China's Ecological Rehabilitation: The Unprecedented Efforts and Dramatic Impacts of Reforestation and Slope Protection in Western China

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In response to the alarming natural disasters China suffered in the late 1990s, the Chinese government has undertaken two of the world's largest ecological rehabilitation projects—the Natural Forest Protection Program and the Slope Land Conversion Program. In addition to presenting the historic perspective and reporting the preliminary impacts of these two programs, this paper discusses the challenges in carrying them out, including the "top-down" administrative mechanism, lack of interagency cooperation and long-term planning, and neglect of appropriate technical practices and market-based approaches. We argue that if properly implemented, these programs could contribute to combating some of the pressing environmental problems in China and the world, such as soil erosion, flooding, climate change, and biodiversity loss. To implement the programs properly, however, major policy and technical changes must be made.

Crisis triggers action. The serious natural disasters that China suffered in 1997 and 1998 have spurred new efforts to protect the country's fragile and fragmented environment. Due to severe droughts in 1997, the lower reaches of the Yellow River dried up for 267 days, putting industrial, agricultural, and residential water uses in the northern plains in great jeopardy (Xu and Cao, 2002). In 1998, massive floods, along the Yangtze River and waterways in the northeast, claimed the lives of over 3,000 people, and led to more than $12 billion in property damages and output losses (Lu et al., 2002). In response, the Chinese government has initiated two major programs—the Natural Forest Protection Program (NFPP) and the Slope Land Conversion Program (SLCP)—to protect and expand its forest and grassland resources throughout the decade. If under SLCP the subsidized grain is priced at 1,400 Yuan/ton, the total investment in the program will amount to about 337 billion Yuan ($40 billion) by 2008 (Xu and Cao, 2001; Tao et al., 2004) making it rank as one of the largest (and most expensive) major environmental programs in the world in terms of government investments and total area covered (The Forest and Grassland Taskforce of China, 2003).

The main objectives of the NFPP are to: (1) protect the existing forests and expand their coverage through artificial planting and natural regeneration, and (2) strengthen ecological restoration and management in all natural forest areas. To achieve these objectives, bans of commercial logging are imposed in the southwest, timber harvests are substantially reduced in the northeast and other regions, and forestation and vegetation activities are proposed. The mission of the SLCP is to convert sloping cropland and degraded rangeland primarily in the upper reaches of the Yellow and Yangtze rivers and other regions of western China back to grass and tree coverage. It is hoped that once the NFPP and SLCP are completed the soil erosion, flooding and desertification problems will be halted, and thus the precarious ecological conditions in China's western regions will significantly improve.

Given the large operating scales, tremendous public investments, and profound environmental implications, these programs have drawn broad attention from academic, environmental, and development circles both domestically and abroad. Nevertheless, a thorough introduction of the two programs and a careful discussion of the related policy issues are still lacking, although some attempts have been made. Indeed, some early works have already appeared in the literature, including *Science* and other prominent journals. Zhang et al. (2000) provided an overview of the NFPP and then debated the policy measures of its implementation with Xu et al. (2000). Loucks et al. (2001) argued that the NFPP and SLCP could strengthen the conservation of pandas in China's forests by enhancing protection and restoration of corridors among remaining forest fragments and increasing habitat preservation.

Zhao and Shao (2002) noted the potential economic and environmental impacts of China's logging restrictions sparked by the NFPP. Lu et al. (2002) also remarked on China's recent forestry programs in the context of sustainable forest management. Additionally, the UN Food and Agriculture Organization (FAO) included China in their study of the impacts and effectiveness of logging bans in natural forests in the Pacific Rim (FAO/APFC, 2001), and Conservation International commissioned the Social Science Academy of Sichuan province to conduct a preliminary study of the NFPP and SLCP (Sheng, 2002).

These and other similar studies have provided useful background information and interesting case descriptions for those concerned with China's forestry and environmental problems. However, their discussions are hardly comprehensive and, in some cases, various aspects of the two programs have not been clearly presented, leading to confusion over the scope of the environmental problems and misconception regarding the actual design and implementation of the programs. For instance, to make their point, Zhang et al. (2000, p. 2135) claimed that from the 1950s to 1995, "natural forest declined to 30% of the total forest area in China." Later, Zhao and Shao (2002, p. 34), who were also coauthors of Zhang et al. (2000), stated that: "As logging of natural forests increased from 20 million cubic meters per year in the 1950s to 63 million cubic meters in the 1990s, natural forest area declined to 30 percent of 1950s levels." It turns out that these two statements are not only inconsistent but also inaccurate. As will be discussed below, China's natural forest declined neither to 30 percent of the total forest area nor to 30 percent of its levels in the 1950s. Also, government and research reports often are inconsistent in their details of the programs, making it hard to understand what actions the Chinese government has really chosen and exactly where and how they will be undertaken.

Furthermore, policy issues associated with the NFPP and SLCP have received only limited attention in previous works. So far, for example, little in the research literature has been said about the heavy reliance on the state to finance the programs, the lack of collaboration between the State Forestry Administration (SFA) and other agencies in implementing them, and the frequent neglect of appropriate technical practices. Also, the tremendous social costs induced by the programs have not been adequately addressed. Thus, the objective of this article is to fill the literature gaps by presenting a careful introduction of the NFPP and SLCP, and addressing some of the major policy concerns with these programs.

Certainly, these programs, if properly implemented, could greatly contribute to both China and the world in combating some of the pressing environmental problems—water runoff, soil erosion, landslide, flooding, and desertification (Du, 2001; Xu and Cao, 2001), as well as climate change and loss of biodiversity (Fang et al., 2001; Loucks et al., 2001). To implement them properly, however, China needs to make major policy and technical changes.

The paper begins with a brief review of the recent history of forest management and land use in China to aid the understanding of why after a series of attempts to protect fragile lands in western China the government decided to adopt both NFPP and SLCP. The second section of the paper introduces the geographic coverage, specific tasks, and project investments for the two programs. Next, the preliminary impacts and the major challenges in implementing the NFPP and SLCP are discussed, followed by some speculation on how the programs should move forward.

Historic Perspective

When the People's Republic of China was established in 1949, the country boasted large tracts of natural forests in the northeast (including Heilongjiang, Jilin, and eastern Inner Mongolia), the southwest (covering Yunnan, western Sichuan, and eastern Tibet) and parts of Xinjiang in the northwest and Hainan in the south. From the late 1950s onward, 136 state-owned forest bureaus were gradually set up in these forest areas to produce timber to fuel the industrialization of the young economy (SFA, 2001). Because of limited financial investments and availability of infrastructure and equipment, however, logging and other operations relied heavily on manpower (CFY, 1987).

Along with this strategy of resource exploitation, the planned economy system created incentives for deforestation. Under this system, the forest bureaus, like other state-owned enterprises, had to provide extensive welfare benefits to their expanding workforce, such as food subsidies, retirement pensions, healthcare, public safety, and children's education and employment (Yin, 1998). Since logging was the major or even single source of revenues, over-cutting became inevitable, while regeneration and management were often ignored.

In addition to economic pressures to over cut forests under their control, the state-owned forestry bureaus lacked the incentives and autonomy to manage and utilize the resources efficiently. Moreover, population expansion and job creation in the forest areas also led to more fuel wood consumption, housing construction, land clearing,

and other problems. Consequently, China's natural forests were depleted rapidly. According to early forest surveys, natural forests amounted to 98.2 million hectares (ha) in 1975, but declined to 66.7 million ha by 1993 (Liu, 2002).[1] Not surprisingly the over cutting also triggered serious forest degradation—the structural deterioration of forest resources was reflected in: (1) reduced per-ha stocking volume, (2) age structure tilted towards younger stands, (3) the changed species composition, (4) poor regeneration, and (5) low growth and yields of plantations (Yin, 1998).

Sadly, the environmental situation in the vast rural society across the country was even worse. The collectivization movement that began in the late 1950s deprived individuals of forest ownership rights, which discouraged people from tree-planting and forest management. While the collectivization of agriculture was still underway, Mao Zedong launched the Great Leap Forward Campaign (1958-1960) in an attempt to rapidly industrialize China's economy. This ill-conceived campaign pushed a significant increase in iron and steel production, which led to an explosion in backyard furnaces, fueled by wood charcoal. Land exploration and reclamation schemes, as part of the national strategy of food self-sufficiency, were also carried out in the 1960s and 1970s. All of these campaigns and rapid development strategies resulted in not only deforestation but also destruction of vegetation (Du, 2001).

In many areas, particular western China, farming on steep slopes became common due to the combined effect of demographic expansion and poor regulation. Coupled with the unfavorable mountainous and hilly landscapes and uneven rainfalls, steep slope farming caused an increase in the scope and intensity of water runoff and soil erosion and a decline in the ecosystem's capacity of regulating water and holding soil. The negative impacts of deforestation and slope farming were determined to be the primary culprit of the record dry up of the Yellow River in 1997 and the widespread flooding in the Yangtze River Basin in 1998. According to official estimates, the

Table 1. Overview of China's Afforestation Programs Since the 1970s [1]

Name of Program	Duration	Coverage	Stated Target	Achievements as of 1999
National Greening Campaign[2]	1987-Present	Has varied over time	Has varied over time	27.9 billion trees planted
"Three Norths" Shelterbelt Program[3]	1978-2050	551 counties in 13 provinces	Afforestation of 35.08 million ha by 2050	25.67 million ha planned
Protective Afforestation along the Upper and Middle Reaches of the Yangtze River	1989-2000	271 counties in 12 provinces	Planting and restoration of 6.75 million ha	4.8 million ha planted
Coastal Shelterbelt Development	1991-2000	195 counties in 11 provinces	Planting of 3.56 million ha	1.08 million ha planted
Cropland Protection and Agro-Foresty in the Plains	1988-2000	918 counties in 26 provinces	Set standard	850 counties reached standard
Taihang Mountain Afforestation	1990-2010	110 counties in 4 provinces	Planting of 4 million ha	3.28 million ha planted
Combating Desertification Campaign	1991-2000	598 counties in 17 provinces	Control desertification in over 7.19 million ha	Desertification controlled in 8 million ha

NOTES:
[1] Table was adopted from Lu et al. (2002).
[2] This campaign is also called the national compulsory tree-planting campaign.
[3] This program also is referred to as the "Green Great Wall."

soil erosion area in the Yangtze and Yellow river basins reached 75 million ha, with sediments of over 2 billion tons (Li, 2001). This situation also has constituted a threat to both the life and effectiveness of the Three Gorges Dam, the Xiaolangdi Dam, and other hydro facilities in the downstream reaches of China's two biggest rivers. Another major environmental crisis in western China has been the uncontrolled grazing and poor maintenance of rangelands, causing extensive loss of grass cover and desertification.

The Chinese government has made efforts to combat the country's growing environmental problems, particularly degradation related to forest ecosystem health. Since 1978, a number of forestry projects have been launched, aimed at safeguarding and generating ecological benefits such as watershed protection, erosion control, stream regulation, and biodiversity maintenance. Major forestry programs have included the: (1) "Three-Norths" Shelterbelt Program, (2) Protective Afforestation Program along the Upper and Middle Reaches of the Yangtze River, (3) Coastal Shelterbelt Development Program, and (4) Cropland Protection Agro-forestry Program in the Plains. Table 1 reports the forestry programs undertaken and achievements made thus far. The geographic coverage of these programs has been extensive and the level of afforestation activity has been significant. Unlike the NFPP and SLCP, however, public direct investments in or indirect subsidies to these programs have been limited, and rigorous implementation has been absent. Sites are poorly selected, seedlings are not properly planted, and saplings are often not well maintained. The historical survival rates have been abysmal, which means these programs have not been as effective as expected.

Similar implementation challenges have faced attempts since the early 1980s to curb farming on steep slopes to conserve water and soil (Xu and Cao, 2001). While various "stick and carrot" measures have been tried, they were by and large piecemeal and incoherent; the central government never mobilized substantial public funds and administrative resources to bring the problem under control. Since rural reforms in the early 1980s, farmers in poor regions have used their greater production freedom to aggressively seek new cropping and grazing lands, often resulting in more ecologically sensitive patches on steeper slopes being claimed and degraded. Yields on these lands have generally remained low and poverty in these regions persisted (Du, 2001).

While in a very different spirit than campaigns created by Mao Zedong, but one with potentially harmful environmental impacts, the Chinese government launched the Great Western Development Program in 1999. Also known as the "Go West" campaign, this program aims to speed up economic development and environmental improvement in western parts of China. The government decided to spend $8.4 billion on four key tasks in western China:[2]

(1) Accelerating infrastructure development, with an emphasis of water resources;
(2) Improving the ecological conditions with a focus on tackling desertification, soil erosion, and worsening floods;
(3) Promoting industrial development; and,
(4) Strengthening science, technology, and education.

Observers believe that this "Go West" strategy signals an attempt not only to begin equalizing economic development between the eastern coast and the inland west, but also to balance economic growth and environmental protection in the west itself (Kynge, 2000; Economy, 2002; Sheng, 2002).

Nonetheless, the successive occurrences of ecological disasters in the late 1990s indicated that while there had been scattered, local-level successes in protecting forest ecosystems, they were overwhelmed by the worsening of the overall situation; more decisive and forceful measures are thus needed to halt the environmental problems. In particular, it became apparent to the central and regional governments that the ecological conditions of the upper reaches of the Yangtze and Yellow river basins are directly related to the economic welfare and ecological security of the middle and lower reaches of these basins. Key in promoting sustainable development in these basins is to control soil erosion and desertification in the upper reaches. It is against this backdrop that the two large programs, the NFPP and SCLP, were launched.

The Natural Forest Protection Program and the Slope Land Conversion Program

In the wake of the 1997 and 1998 ecological disasters, the State Forestry Administration (SFA), charged by the State Council, proposed the Natural Forest Protection Program (NFPP) in 1998 as a large-scale scheme to protect the country's natural forests and to increase afforestation. Specific objectives of the NFPP, as it was initially approved, are to:

- Reduce timber harvests from natural forests from 32 million m^3 in 1997 to 12 million m^3 by 2003;
- Conserve nearly 90 million ha of natural forests; and,

Table 2. The Regional Coverage and Makeup of the Natural Forestry Protection Program[1]

Category	Units	Northeast and Eastern Inner Mongolia	Yangtze River Basin	Yellow River Basin
Provinces	17	5	6	7
Total entities within Provinces	901	137	406	358
National Forest Enterprises	137	86	39	12
Provincial Forest Enterprises	18	16	0	2
Counties	734	23	367	344
County Forest Bureaus	1	1	0	0
County Forest Farms	11	11	0	0

NOTES:
[1] **This Table was adopted from Liu (2002).**

• Afforest and re-vegetate an additional 30.97 million ha by various means (e.g., mountain closure, aerial seeding, and artificial planting) by 2010 (Li, 2001).

China's Remaining Natural Forests

In the national forest inventory completed in 1998, the SFA lowered the criterion for closed forests once again.[3] Based on this new criterion, China's natural forests amount to 106.97 million ha, which is 69.62 percent of the total forest area (SFA, 2000). Of that figure, 55.07 million ha (51.5 percent) is under state ownership, whereas 51.89 million (48.5 percent) is under collective control. In addition to the 100.05 million ha of regular forests, included in the natural forests are 4 million ha of economic forests (cash trees like rubber, chestnut, walnut, mulberry) and 2.9 million ha of bamboo forests. The gross stocking volume of natural forests is 9.073 billion m^3, accounting for 89.96 percent of the nation's total. In terms of age structure, 62.89 percent of the natural forests are immature, partly a reflection of the expansion of naturally regenerated secondary forests.

China's natural forests fall into three categories: (1) forested areas concentrated along upper reaches of the Yangtze, Yellow, and Songhua rivers, and other major waterways; (2) forests already under protection—within 552 nature reserves, 874 forest parks, and parts in eastern Tibet that are inaccessible; and (3) some forests scattered across much of the country (Li, 2001). According to the SFA (2002), the first category forms the catchments for some of China's major hydroelectric and irrigation projects, as well as key navigation and flood control areas, and thus requires immediate protection. Together, these forests constitute 49.58 million ha, or 57 percent of the total natural forests in China. The second and third categories make up 20 million ha (23 percent of the total) and 17.69 million ha (20 percent), respectively.

An Outline of NFPP Tasks

The pilot phase of the NFPP began in 12 provinces and autonomous regions in 1998 and during 1999 and 2000 five more provinces were added. After the pilot phase ended in 2000, the NFPP coverage, which can be divided into four rough geographic areas is as follows:

1) Tibet, Yunnan, Sichuan, Chongqing, Guizhou, Hubei, and Hunan in the upper reaches of the Yangtze River (from the Three-Gorges Dam upward);
2) Gansu, Qinghai, Xinjiang, Ningxia, western Inner Mongolia, Shaanxi, Shanxi, and Henan in the middle and upper reaches of the Yellow River (from the Xiaolangdi Dam upward);
3) Heilongjiang, Jilin and eastern Inner Mongolia in the northeast; and,
4) Hainan Island in the south.

Despite the extensive coverage of the NFPP, China's natural forests and thus their protection remain geographically concentrated in the southwest and northeast. Table 2 lists the operational units of the NFPP in different regions, which reveals that all of the state-owned and most of the province-owned forestry enterprises are involved. Also, the program has incorporated a large number of counties in the Yangtze and Yellow river basins.

The NFPP first mandated that commercial logging would be completely banned by 2000 in the upper reaches of the Yangtze and Yellow rivers to conserve over 61.08 million ha of forests. The ban has caused the annual production loss of 12.4 million m^3 of roundwood. This program also required timber resource removals from these protected forests be decreased from 87.58 million m^3 in 1997 to 26.50 million m^3 in 2000, with the remaining cuttings to accommodate local fuel, housing, and other noncommercial uses. Similarly, commercial logging in Hainan province would be stopped as well. Under this program logging in the northeast and other places would be curtailed substantially to put 33 million ha of predominantly old-growth forests under protection. These logging restrictions have resulted in drop in roundwood production from 18.54 million m^3 in 1997 to 11.02 million m^3 in 2003.

Logging bans and harvest reductions displaced a large number of loggers and other forest employees. The NFPP thus stipulated that those displaced employees would be transferred to pursue afforestation, forest management, and other activities or simply be retired or laid off. In addition, all existing and newly retired personnel would be incorporated into the provincial pension and security systems for their salary, medical, and accidental coverage.[4] Revenue reductions suffered by governments at the provincial and county levels, and educational, medical, and other expenses previously provided by the state-owned forest bureaus, would be shared by the upper-level governments.

Between 1998 and 2000, the central government invested 22.26 billion Yuan ($2.69 billion) in the NFPP.[5] To continue the program the State Council, in its formal approval of the NFPP in 2000, decided to spend 96.2 billion Yuan ($11.63 billion) over the next ten years on forest protection, regeneration, management, relocation of forest workers, and other related tasks. Under this plan, the central government would invest 78.4 billion Yuan (81.5 percent of the total), with the remaining 17.8 billion coming from the involved provinces.

To expand forest and grass covers on bare lands, retired croplands, and degraded woodlots and rangeland, the central government provides four types of appropriations to forest bureaus and other entities: (1) afforestation and reforestation of mountain closures, 1,050 Yuan/ha; (2) aerial seeding, 750 Yuan/ha; (3) artificial planting in the Yangtze River Basin (3,000 Yuan/ha) and in the Yellow River Basin (4,500 Yuan/ha); and (4) forest protection, 10,000 Yuan per worker for 340 ha.

The Emergence of the SLCP

To quickly halt soil erosion and flooding from deforestation, the Chinese government took the immediate step to reduce timber harvests in the natural forests and put them under strict protection through the NFPP. However this step alone could hardly be very effective in addressing the underlying land degradation challenges, because slope farming and overgrazing were notorious causes of soil erosion and desertification in western China. Of the 34.07 million ha farmland in the Yangtze and Yellow river basins, 4.25 million ha is on slopes 25º or greater. It is estimated that farming on such slopes can cause the average erosion index to reach 4,000 ton/km^2/year; with proper forest coverage, however, 80 to 90 percent of the erosion could be reduced (Du, 2001). Hence, included in the reforestation and afforestation targets of the NFPP is to convert 5.33 million ha of croplands on steep slopes to forest and grass coverage between 2000 and 2010.

Since the spatial distribution of steep croplands and the characteristics of the involved activities and stakeholders are different from those of natural forest protection (Du, 2001), the authorities quickly realized the difficulty of administering and implementing all of the activities solely under NFPP. Thus, land conversion has evolved into another separate initiative—the Slope Land Conversion Program (SLCP)—whereas the NFPP is now largely confined to the protection, regeneration, and forestation activities within the boundaries of

natural forests (including rural communities inside).

Before the SLCP was formally launched in 2001, provinces conducted trial projects for three years—beginning in late 1999 when Sichuan started a land conversion scheme for slope protection in 120 counties. Experiments in Gansu and Shaanxi followed before the SLCP was expanded nationwide in 2001 to include 25 provinces and autonomous regions. During the first three years SLCP trial projects converted 1.2 million ha of land with an expenditure of 3.65 billion Yuan (Xu and Cao, 2002). After the trials, the government announced its intention to convert 32 million ha of marginal croplands on steep hillsides and slopes to grassland and forests in the next 10 years (2002-2011).

Deforestation and slope farming were determined to be the primary culprit of the record dry up of the Yellow River in 1997 and the widespread flooding in the Yangtze River Basin in 1998.

According to the SLCP plan, the government would subsidize 2.55 tons of grain per year to farmers for retiring one ha of cropland in the upper reaches of the Yangtze River, and 1.50 tons in the upper and middle reaches of the Yellow River. The duration of the grain subsidy is set at five years for cash crops, such as chestnut, tea, and orange; and eight years for more environmentally benign species, such as black locust, pine, and cedar. Therefore, it has been commonly dubbed the "Grain for Green" program (Xu and Cao, 2001). In addition, the SLCP gives farmers a one-time cash subsidy of 750 Yuan/ha for purchasing seedlings and/or seeds, and 300 Yuan/ha/year for tending and miscellaneous expenses for the duration of grain subsidies.

The State Council has also promised that, if necessary, the period of grain and cash subsidies may be extended (Du, 2001). Moreover, farmers' agricultural taxes could be exempted under the plan and the loss of local revenues due to reduced agricultural output and tax base would be shared by the central government. Overall, it has been projected that, if the subsidized grain is priced at 1,400 Yuan/ton, the total investment in the SLCP will amount to about 10 billion Yuan per year ($1.2 billion) (Xu and Cao, 2001), making it rank as one of the largest (and most expensive) major environmental programs in China.

Preliminary Impacts

So far, the NFPP and SLCP have made substantial progress in reaching their intended goals. In the natural forest regions, targets of logging bans, harvest reductions, and resource protection have been largely met (SFA, 2002). Altogether, under the NFPP the decrease of commercial roundwood production by 20 million m^3 stands as one of the most dramatic logging ban accomplishments in the history of world forestry; it is even larger than the federal harvest reductions that occurred in the U.S. Pacific Northwest in the early 1990s to protect habitat for wildlife species (U.S. Forest Service, 2001).[6] The production drop led state-owned forest enterprises to abandon about a half of their logging, hauling, and processing assets (30 billion Yuan) (Li, 2001). Moreover, an annual one billion Yuan of interest payments to loans used by these forest enterprises cannot be paid and must be written off by the government. Under SLCP by the end of 2001 the total area of afforestation reached 2.195 million ha (which includes artificial planting of 1.377 million ha and aerial seeding of 0.818 million ha). Mountain closure reforested area accounted for 1.884 million ha (CFY, 2002).

In terms of timber workers, the central and local governments have taken major steps to deal with the large number of employees displaced by the NFPP bans. Government statistics show that of the 1.2 million logging and processing workers affected by the NFPP, 0.512 million were transferred, retired, or redeployed to other sectors of the local economies by the end of 2001. Personnel for forest protection and management increased from 55,000 in 1998 to 150,000 in 2001, with tree planting, forest regeneration, management, and protection being greatly strengthened (CFY, 2002). The total investment by the central government for transferring and redeploying timber workers has reached 31.89 billion Yuan. At the regional and local levels, governments and enterprises have taken concerted efforts to enhance employment opportunities and transform the forest-based economy. Ecotourism and other development activities—such as dairy, cattle and deer farming; growing annual crops of mushrooms, fruits, and ginseng; and collecting wild herbs, nuts, vegetables, and other products—have been widely promoted.

Tables 3a, 3b, and 3c summarize the results of a recent survey of the economic impacts induced by the NFPP. The tables illustrate that along with the substantial

Table 3A. Gains and Losses Induced by the NFPP: The Case of the Qinhe Forest Bureau in the Northeast (unit: 1,000 Yuan)[1]

Item		Year			
		1998	1999	2000	2001
Investments in forest protection and management	Total	10,871	6,520	13,632	0
	State Appropriation	5,627	6,520	5,720	0
	Provincial Match	5,244	0	0	0
	Enterprise Self-Raising	0	0	7,912	0
Gross production value		20,170	80,227	81,604	117,737
Changes in enterprise revenues[2]	Log Production	1,559	-15,480	-21,382	-24,419
	Wood Processing	-3,192	-6,232	-3,152	4,538
	Other Businesses	92	9,218	9,228	14,258
Changes in local tax revenues[2]		-148	-808	-1,278	-288
Changes in employee incomes[2]		21,823	48,233	76,365	70,752
Changes in farm household income[3]		-900	-11,568	-13,841	-15,900

Table 3B. Gains and Losses Induced by the NFPP: The Case of Yanbian Forest Bureau in the Southwest (unit: 1,000 Yuan)[1]

Item		Year			
		1998	1999	2000	2001
Changes in enterprise revenues[2]	Total	6,570	10,304	7,252	12,877
	State Appropriation	8,087	8,296	7,015	13,224
	Province Match	0	3,525	1,754	1,170
	Enterprise Self-Raising	-1,404	-1,544	-1,784	-1,935
Gross production value		1,296	-18,868	-14,918	-33,218
Investments in forest protection and management	Log Production	-22,515	-27,956	-28,046	-29,712
	Wood Processing	-1,078	-6,348	-4,178	-4,178
	Chemical Making	-1,662	-2,252	-2,482	-2,482
	Other Businesses	274	481	820	792
Changes in local tax revenues[2]		-1,258	-3,958	-4,248	-4,008
Changes in employee incomes[2]		4,937	7,032	9,467	9,568
Changes in farm household income[3]		-1,930	-6,286	-6,872	-7,533

Table 3C. Gains and Losses Induced by the NFPP: The Case of Ebian Forest Bureau in the Southwest (unit: 1,000 Yuan)[1]

Item		Year			
		1998	1999	2000	2001
Investments in forest protection and management	Total	47,297	23,133	48,212	22,873
	State Appropriation	44,860	22,230	51,635	18,960
	Province Match	1,598	1,738	858	608
	Enterprise Self-Raising	1,565	-705	-1,815	-1,415
Gross production value		75,517	-55,708	-67,870	-55,176
Changes in enterprise revenues[2]	Log Production	2,194	-67,494	-55,967	-61,430
	Wood Processing	7,323	-12,757	-16,527	-18,957
	Chemical Making	1,037	-3,063	-3,113	-3,203
	Other Businesses	3,612	-5,388	-5,319	-467
Changes in local tax revenues[2]		143	-9,017	-12,487	-13,407
Changes in employee incomes[2]		6,618	410	-1,768	5,859
Changes in farm household income[3]		-571,178	-566,798	-548,146	-541,465

Notes:
[1] Table was adopted from Liu (2002). Except changes in farm household income, data were from the local forest bureau annual financial reports.
[2] Calculated by comparing to the average level of 1993-1997.
[3] Farmers in the local communities are not formal employees of the forest bureau. Prior to implementing the NFPP, however, a significant portion of their income was derived from seasonal employment by the forest bureau, manufacturing activities based on raw materials purchased from the forest bureau, and services provided for the forest bureau. Changes in farm household income were estimated from a household survey.

investments made primarily by the central government, forest bureau revenues from logging and processing have indeed declined dramatically. Accordingly, local tax incomes have suffered large decreases. However, revenues from other business investments have increased following the logging bans and harvest reductions, and incomes of state employees have increased significantly. In contrast, farmers in communities inside and surrounding the natural forests, who are not formal employees of state enterprises, have experienced a severe reduction in their incomes, as a result of lost direct employment and indirect service opportunities.

Wood production reduction caused by the NFPP has mostly affected the supply of large-diameter logs (> 26 centimeters), which has in turn enlarged the gap between domestic supply and demand. The SFA projected that 13.45 million m^3 of roundwood could be produced from plantations in 2000 to alleviate the wood shortages. However, this extra production has not materialized. In contrast, imports of log, lumber, pulp, and paper products have increased enormously, topping 73 million m^3 in roundwood equivalence in 2001 (SFA, 2002). Valued at $10.13 billion, these products accounted for 4.16 percent of China's total import expenditure in 2001 and recorded an increase of more than 35 percent over the previous year.[7]

While farmers did not receive as much benefit from the NFPP, they have participated in the SLCP with enthusiasm, because they view the SLCP as a window of opportunity not only to protect the environment, but also to improve their welfare through diversifying production and introducing new farming and grazing practices. By the end of 2001, more than one million ha of sloped cropland was retired and planted with trees. In that year alone, the total investment was 3.214 billion Yuan, including grain subsidies of 2.036 billion,

Table 4. Farmers Responses to the Slope Cropland Conversion Program[1]

		Survey Unit[2]						
		Dingxi (Gansu)	Zhouzi (Inner Mongolia)	Ansai (Shaanxi)	Pengyang (Ningxia)	Heqing (Yunnan)	Dafang (Guangzhou)	Tianquan (Sichuan)
Land Retired (ha)	Targeted	1,200	9,333		4,667	1,000	1,333	2,600
	Completed	2,000	9,366		5,080	1,000	1,333	4,600
Degree of Household Satisfaction[3]	Satisfied Households	107 (96%)	196 (97%)	184 (96%)	63 (97%)	211 (99%)	51 (88%)	117 (63%)
	Dissatisfied Households	4	5	8	2	2	7	69
Yield in 1999 (kg/ha)	Retired Land	1,369			1,464		2,329	3,106
	Remaining Land	2,220			2,075		2,731	8,646
Income per Capita (Yuan)	Before the Program	2,022			1,118	1,672	1,484	3,106
	In 2000	1,487			1,134	1,921	1,197	8,646
Cropland per Capita (ha)	Before the Program	0.336			0.460	0.100	0.149	0.127
	In 2000	0.227			0.184	0.068	0.040	0.023

NOTES:
[1] Table was adopted from Xu and Cao (2002). Blank cells indicate no data available.
[2] Gansu, Inner Mongolia, Shaanxi, and Ningxia are in the upper reaches of the Yellow River while the other three provinces are in the upper reaches of the Yangtze River.
[3] The number in the parentheses indicates the percentage of satisfaction.

seedling/seed subsidies of 0.737 billion, cash compensation of 0.35 billion Yuan, and other expenditures of 0.091 billion (CFY, 2002). The national target for 2002 was to retire 4.67 million ha (Xu and Cao, 2001). Table 4 shows that of the seven counties surveyed in 2001, per capita cropland in the upper reaches of the Yellow River ranged from 0.33 to 0.40 ha before implementing the SLCP; thereafter, it decreased to between 0.17 and 0.23 ha. Likewise, per capita cropland in the upper reaches of the Yangtze River fell in the range of 0.10 to 0.17 ha before implementing the SLCP; thereafter, it reduced to between 0.02 and 0.07 ha.

According to Xu and Cao (2002), a very high percentage of the surveyed farm households were satisfied with the program. Five of the seven counties had a degree of satisfaction of over 90 percent. The actual land retirement was no less than the planned targets in each county. To be sure, these positive responses had much to do with the government incentives—food subsidies, which were even higher than the household annual production. Tianquan, Sichuan, was the only exception, where the household production was greater than the grain subsidy, and thus farmers displayed a higher degree of dissatisfaction. Notably, subsidized grain is free, whereas production requires labor, seeds, and other inputs at the expense of farmers themselves. Of course, this generous gesture of grain subsidies to ensure food security at the local level due to reduced farmland was made possible by the recent food surplus at the national level (Du, 2001). The dependence on a potentially short-lived food surplus raises the question of the sustainability of

Box 1. The NFPP and SLCP: Sichuan's Experience

Located in the upper reaches of the Yangtze River, Sichuan province has high topographical, elevation, and climatic variations. As such, the province features very rich flora and fauna resources, but fragile ecosystems. About 65 percent of the province's forests, accounting for 80 percent of its total stocking volume, is concentrated in Sichuan's western region. However, these old-growth forests have suffered heavy cuts due to the build-up of an expansive logging industry since the late 1950s. Also, of Sichuan's 452,000 ha of cropland, 38.3 percent is on slopes of at least 5°, and 17 percent on slopes of even greater than 25°. Most of the hilly and mountainous slope cropland is found along the primary tributaries of the Yangtze, such as the Jinsha, Yalong, and Mingjiang rivers, and it is in these places that a large portion of the province's 199,800 ha of eroded land came into existence because of the combined impact of forest depletion and farming malpractice (Sheng, 2002). Annually, 600 million m^3 of topsoil is washed downstream and added to the riverbed.

As early as 1996, the then-premier Zhu Rongji had already urged Sichuan's government officials to reduce timber harvests, speed up tree planting, and strengthen forest management in order to improve the fragile and threatened environment. Despite his promise of financial assistance to carry out the necessary tasks, Sichuan's planning and action were slow and small due to concerns over lost revenues and employment.

But the historical flooding in summer 1998 propelled the provincial officials to take swift and decisive action. Commercial logging was banned by September, hauling of the cut trees was ordered to finish by June 1999, and logging and hauling workers were to be transferred to tree planting, forest protection and management. Anecdotes relate drastic measures such as the government blowing up bridges and sealing off mills to stop wood transportation and processing. Not surprisingly the "sudden death" of the logging and manufacturing industry led to heavy economic losses of uncollected roundwood and unfinished products, and transport and processing equipment.

While touring the Sichuan and other provinces to survey regional recovery from the flooding and the implementation of natural forest protection the in fall of 1999, Premier Zhu was convinced of the need to further convert slope cropland to control water runoff and soil erosion. Thus, he instructed the leaders of these provinces to pilot land retirement and conversion with government subsidies. In response Sichuan initiated slope cropland conversion in 120 counties in October 1999. The program spread across the country next year when the State Forestry Administration, State Planning and Development Commission, and Ministry of Finance jointly issued guidelines for land retirement and conversion in the upper reaches of the Yangtze and upper and middle reaches of the Yellow.

For policy changes of such magnitudes, however, Sichuan's provincial leaders did little planning and consultancy with local administrators, enterprise managers, and others as to how to mitigate the losses and make them effective. Further, while compensation was made to state enterprises and their employees under the logging bans, the livelihoods of farm households in and around state forests, who depended on logging and hauling operations for seasonal work and service opportunities, were completely ignored. Moreover, their farming, fuel, and other needs for wood were not properly considered. An even more egregious example of poor compensation is that as much as 45 percent of the total area under the coverage of logging bans and forest protection belongs to the local communities whose normal operations have been disrupted without reimbursement from the provincial government (Yu et al. 2002). These examples of insufficient compensation have caused widespread concerns and complaints.

Regarding the land retirement and conversion, the very short lead time made it almost impossible to contemplate which tracts to retire, what species to plant, where to obtain seedlings, and how to deliver the food and cash subsidies promptly and efficiently. And as the designated administrative agency, Sichuan's Department of Forestry did little coordination with other agencies on how to implement the specific tasks. For example, the Departments of Agriculture, Water Resources, and Civil Affairs were not directly involved. The whole land conversion initiative has come close to the familiar phenomenon of mass environmental campaigns—mobilizing farmers to retire cropland and plant trees, with little worry about how heavy the costs may be, what can be done to make it effectively implemented, and whether the original goals will be met.

such subsidies.

Table 4 also shows that farmers' income per capita changed in different ways. In some cases, household income has actually increased following the land retirement. Counties where income decreased may have been due to delayed delivery of grain and cash subsidies. Notably, income from non-farming activities has increased across all of the counties surveyed, suggesting that the potential for a structural adjustment—reducing slope farming and exploring non-farming opportunities simultaneously—does exist, and these new activities should benefit the local people and lead to sustained environmental improvement.

While the central government design of NFPP and SLCP has attempted to balance forestry conservation and poverty prevention needs, it is ultimately the local government implementation that determines the success or failure of these two ambitious programs. Box

1 provides insights into some of the challenges these programs face in enforcing compliance and creating a safety net for farmers and timber workers. Interagency conflicts and poor communication between provincial and sub-provincial governments are but a few of the local obstacles to smooth implementation.

Major Challenges

In light of the ambitious goals and cross-sectoral impacts of the programs, the NFPP and SLCP face some tough challenges. These challenges, which are discussed below, include: (1) heavy reliance on state finance, (2) lack of inter-agency cooperation, (3) insufficient consideration of local interests and conditions, (4) neglect of appropriate practices, and (5) rigidity and inconsistency of certain policy measures.

Top-Down Initiative and Governance

Even though the local financial commitments were set at 18.5 percent of the total NFPP expenditure, they have rarely materialized (Liu, 2002), which has made the program rely too heavily on central government financing. For example, the financial obligation of Heilongjiang province amounted to 0.4 billion Yuan in 2001, but it actually invested only two million. Given this poor regional support, it is difficult to accomplish all the program tasks as planned. Similarly, because the State Forestry Administration (SFA) has been charged with administering the programs, agencies responsible for agricultural and livestock production, water and soil conservation, and poverty alleviation are not formally involved, which has meant inter-agency cooperation and coordinated implementation are very weak.

In terms of policy approach, the central government has not actively pursued market-based mechanisms (e.g., open bidding for projects) for carrying out specific activities of the NFPP and SLCP, relying instead on top-down allocations for most project activities. The potential for compromising effectiveness and misappropriation of central funds abounds. While the Chinese leadership is becoming increasingly aware of environmental problems and appears committed to finding solutions, central officials need to confront the weaknesses in the campaign-style strategies, which are too reactive, dramatic, and inflexible. As Economy (2002) pointed out in her discussion of the weaknesses of the "Go West" campaign: (1) such campaigns tend to be highly politically charged with significant investment up front but little follow-through past the stated targets of completion; (2) central government officials rarely consult local officials to engage them in the campaign decision-making and execution processes; and (3) campaigns rarely employ the best policy approaches, technologies, and/or economic incentives to change behavior. Moreover, these efforts, by focusing on remediation rather than prevention, have given too much emphasis on environmental impacts instead of underlying environmental drivers (e.g., population growth, road expansion, policy shifts, local corruption) (UNDP, 2002). Without effective prevention and attention to the underlying drivers, however, the prospect of long-term success of environmental campaigns is less likely.

Central officials need to confront the weaknesses in the campaign-style strategies, which are too reactive, dramatic, and inflexible.

If more projects were contracted out and subject to open bidding, they would enable governments at different levels to involve various intermediary organizations, including private for-profit and not-for-profit ones, into the implementation of the forest protection and slope conversion programs. These organizations could bridge the gap between the policy initiative from the center and its localized implementation. Furthermore, they could improve the efficiency and effectiveness of the NFPP and SLCP by acting as independent parties for certifying and monitoring project activities.

Inadequate Assessment and Compensation of the Social Costs

In the southwest where the NFPP was introduced first, half of the forest areas are community forests owned and managed by rural households individually or collectively, and the bulk of them are not primary natural forests. While they also have been subject to logging bans, farmers' losses, estimated at 5.7 million m^3 of roundwood or 2.3 billion Yuan of sales revenue a year (Yu et al., 2002), have not been compensated. This major "taking" has not only greatly dampened farmers' confidence in government policy, but also created tremendous land tenure insecurity and investment disincentive. The NFPP should thus either provide adequate compensation for foregone timber revenues or relax the bans.

Encouraged by the enthusiastic response from the farmers and local governments, the central authorities substantially expanded the operation scale of the SLCP

in 2002. In doing so, however, the central government ignored the fact there could be decreasing returns to scale—as the program targets get larger, the implementation costs go up faster. Ironically, these implementation costs have not been clearly considered. To make the situation worse, many local governments have been running budget deficits in the last two to three years due to poor performance of their economies. The sudden increased workload has thus led to an even heavier financial burden. Consequently, the quality of SLCP project tasks has deteriorated and the monitoring has weakened. In addition, the delivery of food and cash subsidies to farmers have been delayed and even misappropriated, causing widespread complaints (Xu and Cao, 2002). Many scientists and local planners feel that the SLCP should have been expanded at a slower and more feasible pace.

Insufficient Attention to Local Interests and Conditions

China's SFA is biased towards planting trees in carrying out the SLCP projects, with less interest in grass and engineering measures. As stated by the Forest and Grassland Taskforce of China (2003, p. 3),

> Implementation regulation has not been tailored to local conditions, and there has been an overemphasis on tree planting rather than restoring original vegetation cover. The SLCP does not give sufficient consideration to the ecological and economic functions of grasslands in semi-arid areas and the need to restore these ecosystems.

Partly because of this overemphasis on tree planting, the central government has decided to create a separate program of 20 billion Yuan, under the coordination of the Ministry of Agriculture, to recover and restore grasslands in the west over the next five years.

Furthermore, without proper consultation and a direct stake in the endeavors, local people tend not to maintain the trees and grass, leaving meager results of survival and growth. More broadly, the authorities have failed to realize the importance of the incentive structure and project governance, with too much dependence on administrative means. Without clearly set responsibilities and appropriate incentives, however, some of the investments will be wasted, and forest enterprises, workers, and rural households will not be actively engaged in forest and grassland protection and management. Institutional instruments, including contractual arrangements, the rule of law, and community-based initiatives, should be developed to improve the performance of SLCP projects. Evidence indicates that many opportunities indeed exist for saving subsidies while enhancing effectiveness of slope restoration (Xu and Cao, 2002; Du, 2001).

To promote more sustainable forestry management, private investments must be encouraged and protected, given the dominance of the non-state sector in commercial forestry (Hyde et al., 2003; Lu et al., 2002). But farmers in the vast south are still subject to excessive cutting regulation, price control, and taxation. Although they have been granted long-term land use and tree ownership rights, their interest and productivity in timber production remains abysmally low (Yin et al., 2003). This is in stark contrast to heavy subsidies for the environmental rehabilitation. China's forest development calls for a balanced and consistent policy portfolio.

Finally, emerging international experience has indicated that community-based forestry management is an effective way to accommodate local interests and conditions, and identify solutions to the overly top-down government programs. The essence of community-based resource management is to use locally initiated activities to serve local needs in a participatory manner (World Bank, 2002). In fact, growing efforts have been made by international organizations, especially development and environmental foundations, to introduce the international experience into China. For instance, the Ford Foundation, in conjunction with governments in Yunnan and Sichuan, has successfully promoted community forestry. Such bottom-up forestry initiatives have drawn the participation of a broad range of stakeholders, making government policies more easily acceptable to local interests and government goals more compatible with local needs (Kitamura and Cao, 2003). Conservation International, WWF-China, and Oxfam America also have nurtured examples of stakeholder participation in protecting watersheds, nature reserves, and natural forests in southwest China (Sheng, 2002; Lazarus, 2002).

Lack of Careful Long-Term Planning

While environmental conservation is a central goal of the NFPP, its induced effects on timber markets and long-term timber supply have not been adequately considered. For instance, the SFA claimed that by 2005, roundwood production from plantations that are part of the NFPP should reach 39.3 million (SFA, 2001). However, by 2003 actual plantation production had already fallen way short of projections, so reaching this target is unlikely. Even if the roundwood production target is met, the log quality may not meet the

consumption requirements. One unanticipated outcome from the logging ban has been the potential introduction of invasive species through importation of wood products, making quarantine an enormous task. Increased imports can also have adverse impacts on forests and the environment in exporting countries (Loucks et al., 2001). Incidents of illegal logging in Myanmar (Burma) and other countries that export timber to China constitute an issue the Chinese government should not ignore. China's timber supply problems ultimately should be solved in conjunction with better demand-side management of wood products. Unintended effects of the SLCP that the Chinese government needs to assess and address include distortions of local grain markets and reduced food prices (The Forest and Grassland Taskforce of China, 2003).

Besides the growing timber shortfall problem is the burning issue of what will happen if the government investments and subsidies stop in a few years. In other words, the institutional and policy climate must be stable and incentives must be sustained so farm households and their villages, as well as forest bureaus and their employees, will maintain their interest in tree planting, forest management, and grassland protection after the NFPP and SLCP campaigns end. Thus, consideration must be given to exit options for the logging bans and the termination/extension of land conversion schemes. While diversifying local economies has made strides, further actions, particularly public investments in capacity building and technical training are necessary. These will empower the rural population, and ensure the success and sustainability of various initiatives.

The Need for Better Technical Practices

The SLCP has been plagued with such challenges that impede the program's progress such as: (1) lack of adequate preparation, (2) targets in excess of the feasible capabilities of local entities, (3) a rush for participation, and (4) failure to deliver the promised subsidies. Additionally, seeds and seedlings have to be acquired from far away, which potentially lowers the seed quality and reduces the suitability of the seedlings to the local conditions.

The selection of land to be retired is also problematic, with much of it located along access roads for inspection. The environmental impact of the SLCP is not clearly understood in that it is impossible to quantify how much erosion originates from deforestation as compared to other driving forces, such as inappropriate farming and road development in mountainous regions. As found by the Forest and Grassland Taskforce of China (2003), the selection process of sites to be converted has been inadequate and often did not include the most erosion-prone slope lands. In addition, to carry out the environmental restoration projects it is necessary to adopt an ecosystem management approach, with emphasis on sustainability, system functionality and integrity, and human interaction, and to better integrate conservation needs into development policies (Loucks et al., 2001).

Closing Remarks

This paper has outlined and discussed the multiple challenges facing implementation of China's Natural Forest Protection Program and the Slope Land Conversion Program. The goal of this discussion has been to promote better understanding of not only these programs, but also the urgent need for more appropriate policies and technical measures in carrying them out. As stated earlier, these programs, if properly implemented, could make valuable contributions to combating some pressing environmental problems, including soil erosion, flooding, and desertification as well as climate change and loss of biodiversity. Indeed, their early implementation has demonstrated not only these prospects, but also the opportunities for structural adjustment of the rural economy and the enhancement of land use efficiency. To improve effectiveness, however, China must address a whole host of policy and technical issues.

Finally, the international community needs to be more actively involved in assisting and facilitating the execution of these programs. For example, the international community could bolster contacts between governmental and nongovernmental organizations (NGOs) on the numerous environmental issues, encourage the exchange of the involved professionals, provide training and expertise on market-based solutions to relevant environmental problems, and support the engagement of domestic environmental NGOs and other institutions in these programs (Baldinger and Turner, 2002). Hopefully, stronger domestic policy implementation combined with greater international cooperation on forestry issues will make these ambitious programs more successful and beneficial.

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Endnotes

[1] There were no systematic, nationwide forest inventories in the 1950s and 1960s. Fang et al. (2001) estimated that China's total forest area in 1949 was approximately 102 million ha.

[2] Western China covers six provinces (Shaanxi, Sichuan, Yunnan, Guizhou, Gansu, and Qinghai), five autonomous regions (Inner Mongolia, Guangxi, Ningxia, Xinjiang, and Tibet), and one municipality (Chongqing).

[3] According *State of the World's Forests* (FAO, 2001), forest refers to land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha. Forests with a tree canopy cover of more than 40% are called closed forests, whereas those with a canopy cover between 10 to 40 percent are called open forests. However, China lowered the canopy cover for closed forests down to 30 percent in the late 1980s and further down to 20 percent in the late 1990s.

[4] Institutional welfare provision for current employees is mandated by law.

[5] For comparison, the country's total expenses on waterway maintenance and other related activities reached 46.5 billion Yuan during 1997-98, of which 7.8 billion Yuan was spent in the Yangtze River Basin alone.

[6] In comparison, China's 1997 total production of commercial roundwood was 56.1 million m^3, of which 61 percent came from old-growth forests and as much as 98 percent of 18.8 million m^3 produced by the state-owned forest bureaus was from primary natural forests.

[7] China's dramatically increased imports of timber products have drawn broad international concerns over the potential spread of deforestation and negative impacts on the livelihoods of forest-dependent communities in the exporting counties, such as Burma, Indonesia and Russia (Forest Trends, 2000).