou 2006).

Private sector initiatives were implemented by parties with longer-term interest in the land, with leases ranging from 30-50 years. They had plans for continued management, accrual of benefits and reinvestment through the lease period.

Long-term returns on such investment and sustainability of these efforts remain to be seen. Heavy timber taxes and fees were identified as a constraining issue in two cases leading to low returns and an unfavourable environment for investing in trees.

5.4 Coastal protective forest system development project

The coastal region adjacent to the South China Sea is relatively well developed economically and covers 48.2 percent of the land area of Guangdong. It has a complicated land relief with interlaced mountains, hills, plateaus, plains and beaches (GAS 1991). Since 1949, the region has been active in establishing a shelterbelt against typhoons and sandstorms through large-scale *afforestation* along the long, 3041 km coastline.

Given the region's importance for China's economic development, the National Coastal Protective Forest System Development Project was initiated in 1991, to be implemented in two phases from 1991 to 2000, and 2001 to 2010. The project aimed to stabilise sand dunes and establish shelterbelt forests to protect agriculture, fisheries and salt fields from typhoons and sandstorms; safeguard life and property; and promote coastal tourism and further economic development (Chen and Gan 1996, Chen and Hu 2000). Guangdong is one of seven provinces implementing this project and the *afforestation* target was 450,000 ha. Project plans were to:

- 1) Rebuild, regenerate and modify the main skeleton of the coastal protective forest belt.
- 2) Rebuild and modify the hedges around agricultural fields.
- 3) Afforest the first range of mountains/hills adjacent to the coastline.
- 4) Protect and develop mangrove forests on the beaches.

The project was another top-down program, initiated at the national level but executed by local forestry bureaus as well as two state forest farms. The Guangdong Forestry Bureau in turn passed measures and regulations to support project implementation. Financial support from the state was low and funds had to be raised from different local sources. The actual investment was 1063.301 million RMB, with the state financing 3.4 percent; the province 2.4 percent; the cities, districts, townships and various departments providing 66.3 percent; and local farmers 27.8 percent as well as 48.752 million man-days of free labour (SMD 2000). Cost per ha afforested excluding the free labour was low at 1754 RMB.

Local forestry bureaus contracted special *afforestation* teams or the landholders (farmers, collectives, state forest farms) to rehabilitate and manage their own areas. The greening companies or professional *afforestation* teams selected through open bidding were responsible for land preparation, *afforestation*, tending, and quality

of the forest within the contract period. Tenure remained with the collectives or households who were to protect the area. The landholders who were contracted to afforest were provided seedlings, subsidies and loans. Local forestry bureaus were responsible for project management, technical guidance, supervision and funding. Township governments were responsible for solving land tenure conflicts and protecting the *ecological forests*. Coastal shelterbelts were to be protected as *ecological forests* and tenure-holders receive economic compensation on such sites. In commercial forest areas (hill sites), tenure-holders could grow and derive income from timber and *economic* plantations.

Joint management arrangements were adopted on some sites in this project as well. This is illustrated in one case study where the forestry bureau and local village entered into a 60-year agreement. In this case, the Yangxi Forestry Bureau would plant, manage and log the commercial forest areas for 70 percent of the profit from timber sales while the local community would protect the area for 30 percent of the profits.

Participation of local people in decision making is unclear. In the jointly-managed case, local people participated only in site identification but not in deciding which sites should be included or what rehabilitation methods should be used. In two other cases, project managers said communities had high influence on decision making, but the claim cannot be validated due to a lack of information on the degree of participation in different processes. However, all projects involving multiple stakeholders had clear, signed contracts setting out benefit and cost-sharing agreements and rights, authority and responsibilities.

In the coastal protective shelterbelts now classified as *ecological forests*, species such as *Casuarina equisetifolia*, *Acacia confusa* and *Acacia auriculiformis* were planted for their fast growth and ability to endure wind, sand and saline conditions. Native *Acacia confusa* was also chosen for its natural regeneration capacity besides its suitability to the site. Natural regeneration was allowed in the understorey. Fast-growing timber and *economic* plantations were developed on suitable slopes and foothills of the mountains using species such as *Eucalyptus urophylla*, *Dimocarpus longan*, *Litchi chinensis*, olive, waxberry, and bamboo. Other areas were naturally regenerated by way of *mountain closure* or planted with broadleaf species to conserve water and soil. Any harvesting was to be done through selective cutting.

The Guangdong Forestry Bureau issued in 1991 and reissued in 1995 revised guidelines for inspection to enhance the *afforestation* quality and strengthen supervision and management. On this basis, the local forestry bureaus, the Guangdong Forestry Bureau and the Guangdong Investigation and Design Institute of Forestry monitored and evaluated the sites annually during the project



Casuarina equisetifolia planted in the Coastal protective forest system development project, Dianbai county. (Photo by Zhong Chonglu)

period. They monitored the area afforested and its quality, stand maintenance and the funding situation. Mobilisation and propaganda efforts via public broadcast, television and newspapers were held to increase the awareness of government authorities and the people about the protective forest system.

Within 10 years, a total 606,000 ha was afforested as against a target of 450,000 ha, with 480,000 ha by planting, 16,000 ha by aerial seeding and 110,000 ha through *mountain closure* or natural regeneration. The breakdown in terms of forest purposes was 325,553 ha of protective forests, 147,533 ha of timber plantations, 100,813 ha of *economic plantations*, 353 ha of special use forests and 31,633 ha of fuelwood forests (SMD 2000). The area planted by the special *afforestation* teams amounted to 298,380 ha and the rest was planted by collectives and farmers on their allocated lands.

Short-term survival of plantings was quite high at 80-95 percent but it was difficult to maintain the plantations in the long run. From 1991 to 2000, the forested area in the coastal region increased from 1.21 to 1.38 million ha (SMD 2000) only despite 606,000 ha being afforested, though some of it may have still been young plantations. Typhoons (about five-six per year) destroy the protective forests, particularly the coastal shelterbelts. In 1995, a typhoon destroyed 20,573 ha. There was also poor growth or degradation in areas or of species due to poor species-site matching and pest, frost and fire damage. *Casuarina equisetifolia* was affected by numerous pests and diseases. Similar reasons — frequent typhoon

attacks and mono-specific single-strata forest stands — were blamed for site degradation in the coastal areas prior to this project as well, suggesting that the underlying causes of degradation were not addressed or were difficult to address. Whether the protective forests are indeed serving their function of protecting inland areas while absorbing some of the typhoon impacts, should be assessed.

The Coastal sites did not use slash and burn techniques to clear the land which could have increased soil exposure. From 1991 to 2000, the area affected by soil erosion was reduced from 109,900 to 60,700 ha in the overall coastal region (SMD 2000). The project planted shelterbelts of species suited to the harsh conditions and thus able to survive and perform a protective function, though some of the planted areas were destroyed as indicated above. Little information exists on whether the coastal shelterbelts did serve to protect the agricultural areas, salt fields and living environment beyond. Rice yield in the coastal area increased from 5.3 billion kg to 6.3 billion kg from before the project to 2000 (SMD 2000), and the relationship between rice yields and *afforestation* versus other factors needs to be assessed.

The three case study sites were highly developed with good roads, transport, market access, health and education facilities through government economic development in the recent past. From 1991 to 2000, per capita income/year in the coastal region increased from 1760 to 3882 RMB (SMD 2000) due to overall economic development. Per capita income/year from fruits increased from 174 to 464 RMB and this is more directly linked to the rehabilitation activities. However, dependence on forest/tree products was low for both income and subsistence in the cases assessed.

A lack of local support affected rehabilitation efforts in two cases that were mainly for protection purposes, and a tenure conflict affected the third case which was for commercial purposes. The forests were protected through patrols and notices on the two *ecological forest* cases. Economic compensation for *ecological forests* was insufficient given people's substantial investment in funds and labour and the lost income from the land. If the compensation fees were not increased, then protection and management could become a problem. Already governance and protection systems needed strengthening to prevent illegal logging, encroachment and forest fires. However, whether even current compensation rates can be sustained in the long term is an open question. It was also recommended in one case that tenure of protective forests is best held by the community or group, and not by households.

With low state investment, it was necessary to raise funds from many channels and this was accomplished following the experience of the Greening Guangdong

project. However there was a shortage of funds for maintenance of the areas afforested (SMD 2000). Local forestry bureaus (*ecological forest* sites) and communities (hill forests) were to protect the rehabilitated areas in the long term. No financial or market analysis was undertaken on even the hill forests because the overall project was mainly concerned with environmental benefits. Typhoon damage and poor growth hampered production on some sites. Problems with implementing logging quotas and issuing logging and transportation licences affected sustainable forest management in the hills.

5.5 City forest landscape rehabilitation projects

Since the 1990s, some developed cities in Guangdong, such as Guangzhou, Shenzhen and Zhongshan sanctioned plans and projects and disbursed funds to transform their degraded forests and forest land into appealing forested landscapes. The driving force was that a green aesthetically-pleasing environment for living and working would encourage economic investment by national and foreign agencies and help promote tourism, besides benefiting local residents. The objectives were to rehabilitate existing degraded forest land, improve forest stand structure and function and increase its capacity to resist natural disturbances, and improve landscape beauty.

From 1991-93, the Guangzhou city and district governments and forestry bureaus initiated and executed a project to rehabilitate 5386 ha of degraded forestland surrounding the ten entrances and exits to Baiyun district. In 1997, Shenzhen city passed a five-year plan (2001-2005) to develop 44795.3 ha of *ecological forests* with the district greening committees being responsible for accomplishing tasks (SDASFB 2000, RITF *et al.* 2002). The Zhongshan municipal government sanctioned a project to rehabilitate 4618 ha of degraded forest land and establish *ecological forests* in the Changjiang tourism zone and hills adjacent to three lines of roads in the city from 2000 to 2008. Shaoguan City decided to afforest 45,500 ha of barren lands from 2002-04 for both economic (timber production) and environmental reasons (biodiversity and forest cover). The project was to be executed by local forestry bureaus and collective and state forest farms within. Other cities like Kaiping adopted the lessons learnt from Shenzhen and Zhongshan and established their own projects to rehabilitate degraded forests and barren land along main roads. Costs/ha varied from 9961 RMB in Zhongshan city to < 1600 RMB in Shaoguan, Shenzhen and Guangzhou cities. Funding was to come mainly from the city, county, district and township governments and forestry bureaus.

As in other projects, in commercial forest areas, the landholders or communities are allowed to use and earn income from the forest products. In *ecological forest* areas, the landholders are not allowed to harvest the timber and are instead paid economic compensation and allowed to harvest fruits and other non-timber forest

products. The government makes most decisions with regard to the rehabilitation project and there is little local participation.

In commercial forest areas, local governments contracted landholders to plant trees and manage the areas for the products, while providing technical and funding assistance. The *ecological forest* projects were mostly executed by commercial greening companies who compete through a public bidding system and are selected through just, fair and open procedures. Clear contracts are signed between the successful bidders and the city governments, setting out the tasks and responsibilities. The greening companies are usually required to plant and maintain the area for a few years and ensure survival and high quality of the *afforestation* efforts as planned and agreed on. The city governments have monitoring and evaluation measures to ensure successful rehabilitation. After the establishment period, the areas are returned to the landholders (township government or village committee) for continued maintenance.

The city landscape projects tend to emphasise high planning and management standards (FSDIGD and ZFB 1999, Liu 1999) and clear delineation of rights, responsibilities and benefits so that the projects operate smoothly. In the Zhongshan project, management teams of government representatives were set up for different aspects such as bidding, quality monitoring, and financial management. A high quality seedling nursery was set up and special technicians made responsible for ensuring the quality and quantity of seedlings.



City forest landscape rehabilitation with mixed species, Guangzhou. (Photo by Takeshi Toma)

In keeping with the objectives, the methods used were different from other rehabilitation projects. The City landscape projects aimed to create improved forests in terms of species, stocking, structure, environmental and economic benefits, and aesthetics. To this end, they planted a mix of species for their differing characteristics such as fast growth, sprouting ability, site adaptation, aesthetics, bearing fruits and other economic products, water conservation and fire resistance properties. Almost all species planted were native, the common ones being *Castanopsis* species, *Schima* species, *Elaeocarpus sylvestris* and numerous fruit tree species. Natural regeneration and aerial seeding was also used in the Shaoguang case. Sites were commonly prepared through spot brushing and not slash and burn practices, and terracing was common.

In the Shenzhen project, 21 native tree species were chosen for planting on six trial sites of 340 ha between 1998-99, based on species-site matching and aesthetic considerations (Lin and Mo 2003). In the Zhongshan project, 8-10 tree species (slow and fast growing, native and exotic) were selected for each type of forest based on the plan and objectives, local site conditions and availability. More than 30 broadleaved tree species and 75 percent native tree species were used. Native broadleaved tree species currently occupying the land were to be retained.

City landscape projects also tend to use available technical expertise to guide the rehabilitation efforts. In Shenzhen's case, an expert group composed of experienced forestry professors and associate professors from the Research Institute of Tropical Forestry (RITF) was established to provide technical guidance and instruction. In Zhongshan, the Guangdong Forestry Bureau (GFB) and the Guangdong Forest Survey and Design Institute assisted with preparing the project's plan and layout. The plan was subsequently evaluated by an expert group composed of professionals from university and research institutes. Forestry experts from the Guangdong Academy of Forestry (GAF), RITF and South China Agriculture University (SCAU) were invited to identify tree species. Technical cooperation with relevant forestry research departments was undertaken and training was given to the labourers to help them clearly understand the plan and technological requirements. Local forestry bureaus provide assistance technical guidance, training in other cities (Guangzhou and Shaoguang).

The city and local forestry bureaus and governments conducted education and awareness building campaigns for forestry farmers, local communities and citizens through television and public broadcasts, distribution of propaganda materials, and meetings. Inspection and evaluation measures were in place to ensure quality and fulfilment of plans. In Shenzhen, a special inspection group of forestry experts was set up to supervise, inspect and evaluate the project in each phase and resolve

the problems. The group was to also carry out a final inspection of the quality of the rehabilitation accomplished. In Zhongshan, all processes such as clearing, digging, fertilising, planting and tending would be checked and the contractor could not proceed with the next step if found lacking.

It is still too early to judge the outcomes but preliminary results indicate good survival (≥ 95 percent) and growth of rehabilitated city landscape forests with improved quality, particularly the ones established by the greening companies. In the Zhongshan project, the RITF is tracking and monitoring the environmental and social benefits and effects of the project (including effects on soils, water, air, and forest quality) but results are not published yet. Some early plantings of *Acacia* and pine monocultures were severely affected by pests and subsequently replaced with mixed species plantings. Some areas were affected by forest fires and firebreaks of *Schima superba* were recommended.

All city cases were highly developed with good roads, transport, market access, health and education facilities except for Shaoguan. All cases had forest patrols and fire prevention measures, and external pressures for grazing and other uses had decreased. Local people depended little on forest/tree products except in Shaoguan where dependence increased because people were using the products available in the rehabilitated areas they held. Near Guangzhou, increased LPG use reduced pressures for fuelwood. Average income increased in all four city cases due to overall economic development and not due to the forestry sector.

All city landscape projects had no long-term management, monitoring and evaluation, and financial reinvestment plans beyond the project period. Heavy timber taxes and fees were identified as a constraining issue in Guangzhou leading to low returns, but not so in the recent Shaoguan project since policies are more favourable for commercial forestry now. Marketing strategies are absent but the project managers believe market prospects are good. Deng² (2002) and Qu (2002) concluded that the overall compensation level of four RMB/*mu*/year for *ecological forests* in Guangdong Province was very low, probably only 5-10 percent of the actual opportunity costs. In 2001, the average output value that could be earned from one *mu* of forest land was 85 RMB (Deng² 2002). The provincial compensation rate was increased to eight RMB from 2003 but is still very low. Whether even the current rate of payment can be sustained long-term is an open question. A combination of incentives such as the inclusion of *economic plantations* in these city landscape projects appears more promising. Su (2004) assessed two city landscape projects and suggested that long-term management was critical along with inclusion of economic options in *ecological forests* in less developed cities with more forest dependence.

Other cities are adopting these successful approaches and establishing their own projects. The Guangdong Government's new "*ecological* province creation campaign" encourages cities and counties to adopt these successful greening experiences. However, cities rehabilitating their degraded forest landscapes tend to be economically well off with high employment and income levels. City funds are available for investing in forest rehabilitation and paying economic compensation to landholders, local dependence on forest land is lower, and LPG rather than fuelwood is used for cooking.

5.6 State Forest Farm and Joint Afforestation initiatives

State forest farms are owned by the local district city, city or county forestry bureaus. They have played an important demonstrative role in developing collective forests, rehabilitating degraded forest lands and establishing timber plantations. By 1987, Guangdong had 233 state forest farms that afforested 695,300 ha (GCEB 1998, Yun and Xie 2003). More than 948.4 million RMB was spent on rehabilitation from 1952 to 1987, equalling greater than 1364 RMB/ha afforested. Costs were relatively low but may not include staff and overhead costs generally included in projects and private initiatives. *Afforestation* activities were funded by the State and province, national bonds and low-interest loans. Activities were initiated and executed by the provincial forestry bureau, and monitored and evaluated by the provincial forestry bureau and the Guangdong Forest Survey and Design Institute. Periodic technical assistance was provided by the local forestry bureaus and the research institutes.

State forest farms have had independent forest rehabilitation and management activities since the 1950s and have participated in larger national and provincial projects since the 1980s. The state forest farms rehabilitate and manage the commercial forest areas for timber production and receive policy incentives such as reduced taxes and expanded logging quotas to facilitate this. They receive economic compensation for protecting the *ecological forest* areas. The main *afforestation* species used were long-rotation timber species - Masson pine and Chinese fir, with some broadleaved tree species for soil and water conservation and fruits. In the Xijiang state forest farm case, the site was prepared using brushing and scarification, and burning was done only where it was difficult to kill the weeds. Cover cropping was used to protect the soil and some areas were naturally regenerated. Timber harvesting was done through clearfelling, with selective cutting in soil and water conservation areas.

Average short-term survival rates in the Xijiang state forest farm were good at 80-90 percent and the area is still afforested at present. The State Forest Farm has been producing timber, fuelwood, herbs, resin and fruit for a long time now. Market prospects were good in the Xijiang case despite low prices and the timber was

saleable. The farm fared well in terms of long-term management, monitoring and evaluation, and financial reinvestment plans and implementation. High timber taxes and low economic compensation for *ecological forests* were some constraining factors.

Average income in the Xijiang state forest farm area has increased due to overall economic development and local people have reduced dependence on forest/tree products. Project benefits go to the State forest farm employees after paying taxes. Local community participation in decision making was low to absent, but the farmers were allowed to use fuelwood, litter, herbs and other non-timber products for subsistence though use is now low due to development in the area. The State Forest Farm and Joint Afforestation cases now have good roads, transport, market access, health and education facilities. The afforestation sites were well protected with firebreaks, patrols and policing. Some low-level fires continued but other pressures decreased. A land dispute between the state forest farm and surrounding farmers was resolved early on.

State forest farms have also engaged in joint or cooperative efforts with collectives. In the two Joint Afforestation cases assessed, the state forest farms invest in, plant, manage and log the areas. The communities (village committees) provide the land and assist in managing, monitoring and protecting the areas. The township forestry stations provide guidance. Benefits/profits from timber production were to be shared between the stakeholders in the ratio 50:40:10. These cases were initiated and executed collaboratively by the three stakeholders in village water protection areas; with medium-high local community participation in decisions on rights, responsibilities, authority, and cost and benefit sharing over a 30-year contract period.

The areas were well developed in terms of roads, transport, market access, and health and education facilities. Local dependence on forest/tree products was never very high and the sites were well-patrolled and protected. *Afforestation* cost per ha was low at 1400 RMB, similar to that in the state forest farms. The cases had 30-year management and financial plans, and had checked out the market prospects for the products to be generated. The managers believe that the provincial government's reducing taxes and fees and easing logging rights will help project viability.

Unlike the state forest farms, these sites were planted with exotic fast-growing slash pine and *Acacia mangium* for timber, resin and fuelwood. The main goals were to increase forest cover; produce timber, resin and fuelwood; and conserve soil and water. The sites were newly planted and have not yet started producing timber, fuelwood and resin. One case used slash and burn practices of site preparation

though it aimed to conserve soil and water. According to Yang *et al.* (2005), slash and burn practices lead to substantial removal of nutrients, degradation of soil structure, soil exposure and high susceptibility to erosion.

Overall, project managers in both the State Forest Farm and Joint Afforestation cases assumed environmental objectives (improve environment, protect watershed, control soil erosion and runoff) would be fulfilled when plantations were established, but specific environmental benefits were not measured. Success was measured only in terms of achieving planting targets.

5.7 Plan for rehabilitating degraded forest land within three years

Guangdong Forestry Bureau planned to rehabilitate 419,186 ha of degraded forest land within three years (from 2002 to 2004). The task has mostly been accomplished with 95 percent of the targeted area or 397,620 ha having been afforested: 276,534 ha through planting and 121,086 ha through *mountain closure* (Deng 2005). Ten collectives and 30 individuals were commended and given awards.

5.8 Ecological forest system development project

The tenth “five year forestry development plan” (2000-2005) of Guangdong had three projects related to rehabilitation (GFB 1996):

- The key *ecological forest* development project included rehabilitating 826,300 ha in the four big watersheds of Guangdong from 2000-2005, by planting 17,900 ha, enrichment planting of 395,100 ha, and regenerating 413,300 ha of forests by way of *mountain closure*.
- The second phase of the coastal protective forest system development project (2001-2010) was expanded to cover 45 counties (or cities and districts) and five state forest farms. The tasks were to establish 750,000 ha of protective forests, regenerate 475,000 ha through “*mountain closure*”, refurbish 218,900 ha of low-yielding forests, and tend 22,500 ha of young forests (FSDIGD 2002).
- The soil erosion control project aimed to enhance soil and water conservation on 1,152,000 ha affected by soil erosion in 21 district cities by planting trees and grasses.

From 1999-2004, Guangdong Province invested 160 million RMB into the *Ecological forest* system development project. They rehabilitated 44,987 ha of degraded forestland through *afforestation* and enrichment planting, and established 693 ha of demonstration plantations in the four watersheds. They afforested 29,100 ha of protective forests and regenerated 28,767 ha of forests through *mountain closure* in the coastal area (Li 2005).

6. Summary of some key characteristics of rehabilitation efforts over 50 years

6.1 Site conditions, degrading factors and project objectives

Case study analysis suggests that most of the rehabilitation project sites were open grass, shrub or barren lands, and not natural forest or cultivated areas. Some sites were degraded plantations arising from past unsuccessful rehabilitation attempts by collective and state forest farms and by the Greening Guangdong project. In these earlier projects, large areas were planted to pure pine, *Eucalyptus* or *Acacia* with uniform stand structures and low resistance to pests and other external disturbances. Repeated human and natural disturbances left many stands severely degraded with poor form, growth and yield, or resulted in further degeneration into sparse forest, shrub, grass or barren land. Their history underlines the importance of dealing with site-degrading factors as part of rehabilitation efforts.

Intensive logging (81%), fuelwood extraction (77%), fire (64%, escapes from ceremonial burning), and pest and disease infestation in established plantations (41% or more) were the dominant factors leading to sites being degraded in the hilly areas. Frequent typhoon attacks and wind damage, coupled with the mono-specific single-strata forest stands were blamed for site degradation in the Coastal areas.



Pest (geometrid) attack in an *Acacia mangium* plantation in Shenzhen city (Photo by Takeshi Toma)

The National Afforestation Project, private sector, State Forest Farm and Joint Afforestation initiatives were primarily focused on timber production. The remaining public sector projects — Coastal, Greening Guangdong, City landscape and *ecological forest* system development project — had mainly environmental objectives.

6.2 Funding sources and financial costs

More than 29.81 billion RMB has been spent on forest rehabilitation in Guangdong since the 1950s, much of it by the provincial project “Greening Guangdong” (Table 3). A substantial

Table 3. Financial costs of rehabilitation initiatives in Guangdong Province (Summarized from Section 5 above).

Initiatives	Total cost (million RMB)	Area rehabilitated (ha)	Average cost/ ha (RMB)
National Afforestation Project	333.23	127,600	2611
Greening Guangdong project (+ one billion man-days of labour)	25,000	3,330,000	7507
Coastal project (+48.752 million man-days of labour)	1063.3	606,000	1754
City landscape project (4 main city efforts)	167	100,299	1665
• Zhongshan city			(9961)
• Others			(<1600)
State forest farms (1952-87, includes infrastructure)	948.4	695,300	1364
Private sector initiatives (Up to 2003)	2300	1,040,000	2211
• Foreign enterprises (Up to 2001)	(1356)	(50,000)	(27120)
• Some cases			(8000-10,000)
• Other cases			(< 4000)
Joint Afforestation initiatives	No info		
Collectives, households	No info		
Total	29,810 +		

proportion of the investment did not bear fruit due to subsequent degradation of the project sites by natural and human factors and poor long-term maintenance. This was true for many of the state and collective efforts prior to the 1980s, besides a proportion of the Coastal, National Afforestation and Greening Guangdong project sites as indicated in Section 5. Funds were invested again and again in new projects to rehabilitate degraded plantation areas arising from earlier unsuccessful rehabilitation efforts.

The cost per hectare planted was very high in foreign enterprise investments (> 25,000 RMB), while the Greening Guangdong, Zhongshan city and some private initiatives were also costly at 7000-10,000 RMB. These private initiatives and the Zhongshan city landscape project had much higher inputs, more intensive management and post-planting maintenance, and spent more on research and technology. It remains to be seen as to whether these higher investments mean better establishment, maintenance and yields. Other public and private initiatives had lower costs at < 4000 RMB. Some government projects, such as Greening Guangdong and Coastal, also depended on free labour to establish plantations.

Most projects were implemented and funded at local levels even if initiated at higher levels. They were top-down approaches with the national and provincial agencies instructing local governments to achieve certain targets within a defined time frame. The area to be planted through the provincial program was particularly

enormous, but also large in the two national programs. Estimates of the relative investment by different sectors since the 1950s suggest that local city, county and township governments may have borne the bulk of the expenses, about 58 percent (Figure 5). The second largest source has been self-funding by farmers and local management units, about 24 percent, without taking into account the free labour provided in the Greening Guangdong and Coastal projects. Bank loans with low interest rates were a major local source of funds. The private sector has been a relatively recent player and its contribution can be expected to increase in the future. Private sector initiatives often use low interest loans available to promote private forestry enterprise on degraded forest lands. Contributions from national and provincial sources have been insignificant although three projects were initiated at those levels. Foreign funding has played a role in only one recorded government project in Guangdong: the National Afforestation Project which was roughly 60 percent funded by a World Bank loan which ultimately has to be paid back by the Government.

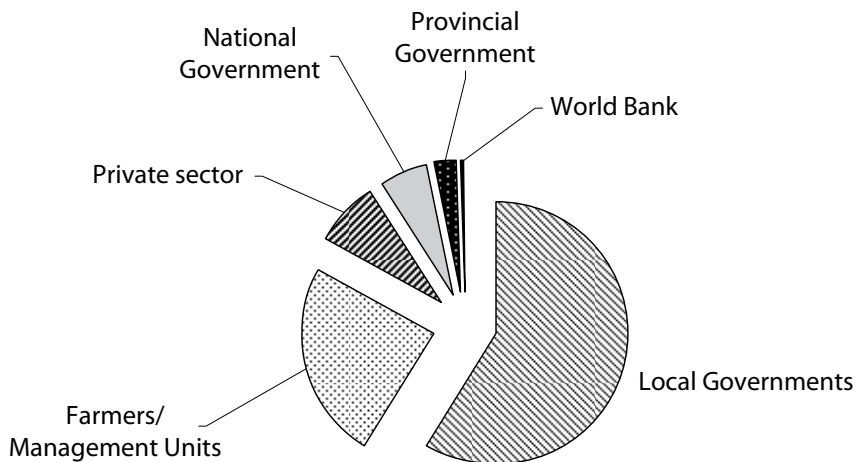


Figure 5. Relative contribution of different sectors to forest rehabilitation investment (Total 29.81 billion RMB +) in Guangdong since the 1950s (Summarized from Section 5 above).

6.3 Silvicultural practices

Case study analysis provided some clues into silvicultural practices conducted at the site level. Land clearing was done through spot and/or strip brushing on 12 sites, slash-and-burn on 8 sites and both practices on 2 sites. Slash and burn practices were primarily carried out in the National Afforestation, Greening Guangdong, private individual and Joint Afforestation initiatives. Some sort of soil and water conservation measures, mostly terracing, were applied in 10 sites. Nine project sites stated that there was either no need (Coastal and private sector



Mixed species planting on a barren hillside in Shenzhen city. (Photo by Takeshi Toma)

initiatives mainly) or they depended (Greening Guangdong, City landscape and Joint Afforestation initiatives) on the growing ground vegetation and trees to conserve the soil and water (in one site, broadleaf trees were planted for this purpose).

Planting trees was the dominant initial revegetation method in all cases. Natural regeneration was also allowed in 50 percent of the samples: planting and then allowing natural regeneration, or natural regeneration with or without enrichment planting. Natural regeneration was found mainly in the four government projects, the State Forest Farm and in vegetation belts separating the *Eucalyptus urophylla* in two private company sites. Aerial seeding was mentioned in one City landscape site but formed a part of the overall Coastal and Greening Guangdong projects.

The most common species planted were *Eucalyptus urophylla* (32 percent of samples) with rotation periods of five to seven years, and the native Masson pine and Chinese fir (22-27 percent of samples) with rotations ranging from 15-30 years for timber (Annex 3). Earlier government initiatives (National Afforestation, Greening Guangdong and State Forest Farm) favoured the long-rotation native Masson pine and Chinese fir which had good timber and matched local conditions. Fast-growing and high-yielding *Eucalyptus urophylla* primarily for pulp was found in recent private sector initiatives plus two earlier government programs.

City landscape projects had the highest diversity with three to six species per site as suited to their objectives of creating long-term stable forests with mixed

species and structure for ecological benefits, aesthetics, and for producing fruits, fuelwood and perhaps timber in the long run. Private company initiatives and the Greening Guangdong project had the next highest diversity with mixed short- and long-rotation timber species in each site. Planted species diversity was much lower in other project types.

The National Afforestation, City landscape and State Forest Farm initiatives had > 50 percent native species planted. Native broadleaved species were stated to be chosen for suitability to local site conditions and water retention capacity. Native *Betula alnoides*, Masson pine and Chinese fir were chosen for their rapid growth, favourable timber quality, site suitability, and available timber market. Two additional native species – *Acacia confusa* and *Castanopsis fissa* – were also chosen for their natural regeneration capacity as well as site suitability. In the coastal sites, specific exotic species such as *Casuarina equisetifolia* were chosen for their ability to withstand the harsh conditions. The Greening Guangdong project involved planting large areas with poor site quality, and available exotic species were chosen to green the land rapidly given the limited funds and five-year timeline. The private sector and Joint Afforestation initiatives were all wood production-oriented, primarily pulpwood, and focused on exotic, fast-growing species.

Most projects planned to harvest through clear cutting except for the Coastal project, which planned selective cutting; one Greening Guangdong case which planned a combination of selective and clearfelling; and the State Forest Farm, which planned to use some selective cutting for soil and water conservation purposes. Two City landscape projects had no planned harvests, being purely for ecological purposes. Revegetation methods planned for the second and subsequent rotations were largely to replant the sites with the same species, except for *Eucalyptus urophylla*, *Albizia falcataria* and some fir which would be coppiced. Some natural regeneration was specified on three sites.

7. Lessons learned

7.1 Success

Guangdong Province in Southern China has successfully rehabilitated a large portion of its degraded forest lands as defined, reducing the area from 7.67 million ha in 1949 to 1.19 million ha in 2003. However, successful rehabilitation does not necessarily mean an increase in ecological integrity of the land (See Section 7.3.2 on environmental outcomes). Most of the decrease in degraded forest land was achieved from 1985-93 through a single large program, “Rehabilitating degraded forest land in five years and greening Guangdong in 10 years”, initiated

by the provincial government in response to a Central Government edict to green the country. Prior to that project and subsequently as well, numerous other initiatives on a smaller scale have been undertaken. Earlier efforts were undertaken primarily by the state and collective forest farms and forestry bureaus in response to numerous edicts and/or supportive policies issued in this regard by the Central or provincial government. Efforts in Guangdong from the mid-1980s include targeted, top-down government projects such as the above-mentioned Greening Guangdong project, the National Afforestation Project, the National Coastal Protective Forest System Development Project and City Landscape Forest Rehabilitation Projects. Additionally, timber plantations on degraded forest lands by the private sector emerged with favourable policy incentives and burgeoning markets for commercial forestry development. The province has thus been generally successful in achieving targeted planting, survival and increased forest cover in the short-medium term; as well as attracting and sustaining interest in forest rehabilitation by different actors.

Factors contributing to this general success:

7.1.1 Public sector projects

1. Political support for rehabilitation and for specific projects with many edicts, regulations and guidelines to government agencies and state and collective forest farms since the 1950s. These edicts related to rehabilitation tasks to be accomplished, quality standards, forest protection and management, classification into “ecological” and “commercial” forests, and timber production among others.
2. A working forestry administration at different levels with targeted management and responsibility systems for fulfilment of the project tasks, which provide criteria for performance evaluation. Good supervision, inspection, and reward-and-punishment systems linked to wages and political positions served as major incentives in the Greening Guangdong project.
3. Effective leadership, organisation and project management at each administrative level. Setting up a leading group and specific project office for the Greening Guangdong project within the forestry administrative authorities in each county and city helped to assign clear responsibility for project organisation, implementation and inspection. Similarly for the National Afforestation and City landscape projects.
4. Well-designed and planned schemes in all projects. Implementing units were to submit project plans, design specifications and annual operative flow charts.
5. Establishment of demonstration sites for *afforestation* by the administrative authorities in each county to guide and lead the work in the Greening Guangdong project.

6. Large mobilisation and propaganda efforts via the public media and conferences helped to increase awareness and participation of farmers and communities in all projects, and also of government authorities in the Greening Guangdong and Coastal projects. Both good and bad examples and experiences were reported by the media with due praise or criticism in the Greening Guangdong project. To a lesser extent, awareness campaigns were conducted in private sector initiatives too.
7. Numerous revegetation methods used to fulfil the tasks. Planting was the dominant method but was combined with natural regeneration in all government projects, and aerial seeding in the two larger projects, Greening Guangdong and Coastal. Many trials and substantial experience with aerial seeding helped in successfully applying this strategy.
8. Promoting the use of LPG and other fuels instead of fuelwood in the Greening Guangdong and City landscape projects. This took some pressure off the rehabilitated areas.
9. In general funding available through loans or from local government sources has enabled all sites to meet targets. Funds were raised through innovative mechanisms from several different channels in the Greening Guangdong and Coastal projects.

7.1.2 Private sector projects

1. Grant of tenure to households and longer-term stabilisation of tenure rights ultimately helped to support rehabilitation efforts after a small increase in degradation. Households and communities were then able to benefit from growing trees for timber or non-timber forest products and environmental service payments depending on the land classification.
2. Flexibility for tenure holders to transfer, lease or contract their land holdings led to numerous other actors being involved (most notably the private sector) and outside capital becoming available for rehabilitation. It also led to diverse and effective institutional arrangements such as jointly-managed or *stock-shared* forest farms. These collaborative efforts provide promising models, whereby skills and assets of different stakeholders can be combined for mutual benefit.
3. Resolution of land tenure and benefit-sharing disputes on project sites, and clarified tenure.
4. Improved open wood markets led to higher economic returns from tree growing and raised public interest in rehabilitating degraded forest lands. Most, though not all, sample sites indicated good market prospects.
5. Supportive policies issued by the Central or provincial government for private sector involvement such as priority rights for obtaining logging permits and quotas, credit assistance, decreased taxes and fees, and establishment of demonstration sites.

7.1.3 Across sectors

1. Favourable site conditions for tree growth including *economic plantations* (non-wood products such as fruits and spices for cash income) in most areas, except the exposed coastal areas.
2. Rapid economic growth, urbanisation and infrastructure development leading to improved markets for forest products from the rehabilitated areas, availability of prosperous city funds for rehabilitation and environmental service payments, and reduced local dependence on forests with improved incomes in the urban areas. Rozelle *et al.* (2003) also note that economic growth had a positive effect on forest cover in parts of China. However, increased forest product demand in China has had negative impacts on forests in the Asia Pacific Region (Katsigris *et al.* 2004, White *et al.* 2006).
3. Targeted benefits for communities in all projects such as timber, fruits and other products, rental payments, profit-sharing and economic compensation payments. *Economic plantations* (non-timber products) and profit-sharing are the most promising incentives, the former partly due to non-timber products having lower tax and harvesting restrictions when compared to timber products.
4. Clear legal contracts between the stakeholders and arrangements for sharing rights, responsibilities, costs and benefits.
5. Inclusion of monitoring and evaluation arrangements on all projects (local forestry bureaus, expert teams, or provincial institutes). Inspection and evaluation by specialist teams for each stage in the *afforestation* process helped to ensure quality in the National Afforestation and City landscape projects.
6. Provision of technical assistance from the local forestry bureaus and research institutes to people implementing the projects on the ground. Free supply or availability of technical assistance for *afforestation* by the private sector. Inviting experts from research institutes as technical consultants for project design, training and guidance enhanced the technical viability in the National Afforestation and City landscape projects.

7.2 Sustainability

Assessment of 22 individual cases also suggests that the efforts since the 1980s have been quite successful in terms of target planting, survival and increased forest cover in the short-medium term. But how about the long-term sustainability of the *afforestation* efforts? In general, forest cover was maintained on much of the sites in the long-term, though of varying quality and ecological functionality. However, some project sites have been the target of repeated rehabilitation attempts, suggesting that some initiatives lacked long-term sustainability. Projects not only attempted to rehabilitate open lands but also degraded plantations arising from earlier unsuccessful rehabilitation efforts. The long-term sustainability problems

and issues that Guangdong forestry faces can be divided into three aspects: a) technical, b) socio-economic, and c) long-term management and financing.

7.2.1 Technical

Roughly half the 17 cases with sufficient time to allow assessment had some loss and degradation problems in the longer term due to poor growth, pests and disease, frost or fire damage. Storm and typhoon damage affected some coastal sites. In the overall Greening Guangdong and National Afforestation projects, 13 percent and 27 percent respectively of the afforested areas were degraded in the long-term. City landscape sites were doing quite well in terms of long-term growth and forest quality.

Factors leading to technical sustainability or lack of it include:

- Limited species-site matching, particularly of exotic species, and the establishment of vast monoculture landscapes of pine, *Eucalyptus* and Chinese fir with uniform stand structures that led to poor growth and yield as well as increased risk of pests, disease and fires on some sites. This is particularly so in the past rehabilitation activities by collective and state forest farms, the Greening Guangdong and National Afforestation projects.
- Using superior certified seeds and seedlings helped to ensure forest stand quality, while low quality seedlings resulted in poor growth in the National Afforestation Project.
- Mono-specific and single-strata forest stands were also partially blamed for past site degradation in the coastal areas. In the recent Coastal project, natural regeneration was allowed for and species were chosen for their suitability to site conditions and their ability to resist and contain wind and sandstorms. Only selective cutting was permitted.
- Private sector and Joint Afforestation initiatives had mostly exotic species monocultures, despite risks associated with site suitability and pest and disease susceptibility. One company site had concerns that site productivity may degrade over time with continuous rotations of pure *Eucalyptus*.
- City landscape sites did well in terms of long-term growth and forest quality because they planted a mixture of species (much of them native) to specifically create improved forest diversity, structure and function. Species choice was matched to site conditions, the ecological functionality required and local needs.
- Using a bidding system and contracting the *afforestation* task of the project to a qualified agency ensured quality standards in City landscape and Coastal sites.

The technologies chosen did not specifically match with site conditions in most samples, except for the Coastal and City landscape sites.

7.2.2 Socio-economic

Logging, fuelwood collection, grazing and other unauthorised human disturbances were reduced on most sites except for some private sector sites where people took wood. There was insufficient local community support for some private sector efforts, and on some coastal project sites that were established purely for environmental purposes.

Factors reducing unauthorised logging and other human disturbances on most sites:

- Good patrol and protection measures and agreements with local people for protection.
- Longer-term stabilisation of tenure rights, and diverse and effective institutional arrangements with clear contracts allowing households and communities to derive economic benefits from rehabilitation.
- Targeted benefits for communities in all projects – timber, fruits and other products, rental payments, profit-sharing, and economic compensation for *ecological forests*. *Economic plantations* and profit-sharing are promising incentives.
- Education and awareness campaigns for farmers and communities.
- Reduced dependence on forests for subsistence with increased income and substitution of fuelwood with LPG, mainly in the urban areas.

Insufficient local community support and unauthorised logging on a few sites was due to lack of site protection, and failure to provide adequate benefits to the community and ensure their involvement and stake in protecting the resources. The specific private sector cases facing the problem did not offer any additional benefits except rent for the land leased and they did not have specific patrol or protection of their sites. Economic compensation for *ecological forests* was inadequate. It did not provide sufficient returns to people for their substantial investment in funds and labour and the income lost from the land.

Local community participation in decision-making was very low in all government projects/cases, where communities had to undertake the projects on their allocated lands. Private sector and small local Joint Afforestation initiatives were more participatory.

7.2.3 Long-term management and financing

With low state investment and short project durations, there was a lack of focus on and funds for long-term management of the areas afforested in the four government projects (Greening Guangdong, National Afforestation, Coastal and City landscape). This lapse contributed to degradation in the long term in at least the first three cases. The rehabilitation edicts had to be executed at lower levels

by officials raising their own funds and the focus was only on achieving planting targets. Little attention was paid to regeneration after logging of the timber or after fires. In some areas governance was also relaxed with respect to enforcing logging quotas and guidelines, and preventing illegal logging and occupation.

Recent efforts initiated and implemented by landholders such as the private sector, collectives and state forest farms individually or jointly with other actors had long-term management plans. This was because of their investment in the land over a long-term lease or contract period, and expected benefits accruing over that time.

Long-term financial viability through reinvestment in production forests was constrained in seven of the 18 cases with timber production objectives. In six cases across actors, heavy timber taxes and fees led to low investment returns. In two government project cases, market prospects were low but elsewhere, prospects were favourable. Low growth and yield on one site also led to lower potential returns. The State Forest Farm had an *ecological forest* section where economic compensation payments did not meet the management costs. The long-term sustainability of paying economic compensation for *ecological forests* even at the current rate is open to question but more assured in richer cities and areas.

7.3 Meeting other planned objectives

7.3.1 Production and marketing

Of the five sample sites with mature trees for timber, a private company site and the State Forest Farm had harvested the trees, while the three government project sites had not. Deng¹ (2003) indicates that the private sector had already generated substantial income from timber and forest products by 2001. This can be expected to increase. Good market prospects and marketing plans led to good production outcomes for the private sector initiatives. The government project sites do not appear to have timber marketing plans although market prospects were good. The farmer households and communities involved in these projects need timber production and marketing support systems. However, the government project sites with fruit tree and other *economic plantations* were contributing substantially to income for local communities given shorter time to production, no harvesting restrictions, few taxes and high returns.

7.3.2 Environmental outcomes

Most sites and initiatives appear to have fulfilled their *afforestation* objectives. The managers of the four government projects and the State Forest Farm expressed the belief that they had fulfilled other environmental objectives with plantation establishment, i.e. improving the environment, protecting watersheds, controlling

runoff and soil erosion, and protecting the coastal area from sandstorms and typhoons. However, specific environmental benefits were not measured. Further ground level analysis would be required to verify any such outcomes. This analysis is particularly important given that concerns over soil erosion, frequent droughts and floods continue to be major factors driving rehabilitation.

Also the Government pays economic compensation to landholders of *ecological forests* for environmental benefits though such benefits remain unquantified (Qu 2002). Increased forest cover with greening of barren or grasslands does not necessarily mean an increase in ecological integrity of the land, since there has been no meaningful measurement of biodiversity, ecosystem function, or ecological resilience of the plantations. The logging ban in the *ecological forests* could augment natural regeneration and thereafter biodiversity. In general, scientific evidence is needed to make the term *ecological forest* appear more meaningful.

7.3.3 Livelihood outcomes

Communities were the targeted beneficiaries on all sample sites. Project managers said that local income had increased everywhere, although they related this largely to overall economic development. However, communities strongly depended on the forest lands for their income on 12 sites and for subsistence on eight sites, suggesting that the rehabilitation projects contributed to higher incomes in part at least. The reasons for high dependence included the availability of forest products (particularly fruits and other non-timber products) from the rehabilitated areas for their use and sale, rental payments from the private sector and profit-sharing arrangements on some sites. The high subsistence use on just three private sector sites reflected poor on-site protection. The livelihood outcomes on the *ecological forest* sites of the Coastal project appear unsatisfactory, with economic compensation payments not balancing the investment made and the income lost from the land.

The information above on livelihood outcomes is indicative, but community perspectives on socio-economic impacts may vary from those of the project managers. Community surveys would be required to clearly establish whether the targeted beneficiaries received the expected benefits, whether it was adequate, and what the socio-economic impacts of the different initiatives were.

8. Conclusions

To implement any future plans, successful approaches and incentives identified from past rehabilitation experiences such as demonstration sites, the bidding system, joint ventures and incorporating *economic plantations* could be adopted and utilised. Furthermore, the quality and long-term sustainability of public and

private rehabilitation efforts for both production and environmental objectives needs to improve. This is the main challenge in Guangdong besides determining whether the projects are meeting the desired environmental and socio-economic objectives. Given that many projects are driven by environmental concerns, and forest development has been identified as the poverty alleviation strategy in the mountain region, it is important to ensure that rehabilitation efforts actually meet these goals. Recommendations based on the lessons learned from the Guangdong study are provided in Chapter V along with insights obtained from the national review in Chapter II.

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Annex 1. Listing of 22 sample sites.

Abbreviation	Name	Location	Main funding source	Time period
National Afforestation	National Afforestation Project	1. Shixing county	World Bank	Jan 91-Dec 94
		2. Wengyuan county		Sep 90-Jul 96
		3. Yangchun city		Sep 90-Jul 96
Greening Guangdong	Rehabilitating degraded forest land in five years & greening Guangdong in 10 years	1. Luoding city	Local governments	Oct 85-Oct 92
		2. Xinhui city		Jan 86-Dec 88
		3. Yunan county		Jan 86-Dec 92
Coastal	Coastal protective forest system construction project	1. Yangxi county	National & local governments	Feb 01-Sep 07
		2. Dianbai county	National, provincial, local governments	Jan 96-Dec 05
		3. Huidong county	Provincial & local governments	Jan 00-Dec 01
City landscape	Forest landscape rehabilitation project for Changjiang tourist zone and first course of hills along three lines of roads	1. Zhongshan city	Local governments	Apr 99-Dec 08
	Afforestation of degraded forest land in Shaoguan city	2. Shaoguan city		Jan 02-Dec 04
	Ecological landscape forest project in Baoan district, Shenzhen special economic zone	3. Baoan district, Shenzhen city		Jan 01-Dec 03
	Rehabilitation project of degraded forest land surrounding 10 entrances to and exits from Guangzhou	4. Guangzhou city		Jan 91-Aug 93
State Forest Farm	Afforesting degraded forest land in Xijiang State Forest Farm	Hilly area along Xijiang watershed from FengKei county of ZhaoQing city to Shanshui county of Foshan city, eight counties	National government	Jan 54-present

Abbreviation	Name	Location	Main funding source	Time period
Private company	Fast-growing short-rotation Eucalyptus plantation investment project	1. Gaoyao city	Private companies	1996-2044
	Fast-growing and high-yielding industrial plantation base project	2. Meizhou city		Oct 97-Oct 46
	Rehabilitation of a barren hill as a teak plantation demonstration base	3. Dongjing tea plantation of Jiedong county, Jieyang city		May 99-Apr 44
Private individual	Reforestation projects on degraded forest lands (Leases to private individuals)	1. Liuhe village, Cangcheng town, Kaiping city	Individual investors	Jan 03-Dec 32
		2. Nanlian village, Xiangang town, Cangcheng county, Kaiping city		Jan 03-Jan 38
		3. Hekou county, Yuncheng District, Yunfu city		Jan 03-Jan 33
Joint Afforestation	Joint afforestation projects on degraded forest lands	1. Sanguishan in Hulong village, Chikan town, Kaiping city	State forest farm	Jan 00-Dec 29
		2. Area around Shuixing Reservoir in Xiadong village, Xiangang town, Kaiping city		Jan 02-Dec 31

Annex 2. Policies and regulations that influenced forest land degradation and rehabilitation since the 1950s.

Year	Relevant policies	Effect	By which actor
1950	'Forestry working guideline and operational outline at the county level for Guangdong Province' (draft) — Pay high attention to <i>afforestation</i> , prevent forest fire and illegal logging	Promoted rehabilitation	County governments, forestry administration and public
1954-1958	Agricultural cooperative movement and then the People's Commune Movement transferred individually-managed forest land to Cooperative Communes	Frequent tenure change and tenure conflicts led to severe deforestation in some areas	Communities, local farmers
1958	Central Government directive to undertake large-scale <i>afforestation</i> throughout the country — mobilise the public, develop existing state forest farms, and increase and establish new forest farms for <i>afforesting</i> barren hills	To promote rehabilitation but see 'Great Leap Forward movement' below.	General public, forest farms
1958-61	'The Great Leap Forward movement' —focused on rapid industrial development and iron and steel production in China	Promoted degradation	Government & people
1961	Policies to confirm forest tenure, protect forests and develop forestry issued by the Central Government	Promoted rehabilitation in the regions executed	Local government
1962	Guangdong's policy to establish timber forest plantations and grant cash and grain support	Promoted rehabilitation	Forestry department, local governments, forest farms
1963	Guangdong Communist Party Committee's directive to actively develop state farms	Promoted rehabilitation	Forestry bureaus and state forest farms
1965	Guangdong Government's revised forestry policy to 'closely combine planting, tending and management' with the main focus on <i>afforestation</i> in collectives, supplemented by <i>afforestation</i> in state-owned and cooperative forest farms	Promoted rehabilitation	Forestry bureaus, state and cooperative forest farms
1966-76	Cultural revolution nationwide. During this period, the policies formulated could not be effectively implemented	Promoted degradation	All — period of anarchy

Year	Relevant policies	Effect	By which actor
1981	<p>Central Communist Party Committee and State Council resolutions on 'various problems related to forest protection and forestry development'</p> <p>Guangdong's Government and Communist Party Committee's resolutions to 'stabilise land and forest ownership and implement the forestry production responsibility system'.</p> <p>Commonly called the Three Fix Policy</p>	Generally promoted rehabilitation	Government and forestry authorities at all levels, and all forest land holders (State and collective forest farms, and households)
1982	'Detailed rules for implementation of civil compulsory tree planting' in Guangdong	Promoted rehabilitation	Civil society
1984	Central Government directive to 'green the motherland with high attention and effective implementation'	Promoted rehabilitation strongly	All actors
1984	Guangdong Government's report on relaxing restrictions to ease some policy problems	Promoted rehabilitation	Forestry authorities, State and collective forest farms, and farmers
1984	<p>State Forest Law (1984)</p> <p>Detailed rules for implementation of the State Forest Law (1986)</p> <p>Revised Forest Law of P.R.China (1998)</p> <p>Regulations for implementation of the State Forest Law (2000)</p>	Promoted rehabilitation and protected forests from illegal logging	Civil society
1984	<p>Regulations to speed up economic development in mountainous areas by Guangdong's Government and Communist Party Committee — to promote forestry and alleviate poverty</p> <p>Supplementary regulations (1985)</p>	Promoted rehabilitation strongly	Administrative authorities, farmers, communities, collective and state forest farms, state and foreign enterprises, agricultural banks

Year	Relevant policies	Effect	By which actor
1985	'Resolution to speed up <i>afforestation</i> and greening of Guangdong Province as soon as possible' (Synonymous with the decision to 'rehabilitate degraded forest lands in five years and green Guangdong in 10 years')	Promoted rehabilitation strongly	The party committee and government at all levels, enterprises, communities, forest farms, farmers, and all people in the province
1985	'Temporary regulation on annual forest logging quota management' by the State Forestry Administration. 'Temporary regulation on forest logging quota management' in Guangdong by the Guangdong Forestry Bureau. 'Operative criteria (draft) for forest logging quota management' in Guangdong (1992)	Prevented degradation	All forestry administrative authorities, forest farms and forest management units
1986	'Detailed rules for administration of Guangdong's forest and wildlife nature reserves' Amended in 1997	Promoted rehabilitation and protection	Forestry and nature reserve authorities, local farmers
1987	'Methods for forest administration in Guangdong Province' To promote <i>afforestation</i> and greening of degraded forestland, and regeneration of logged-over land	Promoted rehabilitation	Provincial and city forestry administrative authorities, and assigned individuals in the local county and town governments
1988	Guangdong's decision on 'fulfilling greening standards, monitoring and evaluation, awards and punitive measures'	Promoted rehabilitation strongly	City and county administrative authorities and departments, City governments, Provincial Greening Committee, Guangdong Forestry Bureau
1990	State Council's 'Planning compendium for nationwide <i>afforestation</i> and greening from 1989-2000'	Promoted rehabilitation strongly	Provincial governments

Year	Relevant policies	Effect	By which actor
1991	'Directive to continuously make strong efforts for five years to fulfil planned targets for the Greening Guangdong project' — Adopting targeted management and responsibility system	Promoted rehabilitation strongly	The party committee & government at all levels, enterprises, communities, forest farms, farmers, and all people in the province
1991	' <i>Afforestation</i> , monitoring and evaluation measures for coastal protective forest system development project'(temporary) by the Guangdong Forestry Bureau ' <i>Afforestation</i> , monitoring and evaluation measures for coastal protective forest system development project' issued in 1995.	Promoted rehabilitation of coastal protective forests	All levels of forestry administration, greening committees
1992	Directive to 'Inform staff at lower levels about forest development targets and establish a responsibility system for leaders' in Guangdong	Promoted rehabilitation strongly	Chiefs at all levels of government, Guangdong Forestry Bureau, greening committees, forest farms
1994	Directive to 'Consolidate the greening achievements and speed up modernisation of forestry practices' by Guangdong's Government and Communist Party Committee	Promoted rehabilitation	Government and party committee at all levels, forestry authorities
1994	'Notice to further boost and accelerate <i>afforestation</i> and greening of degraded land' by the Central Greening Committee and the State Forestry Administration Notice on 'the notice' by the Greening Committee and Forestry Bureau of Guangdong province	Promoted rehabilitation	City and county forestry bureaus, greening committees
1994	'Planning compendium on <i>ecological forest</i> system development in Guangdong' – To develop protective forests in the watershed area of four rivers	Promoted rehabilitation	Government at all levels and forestry authorities

Year	Relevant policies	Effect	By which actor
1994	'Guangdong Province Forest Protection Regulation'— classification and management of forests as "commercial" or "ecological", with a logging ban on <i>ecological forests</i>	Promoted rehabilitation & strengthened forest protection	Government at all levels, forestry authorities, forest farms, farmers, local communities
1995	'Measures for monitoring and evaluating the fulfilment of forest resource protection and development responsibilities' in Guangdong. 'Detailed criteria for monitoring and evaluating fulfilment of responsibilities' in Guangdong.	Promoted rehabilitation	Government at all levels, chiefs of administrative authorities, Guangdong Forestry Bureau, Guangdong Greening Committee
1996	Notice to 'speed up city forestry planning and development' by the Guangdong government	Promoted rehabilitation	City, county and township governments
1997	'Administrative methods and measures for <i>afforestation</i> projects invested in by foreign businessmen and companies' in Guangdong — Provision of preferential policies to promote investment in the forestry industry	Promoted rehabilitation	Foreign businessmen and companies
1997	'Notice on further strengthening the governance of forest resources in Guangdong, and strictly forbidding illegal logging and denudation'	Promoted protection of rehabilitated areas and prevented degradation	All forestry authorities in Guangdong
1998	'Decision on organising the second forestry initiative to speed up forestry industrialisation and build high-quality <i>ecological forests</i> ' in Guangdong	Promoted rehabilitation	Government and forestry authorities at all levels, forest farmers, communities, collective and state forest farms, state enterprises
1999	'Administrative methods for <i>ecological forests</i> and its economic compensation measures' in Guangdong	Promoted rehabilitation	Government and forestry authorities at all levels
1999	'Decision on developing individual and private economy' in Guangdong province — to encourage the private and civil society to develop commercial forests	Promoted rehabilitation	Local individuals and civil society

Year	Relevant policies	Effect	By which actor
2000	'Decision to strengthen <i>afforestation</i> and greening achievements, and enhance forestry's three benefits (economic, social and ecological benefits)' by the Guangdong Government — Provision of some preferential policies to the non-public sector to speed up rehabilitation and develop commercial plantations	Promoted rehabilitation	All actors
2000	Guangdong government's clarification and recertification of forest and forest land tenure	To clarify tenure, reduce conflict and promote investment in rehabilitation	All levels of government, forestry authorities, local farmers, communities, collective forest farms, civil society, enterprises
2001	'Suggestion for developing and supporting forestry lead enterprises' at the provincial level	To motivate local forest farmers to participate in joint <i>afforestation</i> efforts with companies	All administrative authorities, lead enterprises, local farmers
2001	'Advice on accelerating <i>afforestation</i> and greening of degraded forest land in Guangdong' — emphasised the responsibility system and related forestry policies	Promoted rehabilitation	All levels of government and forestry administrative authorities, farm households, foreign enterprises, private sector
2002	'The decision on accelerating the development of mountainous areas in Guangdong' by the Guangdong Government and Communist Party Committee	Promoted rehabilitation by developing the local economy and establishing <i>ecological forests</i>	All actors
2002	'Approaches to certify qualified <i>afforestation</i> teams for project design, implementation and inspection' in Guangdong	Enhanced <i>afforestation</i> quality	Forestry authorities at all levels and state forest farms attached to Guangdong Province, <i>afforestation</i> teams
2003	Approved 'Scheme for creating forestry <i>ecological counties</i> in Guangdong' Aims to improve environmental quality and green degraded lands through eight <i>ecological</i> projects	Promoted rehabilitation	All administrative authorities (city, county)
2003	Central Government's 'Decision on speeding up forestry development'	Promoted rehabilitation strongly	All actors

Annex 3. Trees species planted by the sample rehabilitation initiatives.

Species	Exotic/ Native	Timber rotation	Rehabilitation initiatives								Total
			NAP	GG	Coast	City	SFF	PC	PI	JA	
<i>Eucalyptus urophylla</i>	Exotic	5-7	1	1				2	3		7
Masson pine (<i>Pinus massoniana</i>)	Native	18-30	3	2			1				6
Chinese fir (<i>Cunninghamia lanceolata</i>)	Native	15-30	3	1			1				5
Slash pine (<i>Pinus elliotii</i>)	Exotic	12-20		1	1			1		2	5
<i>Acacia</i> spp.	Exotic	5-8		1	1			2			4
<i>Acacia auriculiformis</i>	Exotic	10-15			2						2
<i>Acacia confuse</i>	Native	10-15			2						2
<i>Acacia mangium</i>	Exotic	6-8				1				1	2
<i>Schima superba</i>	Native	7-15				3	1				4
<i>Castanopsis hystrix</i>	Native	15-20				3					3
<i>Casuarina equisetifolia</i>	Exotic	10-15			3						3
<i>Albizia falcataria</i>	Exotic	12	1						1		2
Teak (<i>Tectona grandis</i>)	Exotic	20-25						1	1		2
<i>Castanopsis fissa</i>	Native	7-15				1		1			2
<i>Elaeocarpus sylvestris</i>	Native	10-15				2					2
<i>Schima wallichii</i>	Native					1					1
<i>Lysidice rhodostegia</i>	Native					1					1
<i>Ormosia pinnata</i>	Native					1					1
<i>Taxodium distichum</i>	Exotic			1							1
<i>Pinus caribaea</i>	Exotic	15-25		1							1
<i>Pinus taeda</i>	Exotic	20-25						1			1
<i>Acacia crassicaarpa</i>	Exotic	5-7						1			1
<i>Mytilaria laosensis</i>	Native	20						1			1
<i>Betula alnoides</i>	Native	20-30							1		1
Other broadleaved trees (some fruit trees)	Native	30		1			1				2
Fruit trees (<i>Dimocarpus longan</i> , <i>Litchi chinensis</i> , <i>Camarium alba</i>)	Native					2					2
Total samples			3	3	3	4	1	3	3	2	

NAP – National Afforestation, GG – Greening Guangdong, Coast – Coastal, City – City landscape, SFF – State Forest Farm, PC – Private company, PI – Private individual, JA – Joint Afforestation

Chapter IV

Stakeholder perspectives on constraints and lessons learned in Guangdong Province

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1. Introduction

A workshop, “Review of forest rehabilitation¹ initiatives in Guangdong: lessons from the past”, was held at the Research Institute of Tropical Forestry (RITF), Chinese Academy of Forestry, Guangzhou, on 27 May 2004. This workshop was conducted by the Center for International Forestry Research (CIFOR), Bogor and RITF as part of a CIFOR regional research project to discover lessons from past successes and failures of forest rehabilitation. It provided a platform for different stakeholders involved in rehabilitating degraded forest lands² in Guangdong to share their experiences and perspectives on key problems and make recommendations to address them.

There were 30 participants representing the Guangdong Forestry Bureau, project implementing agencies, city and county forestry bureaus, state and collective forest farms, forestry departments in townships and villages, private companies, individual investors and forestry research institutes. The participants were divided into three groups according to the types of projects they managed. The first group represented the provincial forestry bureau, a state forest farm, and city and county forestry bureaus covering the National Afforestation Project (1990-96) and the project “Rehabilitating degraded forest land in five years and greening

1 See Chapter I for details on rehabilitation terminology.

2 There is no official term “degraded forest land” in China. We estimated degraded forest land in the larger study as the sum of burnt-over forest areas; logged-over areas; *sparse forest*; and some grass, shrub and barren land identified as suitable for planting trees.

Guangdong in 10 years" (1985-95). The second group represented city, county and district forestry bureaus involved in the Coastal protective forest construction project (1991-2010) and City forest landscape rehabilitation projects from the 1990s. The third group were from private enterprise, local joint management forest farms³ and individual investors.

Presented below are results of the three working group discussions on:

- Key issues and problems and recommendations to promote and sustain rehabilitation.
- The main lessons learnt from past experiences.
- Outputs required by various stakeholders for promoting sustainable forest rehabilitation.

2. Key issues/problems and recommendations

The first group, comprising government agencies involved in past large-scale government projects, reported many technical, financial, institutional and policy/legal problems (Annex 1). Their recommendations were closely linked to the problems listed and were addressed to the provincial government, mainly the provincial forestry bureau. Technical issues included lack of effective measures to deal with pests and diseases, fires, and low use of improved species varieties. Their recommendations included building fire-break forest belts, adjusting tree species and forest structure to reduce flammability, providing incentives for using improved varieties and seedlings, and establishing a regional research institute to address the key problems.

Financial constraints included inadequate funds for *afforestation*⁴ and local forestry staff, and high timber taxes. They recommended that all levels of government increase their financial input into forestry to at least one percent of their budget, and improve their oversight of how funds are allocated. Tenure conflicts had to be resolved, coordination between government departments improved, and effective punitive measures introduced for not fulfilling rehabilitation tasks. A central electronic data management system was recommended. Scant attention was paid to subsequent forest management and tending compared with *afforestation* activities and this needed to be addressed to achieve sustainable rehabilitation.

3 Joint management refers to cooperative efforts between institutions — such as forestry departments with other government departments, state forest farms with village committees, village committees with individuals and foreign enterprises — with sharing of land, techniques, management and benefits.

4 *Afforestation* includes forest establishment through planting trees, aerial seeding or *mountain closure* on barren mountains, barren sandy land, *sparse forests*, burnt-over and logged-over forest areas, and some shrublands and grasslands. It also includes planting trees along roads and rivers, around houses and villages and as shelterbelts in farms. The term "*afforestation*" as used in China includes regreening recently deforested areas.



Group discussions in October 2004 workshop at RITF, Guangzhou. (Photo by Takeshi Toma)

The second group, comprising city, county and district forestry bureaus involved in coastal and city landscape rehabilitation projects, found the technical issues most important in their projects, which were primarily for ecological purposes. Their concerns arose from rehabilitation failures as a result of poor species-site matching; large-scale planting of fast-growing, often exotic species and monocultures unable to cope with poor site conditions or disturbances; severe pest and disease outbreaks; and fires (Annex 2). Their recommendations included compulsory species-site matching; establishing forests with mixed species and structure better able to withstand unfavourable environments; using more native species and improved varieties; establishing forest belts as fire-breaks; and, improving research on valuable native tree species. These recommendations were addressed to the responsible local forestry institutions.

Key issues also included a shortage of *afforestation* funds and land tenure conflicts due to unclear boundaries and scattered fragments of forest land⁵ to be rehabilitated. They believed the government needed to take the initiative in planning, organising and managing rehabilitation initiatives. The protection of already rehabilitated forest had to be strengthened. There were also particular recommendations for

5 “Forest land” includes forests, *sparse forests*, shrub land, young plantations, seedling nurseries, *logged-over and burnt-over* forest areas, and all land suitable for planting trees as designated by the different levels of government.

research institutes such as CIFOR to study specific cases to resolve the constraints they faced, and to hold more workshops to assess experiences and find solutions.

The third group, comprising private enterprise, local joint management forest farms and individual investors, provided an economic perspective of rehabilitation on leased or jointly managed forest lands. Financial issues appeared to be critically important to this group. However, private initiatives⁶ are a recent phenomenon and the projects may not have reached a stage where technical and other issues begin posing major problems. The key financial problems cited were high land rents, high forestry taxes, difficulties in obtaining bank loans, and no natural disaster insurance for forestry investments (Annex 3). They recommended greater financial incentives and further facilitation of private *afforestation* activities.

Besides tenure conflicts, the group also noted pest and disease outbreaks and fires as key problems and made recommendations similar to those of the other groups. Safeguards were needed to protect the legitimate rights and interests of the parties who leased and afforested the land, and to allow more freedom to the managers with regard to logging quotas. Recommendations were mostly addressed to the local and provincial government agencies.

3. Key lessons learned

1. Policy stability is a must to encourage investment in, and long-term management and sustainability of *afforestation* efforts.
2. Government needs to strengthen its administration of rehabilitation activities and provide clear policy guidance.
3. Civil society and all government levels need to be mobilised to rehabilitate degraded forest lands.
4. A targeted management responsibility system for forestry administration at different levels helped to fulfil the project tasks.
5. Raising funds from many sources and through various means needs to be explored.
6. Forestry taxes need to be reduced and greater incentives provided for *afforestation*.
7. The private sector could continue to play a positive role. Related policies and measures need to be improved to encourage further private sector efforts.
8. Successful rehabilitation was achieved by instituting joint management and this is a promising approach.

⁶ Private sector here refers to farmers afforesting and managing their allocated lands, and individual investors and private enterprises afforesting and managing leased or subcontracted forest land for their own income. There is no strict recognised definition and many mixed public-private sector institutional arrangements exist in practice.

9. Tenure clarity and security are critical, and need to be ensured.
10. Site-species matching is a prerequisite for promoting stand growth and maintaining long-term sustainability.
11. Mono-specific plantations largely result in poor-quality stands that are very vulnerable to pest, disease and fire damage. Mixed forests are more resistant.
12. Large-scale *Eucalyptus* plantations established in mountainous areas have shown poor growth and also resulted in land degradation. *Eucalyptus* species are not suitable for *ecological forests*⁷ while native species show good potential.
13. Forest fire prevention and management systems need to be strengthened.
14. Efforts should be intensified to disseminate scientific knowledge and promote its application.
15. Forests and forest lands should be classified according to the main functions they are expected to play: *ecological* or commercial. Appropriate rehabilitation efforts for the two classifications need to be developed.
16. Industrialisation and urbanisation have promoted forestry development and rehabilitation of degraded forest land, and this may be a way forward in many areas.

4. Outputs required by different stakeholders

The different stakeholders listed six main output requirements (Annex 4):

1. Provide simple, practical technical guidebooks
 - For *afforestation*, management, monitoring, and evaluation.
 - For establishing seedling nurseries, fertilising, and preventing and controlling pests and diseases for commonly-used tree species.

To be disseminated to provincial and local governments through meetings and training courses.
2. Set up management systems (compact discs, software, handbooks)
 - For monitoring and managing forest fires.
 - For managing information on *afforestation*/ rehabilitation.
 - For forest resource surveys such as remote sensing techniques.

To be provided to provincial and local governments through workshops and training courses.
3. Supply germplasm and seedlings of superior native species or species with high pest and disease resistance, and a handbook on planting techniques.

⁷ *Ecological forests* or non-commercial forests are for the purpose of maintaining and improving the ecological balance and the environment, conserving biodiversity, and providing non-timber forest products.

To be supplied to local governments, and township and private enterprises by research institutes via meetings and training courses.

4. Employ trained forestry personnel in local governments, and trained professionals in township enterprises.
Paper, handbook, training courses, workshops for professionals.
5. Prepare policy document outlining mechanisms/methods for resolving forest land tenure conflicts.
Requested by individual investors.
6. Provide long-standing technical assistance for *afforestation* from the forestry department.
Requested by individual investors.
7. Develop a financial policy through dialogue for supply of *afforestation* funds from government budgets.

5. Summary

The more recently established private and civil sector actors emphasised financial issues, while participants involved in city and coastal ecological rehabilitation projects focused more on the technical problems they already faced. The larger government projects considered an array of issues across the spectrum.

The five overarching problems indicated by all stakeholder groups are:

- a. Pest and disease outbreaks affecting the largely exotic, mono-specific plantation landscape.
- b. Fire problems.
- c. Land tenure conflicts due to unclear boundaries and fragmented forest lands.
- d. Shortage of funds for *afforestation*.
- e. High forestry taxes.

These problems affect the initiation and sustainability of any forest rehabilitation efforts.

The provincial government was called on to provide research and actions to help deal with pests and diseases. Solutions included mixed species forests to reduce vulnerability to pests and fires, using more native species and improved superior varieties to withstand unfavourable environments, and compulsory species-site matching. Clarifying land tenure and settling disputes was a must for sustainable

rehabilitation. Private entrepreneurs and companies in particular demanded their rights and interests be safeguarded, given their efforts to lease and afforest the land.

To improve funding, it was suggested to explore raising money from many sources and through various means. Increasing the financial contribution by all government levels was also recommended, with guaranteed input of no less than one percent of local budgets and improved supervision for how funds are used. Privatisation of rehabilitation initiatives for economic profit is one critical measure, but the private parties called for easier bank loan procurement. There was also a need to reduce forestry taxes, remove the logging quotas, and provide greater economic incentives for *afforestation*. Joint management is another promising approach.

Policy stability is also a must to encourage long-term management and sustainability, as is greater dissemination and use of scientific knowledge. The efforts of all government levels and civil society are required to rehabilitate degraded forest lands, and different sectors could play a role in rehabilitating ecological or commercial forests. Industrialisation and urbanisation have promoted forestry development and rehabilitation of degraded forest land in Guangdong, and this may be a way forward in other similar areas in China.

In terms of outputs, provincial and local governments want practical technical guidebooks and computerised management systems for *afforestation*, fires, and forest resource inventories; and workshops and training courses to enable them to use these tools. Local governments and enterprises seek trained forestry professionals and supplies of superior pest-resistant seedlings, including native species. Individual investors request longstanding technical assistance from the forestry department, and a policy document outlining mechanisms/methods for resolving tenure conflicts. Local government agencies and forestry bureaus would like a policy dialogue to generate and supply *afforestation* funds.

Annex 1. Group 1 key issues and recommendations

No.	Key issues/ problems	Recommendations	To whom?
Technical			
1	Inadequate attention to forest pests and diseases. Lack of specific protection and control measures	Work on preventing and controlling forest pests and diseases	Provincial forest conservation centre and station, forestry bureau
2	Severe forest fires caused by human activities. Underestimating number of forest fires and area burnt due to fear of bearing responsibility	Strictly monitor and regulate fires. Build fire-break forest belts and adjust species and structure to reduce flammability	Provincial government, Forest fires prevention office of provincial forestry bureau
3	Low use of improved varieties	Provide incentives to use improved varieties and seedlings	Provincial government, Provincial forestry bureau, Finance department
4	Need for improved forestry technology	Build regional high-level research institute or branch to address the key problems	Provincial forestry bureau, Provincial department of science and technology
Financial			
1	Shortage of <i>afforestation</i> funds	Increase financial input by all levels of government with no less than 1% of local budgets, and improve the supervision mechanism for using funds	Government at all levels, National People's Congress
2	Insufficient funds for administration and staff salaries in the local forestry departments	Governmental finance department to supply funds for staff expenses at local government level	Provincial government
3	High timber taxation, particularly the forest tending fee and the regeneration fee after logging		
Institutional			
1	Increased land tenure conflicts because of unclear boundaries and scattered forest land fragments	Clarify tenure	
2	Lack of coordination and consistency among forestry departments, municipal authorities and the transportation department with regard to transporting and selling logs from unauthorised felling areas		

No.	Key issues/ problems	Recommendations	To whom?
		Unify information management, download and share electronic version of forms and data	Provincial forestry bureau
Policy/ legal			
1	Little attention paid to forest management and tending compared to <i>afforestation</i>		
2	Inadequate and impractical punitive measures for not fulfilling rehabilitation obligations	Levy a tax for not fulfilling rehabilitation commitments	Provincial forestry bureau, tax bureau
3	The policy of compulsorily regenerating logged-over areas is not implemented well mainly due to funding constraints	Establish a system for generating sufficient regeneration funds and using them specifically to regenerate logged-over forest land	Provincial forestry bureau
		Remove logging quotas for private <i>afforestation</i> and allow forest landowners to make their own management decisions	Provincial forestry bureau
		Reduce and cancel the debts owed by the local forestry departments for bank loans taken out to fulfil the greening ⁸ targets of the 1985-1995 program (trees not reached harvest age but loans are due for payment)	Provincial government
Marketing			
1	Poor marketing of forest products. Insufficient public participation		

⁸ Increasing forest canopy cover to a certain percentage or above, and is expected to result from *afforestation*.

Annex 2. Group 2 key issues and recommendations

No.	Key issues/ problems	Recommendations	To whom?
Technical			
1	Severe pest and disease outbreaks		
2	Severe forest fires	Prevention and better management of forest fires. Establish fire-breaks including natural forest belts	Responsible local forestry agency
3	Little attention paid to improved varieties of native species	Supply improved tree varieties and seedlings, and of native tree species	Forestry research institute
4	Trees planted did not match the local site conditions	Insist on the implementing technicians matching trees with the soil and sites	Department of forest management
5	The Government promoted the planting of fast-growing tree species without adequate site matching, which resulted in economic loss and wasted effort	Government departments stop blindly promoting certain tree species for <i>afforestation</i> without site consideration	Local forestry management department
6	Dominated by monocultures that cannot cope with poor site conditions or disturbances, and result in failures	Expand the establishment of mixed forests that cope better with unfavourable environments	Responsible local forestry institutions
7	Widespread planting of <i>Eucalyptus</i> species resulted in land degradation	<i>Eucalyptus</i> should not be planted in <i>ecological forests</i>	Provincial forestry bureau
8	Little research on native and valuable tree species		
Financial			
1	Shortage of <i>afforestation</i> funds		
Institutional			
1	Rehabilitation affected by increased land tenure conflicts arising from unclear boundaries and scattered fragments of forest land		
2	Need improved planning, organising and management of rehabilitation initiatives	Government to develop a proposal for initiating and organising <i>afforestation</i> , and to play a leading role	Provincial and city forestry bureaus
Policy/ legal			
		Strengthen the protection of coastal shelterbelt forests, and establish related regulations	Provincial forestry bureau
Miscellaneous			
		Hold more workshops like this to sum up the experiences and try to find timely solutions and strategies	CIFOR
		Thoroughly investigate specific projects, and make recommendations to solve problems	RITF, CIFOR

Annex 3. Group 3 key issues and recommendations

No.	Key issues/ problems	Recommendations	To whom?
Technical			
1	Lack of effective methods to prevent and control pest and disease outbreaks	Provide effective methods to prevent and control plant pests and diseases	Forestry research institute
2	Conflict between the slash-and-burn method to prepare land for planting, and the prevention of forest fire	Solve conflicts between burning slash and preventing forest fires	Local forestry bureau
		Provide fertiliser prescriptions for <i>afforestation</i> tree species	Scientific and technical department
Financial			
1	High land rents for private enterprises		
2	High forestry taxation	To reduce forestry taxes and provide greater incentives for <i>afforestation</i>	
3	Difficulties obtaining bank loans	To facilitate loan procurement	Local government
4	Lack of a natural calamity insurance system for forestry investments		
Institutional			
1	Too many conflicts about forest land tenure and forest boundary	To settle land tenure conflicts and disputes	Local government
		Safeguard the legitimate rights and interests of the person who leased and <i>afforested</i> the land	
		Government participation at all levels to rehabilitate the degraded hills	Government at all levels
Policy/ legal			
1	The government has not adequately regulated the fertiliser market to ensure quality	Regulate the fertiliser market to ensure reliability	
		Refine the mechanism for facilitating private <i>afforestation</i> activities	Provincial forestry bureau
		Allow more freedom over logging quota	Provincial forestry bureau, Provincial government

Annex 4. Outputs required by the stakeholders

Agency	Content	Types of products	Style of dissemination
Provincial forestry department	1. Simple technical guidebooks for <i>afforestation</i> , management, monitoring, and evaluation	Pamphlet, guidebook	Mailing, meeting, training course
	2. Application of '3S': Geographic Information System (GIS), Global Positioning System (GPS), and remote sensing technology	Reading materials, handbook	Training course
	3. Information management system for rehabilitation and <i>afforestation</i>	Software or compact discs	Training course
	4. Monitoring and management system for forest fires	Software, handbook	Training course, workshop
Forestry bureau of city, county and district	1. Guidelines for seedling nursery establishment, <i>afforestation</i> , fertilising, prevention and control of pests and diseases for commonly-used tree species	Book, magazine and pamphlet	Mailing, training, provide related information through network platform
	2. Practical techniques for surveying and investigating forest resources, such as remote sensing technique	Compact discs, software	Mailing, training course
	3. Set up information management system for forest rehabilitation	Software and book	Training course
	4. Proposal for local government and forestry bureau (city, county, district) to provide regular funding to carry out <i>afforestation</i> tasks	Setting up a financial policy	Issue document, workshop
	5. Provide germplasm resource of native tree species, and information on planting techniques for the same	Book and handbook	Dissemination by scientific research institute, advertisement, meeting, training
	6. Supervision system for executing rehabilitation-related laws and regulations for different actors	Documents of laws, statutes and regulation	Issue documents
	7. Uniform electronic version of all required forms or sheets for submission by local forestry bureaus to the higher government levels	Put on Web homepage	Download
	8. Enhance the quality and level of forestry personnel in this field	Paper, handbook and report	Training course, workshop
Township enterprise	1. Trained forestry professionals	Training	Training course
	2. Supply tree species with high pest and disease-resistance	Super seedlings	Distributed by scientific research institute
Private enterprise	1. Superior native tree species and their planting techniques	Book	Distribute book

Agency	Content	Types of products	Style of dissemination
Individual investor	1. Forestry department to provide continuing technical assistance for <i>afforestation</i> by individual investors	Policy document	Issue document, training course, workshop
	2. Resolution mechanism and method for solving forest land tenure conflicts	Policy document	Issue document

Chapter V

Conclusions and recommendations

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How have China and in particular Guangdong Province fared in their forest rehabilitation¹ activities and what lessons do they offer for guiding future efforts? Both Guangdong Province and China as a whole have witnessed substantial increases in forest cover² since the 1980s (five and 38 million ha respectively), mostly through rehabilitation of degraded forest land³. But a sizeable proportion of the forests regenerated have poor growth and stocking, and many sites are highly susceptible to pest, disease, frost and fire damage. This is due to limited species-site matching, particularly of exotic species, and the establishment of vast monoculture landscapes of conifers, poplars or *Eucalyptus* with uniform stand structures. Some project sites (particularly the earlier ones) were not maintained or were degraded in the long run and then became the target of repeated rehabilitation attempts. Available mature forest resources for timber production continued to decrease despite an increase in forest cover, since new forests were young and overlogging continued in the mature natural forests till the 1990s.

1 See Chapter I for details on rehabilitation terminology.

2 Forest refers to area with greater than 20 percent (> 30 percent prior to 1996) tree canopy cover, bamboo groves, some shrub lands specially prescribed by the State, farmland shelterbelts, and trees planted around villages, rivers, roads and houses. It includes timber, shelterbelt, fuelwood, *economic* (non-timber products) and special purpose forests.

3 There is no official term “degraded forest land” in China. We estimated degraded forest land in the larger study as the sum of burnt-over forest areas; logged-over areas; *sparse forest*; and some grass, shrub and barren land identified as suitable for planting trees.

The National Afforestation, plain greening and some shelterbelt forest projects report reduced soil erosion and improved protection of farmland as a result of the rehabilitation efforts. Some projects report increased grain yields and positive effects on water availability and flooding. However, others claim that environmental conditions continue to deteriorate and that gains in some areas were offset by losses elsewhere. Plantations with single species, simple structures, and little ground vegetation and litter were not effective in watershed protection and soil conservation in many areas. Also there is concern that site productivity may decline with continuous cultivation of single species such as Chinese fir (*Cunninghamia lanceolata*) and *Eucalyptus urophylla*. There has been very limited scientific monitoring and evaluation of environmental outcomes of rehabilitation initiatives in Guangdong and China as a whole though such objectives continue to drive large public rehabilitation efforts.

In Guangdong, city landscape projects had better long-term growth and forest quality because they planted a mixture of species to improve forest diversity, structure and function and meet local needs. Using a bidding system and contracting the *afforestation*⁴ tasks to qualified agencies ensured quality standards in City landscape and Coastal sites.

Project reports indicate that there were substantial production and livelihood benefits arising from some national programs such as the Three-North shelterbelt, coastal shelterbelt, plain greening and Taihang Mountain greening programs. However, some reports or reviews (for Yangtze River shelterbelt, Three-North shelterbelt, plain greening, desertification control, natural forest protection and sloping land conversion programs) note negative socio-economic impacts as well. People lost their rights to harvest the resources and thus their income source in some areas. Farmers were unsure about the survival and marketability of the species planted through some large programs. In Guangdong, incomes have increased in general with economic development. People also earn income from the regenerated forest products (mainly fruits and other non-timber products), and through rents from land lease and profit-sharing arrangements with private enterprises.

⁴ *Afforestation* includes forest establishment through planting trees, aerial seeding or *mountain closure* on barren mountains, barren sandy land, *sparse forests*, burnt-over and logged-over forest areas, and some shrublands and grasslands. It also includes planting trees along roads and rivers, around houses and villages and as shelterbelts in farms. The term "*afforestation*" as used in China includes greening recently deforested areas.

The farmers and communities require policy support and technical assistance to sustainably produce and market timber. The private sector⁵ including household forest farms in the Three-North region benefited from timber production where restraints such as high taxes and fees and harvesting quotas were absent or removed. China's forest industry and its forest product exports have grown rapidly over the last decade. In *ecological forest*⁶ sites, economic compensation payments⁷ as provided by the governments in Guangdong Province and elsewhere were far below the opportunity costs for use of the land.

In many large government projects, there were problems with long-term maintenance of the rehabilitated areas given no further funds and lack of local participation and stake in the project. Disturbances were reduced on sites where adequate benefits flowed to local people, dependence on forests for subsistence was reduced, and tenure rights were secure.

1. Recommendations for Guangdong

Based on the lessons learned from the Guangdong study, we make the following recommendations to ensure long-term sustainability, positive outcomes and sustained interest in forest rehabilitation. These recommendations cover technical, socio-economic, legal, political, administrative, financial and long-term management aspects. Where recommendations are specifically for public or private sector or for *ecological* or commercial forests, this is indicated.

1.1 Technical aspects

Useful measures that have contributed to successful rehabilitation should be continued. These include demonstration sites, inspection and evaluation systems, and fire prevention and protection measures. Both public and private sector projects, whether for *ecological* or commercial purposes, need to improve or expand in the following areas to ensure the quality and long-term sustainability of rehabilitated forests:

5 Private sector here refers to farmers afforesting and managing their allocated lands, and individual investors and private enterprises afforesting and managing leased or subcontracted forest land for their own income. There is no strict recognised definition and many mixed public-private sector institutional arrangements exist in practice.

6 *Ecological forests* or non-commercial forests are for the purpose of maintaining and improving the ecological balance and the environment, conserving biodiversity, and providing non-timber forest products.

7 The term "Economic Compensation measures or payments" for ecological forests used in China is equivalent to the term "Payment for Environmental (or Ecosystem) Services" used elsewhere.

1. Conduct scientific planning and design

Forestry administrative authorities above the county level should conduct macro-planning in accordance with classified forest management and local site conditions. The project implementers should submit overall design specifications matching the larger plan and an operative flow chart, plus annual specifications and flow charts. These specifications should be the basis for inspection.

2. Ensure species site matching

Choose appropriate species for the site conditions to ensure good growth and yield, and better resistance to frost, pests and other elements.

3. Establish more mixed forests

Establish more mixed forests with multiple layers and species, and include superior native broadleaved tree species to increase the forest's capacity to resist fire, pests and disease. City landscape sites are a good example. This recommendation definitely applies to *ecological forests*, but even commercial forests could aim to establish a few different species with different characteristics to enhance environmental and commercial benefits and minimise risks of pests, fires and site degradation. Natural regeneration could continue to play a large role, particularly in *ecological* projects. In commercial forests, natural regeneration dispersed between single-species stands could act as buffers against pests and fires and help maintain soil fertility.

4. Use superior seeds and robust seedlings

As learnt from the National Afforestation Project conducted in Guangdong, superior planting material should be used with an agency inspecting and certifying the seeds and seedlings for their quality.

5. Use existing scientific knowledge and provide technical assistance

Each step of the rehabilitation process from planning to seedling cultivation, site preparation, forest establishment, tending, and pest and disease control should be based on sound scientific techniques and methods to ensure long-term sustainability and quality. Public sector projects should allocate funds for obtaining such technical guidance from research institutes and experts, and for training project managers and workers. The government should continue to provide technical training and support for the private sector.

6. Assess environmental outcomes

Government sector projects should have plans embedded in the process to scientifically measure and monitor the outcomes of desired environmental objectives from the pre- to post-project period. Some city projects are now conducting such monitoring. More general studies should be undertaken by national or international research institutes to assess environmental conditions and outcomes following rehabilitation by private sector projects.

7. Promote the bidding system

This is primarily for public sector projects and for *ecological* purposes. The

bidding system used successfully to implement and ensure the quality of city and coastal rehabilitation projects in Guangdong could be adopted more widely. Qualified agencies could be chosen through the bidding system. However, with the precaution that since long-term care is left to landholders, they should be adequately involved from the start with benefits accruing to them to ensure their stake in management. Alternatively there could also be bidding contracts for long-term management but this will require ensuring funding for both compensation payments to landholders and management payments to bidding companies on a permanent basis. The feasibility of meeting such costs long-term should be assessed.

1.2 Socio-economic aspects

In Guangdong, collectives or communities are the designated managers of 92.4 percent of the forest land⁸. Hence the socio-economic aspects are critical and it is essential that communities actively participate and have a stake in the rehabilitation process if it is to be sustainable in the long run. Policies should continuously support and refine the factors contributing to successful rehabilitation, such as stable and clear land tenure rights, mechanisms to resolve disputes and flexibility of tenure transfer. All projects should adopt effective institutional arrangements such as joint management⁹ and targeted benefits for communities where possible. To ensure long-term sustainability and positive livelihood outcomes, further improvement in the following areas is recommended:

1. Patrol and protection

Private sector and *ecological forest* sites should have good patrol and protection measures in place and enter into agreements with local people for site protection.

2. Local participation

Obtain local community support and involvement in rehabilitating degraded forest land and protecting the resources in public or private sector projects by

- a. Providing commensurate community benefits such as *economic plantations*¹⁰ in the government and civil sector projects, and joint ventures and profit-sharing in the private sector projects. Economic compensation payments alone for *ecological forests* may be insufficient and the payments too low.

⁸ Forest land is the sum of forest, sparse forest, shrub land, young plantations, seedling nurseries, logged-over and burnt-over forest areas, and all land suitable for planting trees as designated by the different levels of government.

⁹ Joint management refers to cooperative efforts between institutions — such as forestry departments with other government departments, state forest farms with village committees, village committees with individuals and foreign enterprises — with sharing of land, techniques, management and benefits.

¹⁰ Economic plantations or forests are for non-wood products such as fruits, edible oils, beverages, fodder, medicines, spices and industrial materials like rubber for cash income.

It could be combined with fruits and other economic products for the communities where possible.

- b. Actively involving the communities as key participants through the process from decision-making to implementation to obtaining and monitoring benefits to ensure they have a stake in the outcome.
- c. Developing good relations, negotiating and setting out clearly the agreed sharing of costs, benefits, rights and responsibilities in contracts for each initiative.

3. Fuelwood consumption

Efficient fuelwood use as well as alternative energy sources such as gas, wind and solar should be explored and promoted to save forest resources, as in the Greening Guangdong project.

4. Livelihood outcomes

Conduct community surveys to clearly establish whether the targeted beneficiaries received the expected benefits, whether the benefits were adequate, and what the socio-economic impacts were. This could also be a useful monitoring and evaluation tool that could help derive satisfactory livelihood outcomes and support for the project.

5. Production and marketing support

Government agencies (and the private sector maybe through partnerships) should provide timber production and marketing support and more favourable policy incentives for communities rehabilitating degraded forest lands for commercial purposes. Also, adding value and improving markets and marketing of fruits and other non-timber rehabilitation products is recommended.

1.3 Political, legal and administrative aspects

Approaches that have contributed to successful rehabilitation should be widely adopted, such as well-designed and well-planned projects, targeted management and responsibility, penalty and reward systems, effective leadership and management, and communication and awareness building campaigns. Further support or expansion in the following areas is recommended:

1. Policies and political support

Extend strong and responsive political support at provincial and national level to quality, protection and management, and timber production issues in public sector projects; and further incentives for the private sector in commercial and *ecological forests*.

2. Regulations and enforcement

Ensure good post-project follow up by government including enforcement of logging quotas and guidelines.

1.4 Long-term management and financing

Favourable investment policies such as logging permits and quotas, credit assistance and open wood markets issued by Guangdong Province should be maintained and refined to encourage private sector interest and involvement in rehabilitation. To ensure long-term viability and sustainability, the following aspects need to be improved:

1. Long-term management

Ensure focus on long-term management beyond initial plantation establishment in public sector projects to sustain the efforts.

2. Long-term financing

Projects should build in funding mechanisms (including reinvestment from product sales) for long-term management, technical assistance, harvesting and subsequent regeneration. Guangdong's "Forest Protection and Management Regulation" stipulates that "all levels of government should allot funds equal to and not less than 1 percent of their budgets for *afforestation*, forest management and protection, *ecological forest* development, and for forestry science, technology and education". This requirement should be implemented.

3. Timber taxes and fees

Assess and revise timber taxes and fees to ensure financial viability and stimulate investment interest in forestry.

4. Timber production plans

Public sector projects, especially those executed by communities and households, need timber marketing plans and implementation in the long-term.

5. Economic compensation

Assess the viability of the economic compensation incentive and rates to support *ecological forest* rehabilitation and protection. Low rates and lack of guaranteed long-term payments could act as a disincentive to sustainable rehabilitation. Can direct beneficiaries in the public or private sector be identified and part funding be obtained from them? Do the management guidelines and compensation payments actually help achieve the objective of enhancing environmental services?

Guangdong's provincial government has already been working towards addressing some of the problem areas, making the following stipulations in recent years:

- a. The 1998 stipulation to build high-quality *ecological forests* by adjusting the forest composition and structure.
- b. The 2001 stipulation emphasising scientific planning and organising, species-site matching, targeted management responsibility system for rehabilitating

degraded forest land and protecting forests from pests, diseases and fire, and adopting the bidding system in rehabilitation projects.

- c. The 2001 decision to strengthen *afforestation* achievements, and enhance forestry's three benefits (economic, social, and environmental benefits), provided some preferential policies on timber taxes and fees and logging quotas for the private sector.
- d. The 2002 issue of the "Guide to prescribed qualifications for entities and corporations that bid for planning and design, development, supervision and inspection of *afforestation* projects".

More focus and effort is required in the following areas: ensuring active community participation and giving local people a stake in rehabilitation projects; support for communities for timber production and marketing in commercial forests; increased focus on long-term management and financing methods; enforcement of logging guidelines; and measuring and monitoring environmental and social outcomes.

2. General recommendations for China overall

Many of Guangdong's lessons and recommendations to ensure the success and long-term sustainability of its rehabilitation efforts can be adopted for other Chinese provinces as well, with or without modifications. However, some recommendations may only be relevant for areas with similar favourable site and socio-economic conditions. China is a large and diverse country. The poorer remote mountainous areas and arid regions in the west are inhabited by sparse populations of minority ethnic groups. Forests are important in western China for local needs and income, while at the same time there are expectations that these areas should be rehabilitated and conserved for watershed and other environmental services for China as a whole. Much of the western mountain area is currently under a logging ban related to the natural forest protection program and is also the target of the sloping land conversion program (from agriculture to forests).

The eastern region, particularly the coastal region of which Guangdong is a part, is industrially developed and prosperous, has good markets and infrastructure and holds much of the commercial plantation area of China. Within the eastern region, there are remote mountainous sections as well that are less developed and poorer with limited market access. Much of the southern forest region and the northern plains is managed by households, while the natural forest areas of the northeast and southwest are state-managed. Timber supplies from state-managed natural forest regions are declining, while collective and household-managed areas contributed 43% of the national timber production in 2002.

In the past, the central and provincial governments successfully compelled local governments and leaders to meet planned rehabilitation targets through a system of targeted management and responsibility, rewards and penalties. This government-driven system is losing its effectiveness in the new market economy situation but huge national programs continue to call for mobilising substantial financial and human resources to meet targets. The forestry administration is stretched and funding is limited. Also farmers are not required to provide free and obligatory labour for public tasks such as forest rehabilitation any more. In richer developed provinces such as Guangdong, it is easier to develop viable commercial forestry with appropriate incentives and to make some modest payments for environmental services. Poorer remote areas with limited funds and low market access need a different strategy. This diversity in conditions calls for more locally-driven initiatives, leadership and planning to be effective.

Forest rehabilitation and management could possibly contribute to China's western region development plan and help alleviate poverty in that region if local people obtained long-term secure rights over the land and resources as in Guangdong and elsewhere in the south. Also any development initiatives should be participatory and arise from local needs and conditions. With favourable policy incentives and technical, marketing and credit support, local people could rehabilitate forests, derive income from forest products and potentially contribute to environmental services over the long term.

We list below some general recommendations for China as a whole drawing on both the national-level review and the Guangdong study. Where relevant, we point out recommendations that may be more suited for the developed eastern areas and alternatives for poorer remote areas.

1. Promote local initiation, planning and implementation of rehabilitation efforts to ensure their long-term local viability, rather than huge top-down programs. Plans should reflect ground realities and be easily adaptable as required. Lessons from Guangdong and first reviews of the sloping land conversion program indicate that local initiatives tend to be more successful in the long term.
2. Plan the rehabilitation process and choose species and techniques to be used in each case based on the specific objectives to be met (such as reduce soil erosion or produce quality timber), the site and climatic conditions, local needs and marketability in that region. Thus the methods selected would vary for the arid areas, for the mountainous regions, for the eastern plains and coastal areas, and also at a more local scale. They would also differ for watershed protection forests versus timber production or fuelwood forests.

Multiple objectives and needs have to be balanced and may require a considered trade-off.

3. Consider having more mixed forests (species and structure) wherever possible in both private and public sector projects to reduce vulnerability to pests, diseases and fire; reduce market risks and/or meet diverse local livelihood and environmental needs.
4. Scientifically assess the environmental and socio-economic outcomes of the projects to determine whether they are meeting the stated objectives. Focus on quality targets besides the area to be afforested. Use the results of these evaluations to redirect or fine-tune the rehabilitation process.
5. Explore and adopt innovative institutional arrangements as in Guangdong to bring together capital, resources, expertise and diverse interests for mutual benefit. Particularly promising arrangements are joint management or *stock-sharing*¹¹ arrangements where state agencies and/or private enterprises link up with farm households, leading to local stake in protection and management and benefits for all.
6. In richer cities and provinces that can afford to pay and local subsistence needs are low, adopt the bidding system widely used in Guangdong to employ qualified agencies to implement public sector projects for environmental purposes and ensure their quality. Elsewhere, be sensitive to local peoples' needs and consider alternative strategies, such as sustainable forest management for products and environmental services by communities or the private sector with adequate tenure security.
7. Involve local people as key participants in the rehabilitation process from inception to protection to benefit sharing to ensure they have a stake in the outcomes and long-term sustainability of the efforts. Negotiate and set out clearly the agreed sharing of costs, benefits, rights and responsibilities in contracts for each initiative.
8. Ensure adequate short and long-term benefits accrue to local people in the area. Promising approaches from Guangdong include *economic plantations* (fruits and other non-wood products) and profit-sharing in private sector projects. Open quotas, low taxes and good markets for timber can also help

11 Farm households contribute land, and companies contribute funds and establish, manage and harvest the timber plantations in a stock-sharing system. Benefit-sharing arrangements would generally be in the ratio 70:30, company to farm households. Fruits and other non-timber products are often included as additional incentives for farmers.

small-scale farmers directly benefit from timber production as in the Three-North farm forest region.

9. For long-term sustainability and flow of desired benefits, provide and stabilise local tenure rights over the land and the resources as in Guangdong; promote long-term management, income generation and reinvestment plans; and design and enforce appropriate regulations to safeguard the environment while meeting production needs.
10. Explore and promote efficient fuelwood production and management, and alternative energy sources (such as gas, solar and wind energy) as in the Greening Guangdong project.
11. Strengthen local institutions and train professionals to provide technical assistance and production and marketing support to the private sector and farmers involved in forest rehabilitation efforts. Make available superior and diverse planting stock.
12. Leave commercial forestry to the private and civil sectors and market-based mechanisms. Remove existing constraints where they exist, such as high taxes and fees, logging permits and quotas to make commercial forestry viable. Allow investors to manage their resources freely in response to forest conditions and market signals. However, impose some legal safeguards to ensure sustainable management. Consider alternative funding sources for administrative expenses in villages and counties where fees from forestry operations are the main public revenue source.
13. Assess the viability of the economic compensation incentive and the rates to support *ecological forest* rehabilitation and protection, particularly in poorer areas where people depend on forest resources. Explore whether the management guidelines and compensation payments actually help enhance ecological integrity or environmental services. In poorer areas, consider whether sustainable forest management for products and services by tenure-holding farmers could help achieve the same environmental goals while meeting local livelihood needs.



Review of Forest Rehabilitation Lessons from the Past

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Rehabilitation of degraded forest lands has been ongoing in China for centuries. Efforts intensified from the 1980s as forest resources became scarcer and environmental problems worsened. This report presents the main results of a study assessing past and ongoing rehabilitation efforts through a national-level review and more detailed analysis for one province, Guangdong. In Guangdong, a provincial-level review was followed by an analysis of 22 cases and a multi-stakeholder consultative workshop.

The initiatives ranged from large national and provincial government projects to state forest farm efforts, city landscape projects, private sector and joint initiatives. They differed in objectives, costs, implementation strategies, institutional arrangements and incentives offered to local people. The whole country, including Guangdong province has witnessed increased forest cover since the 1980s. But many rehabilitation sites have poor growth and stocking; and are highly susceptible to pests, diseases and fire.

Both positive and negative environmental and socio-economic outcomes have been reported but systematic monitoring and evaluation has been limited. The private sector including household forest farms benefited from timber production where restraints such as high taxes and fees and harvesting quotas were absent or removed. Elsewhere, they found it easier to benefit from fruits and other non-timber products. In ecological forest sites, government compensation payments were far below the opportunity costs for use of the resources.

Many large government projects could not maintain the rehabilitated areas in the long-term given a lack of sustained funding, active local participation and ownership. Locally-driven initiatives sensitive to local needs, site and market conditions tend to be more viable. Adequate benefit flow to local people, secure tenure rights over resources, and mutually-beneficial partnerships and institutional arrangements also help sustainability of the efforts. The report provides key recommendations for the relevant stakeholders to support, plan, implement and sustain forest rehabilitation in Guangdong and China overall.



Review of Forest Rehabilitation Lessons from the Past

This publication is part of a series of six country reports arising from the study “Review of forest rehabilitation - Lessons from the past” conducted by CIFOR and partners simultaneously in Indonesia, Peru, the Philippines, Brazil, Vietnam and China. The content of each report is peer reviewed and published simultaneously on the web in downloadable format (www.cifor.cgiar.org/rehab). Contact publications at cifor@cgiar.org to request a copy.

