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Is the Returning Farmland to Forest Program a Success? Three Case Studies from Sichuan

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Abstract

China's *tuigeng huanlin* or "Returning Farmland to Forest" (RFFP) program has been widely praised as the world's largest and most successful payment for ecosystem services program, as well as a major contributor to China's dramatic increase in forest cover from perhaps as low as 8% in 1960 to about 21% today. By compensating rural households for the conversion of marginal farmland to forestland and financing the afforestation of barren mountainsides, the program, in addition to expanding forestland, aims to reduce soil erosion and alleviate poverty. This paper presents qualitative and quantitative studies conducted on the local implementation of RFFP in three diverse townships in Sichuan. We find the actual results to be more mixed than the official figures would indicate. Though there have been some positive results, we identify problems with site and species selection, compensation for land taken out of cultivation, shift of labor to off-farm activities, and monitoring of replanted sites, which challenge the ecological and economic impacts of these programs and reveal much of the effort of the program has been misdirected. We suggest that efforts are misplaced because of the top-down, panacea nature of the program, which in turn is a feature of Chinese bureaucratic management.

In a world where deforestation rates remain alarmingly high, China has drawn attention to its remarkable increases in forest cover and stand volume (FAO, 2011). Between 1998 and 2008, forest coverage, reported as a percentage of the country's total land area, increased from 16.55 to 20.36 percent, adding 41.6 million ha of forests (State Forestry Administration, 2011). These numbers, along with satellite images of expanding forest cover and wide-scale sociological surveys of household incomes, have earned China domestic and international praise (Bullock and King, 2011; Li et al., 2012; Xu et al., 2006).

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Criticisms appear, however, when we go beyond assessments based purely on increased coverage and biomass, and examine fiscal efficiency, ecological soundness and stand quality, and the displacement of China's timber consumption to other countries. In the decade from 1999 to 2009, an estimated ¥30 billion [approximately \$4.3 billion United States (US)] was spent on forest creation in six key environmental programs; by 2009, 54.4 million ha of forests had been created, but these represented only a 22.9 percent survival rate among the 268 million ha that had originally been planted (Meng, 2011). While an estimated 56.3 billion trees have been planted in the past few decades as forest cover has increased, soil erosion and water loss have not demonstrably improved (Cao, 2008; Qu et al., 2011; Weyerhaeuser et al., 2005); tree planting in the northwest has not only had little success with abating China's dust storms but may have resulted in adverse effects on soil moisture, hydrology, and vegetation coverage (Cao et al., 2011; Luoma, 2012); and compensation to farmers for cropland returned to forest has not always been sufficient to make up for loss of accustomed access or the value from cultivation (Weyerhaeuser et al., 2005; Trac et al., 2007). Lastly, while China is lauded for its improvements to its domestic forests, it has drawn harsh criticism for engaging in illegal timber trade and driving deforestation in Russia, Southeast Asia, and some African countries (Kahrl et al., 2005; Katsigris et al., 2004; Sun and Canby, 2011; Sun et al., 2004).

The real benefits of reforestation at national and regional scales include a more sustainable supply of forest products, restoration of ecosystem services such as erosion prevention, and opening up possibilities for sustainable income in some forest-dependent communities (Liu et al., 2008; Qu et al., 2011; Xu et al., 2006). At the same time, we believe that China's reforestation programs have not been nearly as effective as they could have been, and for two reasons. First, they suffer from what Ostrom and Cox (2010) call "the panacea problem," the tendency to assume that a single policy can be applied uniformly in a great variety of localities and at a wide range of spatial and temporal scales. This often results in cross-scale mismatches—programs that seem appropriate at one scale while proving inappropriate at another (Cumming et al., 2006). Second, like so many of the Chinese government's mobilizational megaprojects (McCormack, 2010) from cleaning up the Huai River (Economy, 2004) to hosting the 2008 Olympics (Gottwald and Duggan, 2008), they mobilize people and resources effectively for a short time, but often fail to maintain their benefits in the medium term. They thus produce "pathologies of resource management" (Holling and Meffe, 1996) in which rigid application of blueprints to problems does not allow adaptive management during the course of a program.

Despite the uncertain benefits of China's aggressive forest expansion, China plans to continue to add forests, using essentially the same strategies. Under UN climate change agreements, China has committed to add 57 million ha of forest above 2005 levels by 2020, which would increase national forest cover to over 25 percent (State Forestry Administration, 2011). But as long as the structural problems of panacea solutions and mobilized megaprojects persist, China's admirable forestation efforts may continue to fall short of their potential.

Here, we examine China's primary national reforestation program—*tuigeng huanlin gongcheng* 退耕还林工程 or Returning Farmland to Forest Program (RFFP)¹, which since its

initiation in 1999 has expanded China's forest cover by more than 27 million ha (Lin, 2012) and will continue to increase forest cover over the next eight years. First, we present a brief history of China's past efforts and challenges with forest creation to illustrate both the conditions that have shaped RFFP and how this particular program was designed to achieve multiple ecological and economic goals. While we applaud these efforts of the RFFP and acknowledge reports of tremendous progress and success, we set out to investigate the local implementation of these programs. In this article, we demonstrate the differential effectiveness of the RFFP by using comparative case studies. We analyze the implementation of the program in three sites, all in Sichuan.

In Sichuan, the RFFP represents both the PRC's ecological ambitions of restoring a degraded landscape,² and its economic ambitions to develop its western regions.³ By converting farmland (particularly marginal cropland) to forestland and afforesting and reforesting barren hillsides, the program intends to reduce soil erosion and expand forest cover; by engaging households in the land conversion, the program also seeks to alleviate poverty and offer opportunities for alternative livelihoods. We present RFFP on-the-ground in each of the locations and evaluate the program by specifically examining the implementation of its approaches and its appropriateness for that location. Considering the achievements and shortcomings of program implementation in each site—the extent of successful tree planting, the proportion of converted farmland that is marginal, whether household income was maintained or improved, and whether alternative livelihoods adopted are ecologically and economically sustainable—we find that the results are mixed. We compare the different conditions and outcomes between the sites to ultimately shed light on the program's inability to reach the full potential of its stated ecological and economic goals. In conclusion, we argue that panacea solutions and the nature of the bureaucratic system are ineffective at dealing with the variable conditions and needs of different local environments and economies, and sometimes lead to less-than-ideal outcomes.

Background

Forest Creation Post-1949

The People's Republic of China has implemented tree-planting programs since its establishment mid-century. In the 1950s, the government carried out extensive afforestation, and in the following decade intercropping and shelterbelt projects were added to the portfolio (Hyde et al. 2003).

However, the benefits of these efforts were negligible. False reporting of afforestation was widely practiced and survival rates were low (Smil, 1993). Young plantations failed due to lack of technical expertise, unsuitable species and site selection, and poorly defined responsibilities (FAO, 1982; Harkness, 1998). Meanwhile, forest extraction swamped

¹*Tuigeng Huanlin* means literally withdrawing from cultivation and restoring forest. The program has various English names, including Grain-for-Green and Sloping Land Conversion Program. Here we use the more accurate translation, Returning Farmland to Forest.

²National Forestry Bureau surveys show that forest cover in the upper reaches of the Yangtze River declined from 30–40 percent to 10 percent between 1950 and 1998.

³While not initially conceived as part of the "Open the West" campaign, RFFP has been adopted as part of this campaign aimed at helping China's western provinces catch up to the East, after decades of increasing regional economic disparity (Yeh, 2005).

successful reforestation. During the Great Leap Forward (1958–1961), in a push to industrialize, Mao encouraged both expansion of agricultural areas and establishment of “backyard furnaces” for steel production, leading to the destruction of local forests across the country (Shapiro, 2001). Between 1958 and 1962, an estimated 20 to 30 million ha, nearly a quarter of China’s forests, were lost, leaving a possible historic low of 8.1 percent forest cover (He et al., 2008; Robbins and Harrell, 2014).⁴ Concurrent forest creation and deforestation continued through the Maoist era; by the era’s end, tree-planting programs had helped increase China’s forest cover to 12–13 percent, but the Cultural Revolution policy of “taking grain as the key link” (以粮为纲) occasioned the “second great cutting” and a net loss of about 5 percent of forest cover between 1977 and 1981 (Hyde et al., 2003).⁵

By the start of the Reform Era, China’s 115 million ha of forestland largely consisted of low-quality forest and degraded natural forestlands (Robbins and Harrell, 2014; Hyde et al., 2003). Efforts to increase forest cover and stand volume were reinitiated in 1978, but the “third great cutting” in the early 1980s, which has been blamed on excessive harvest by timber farms and insecure forest tenure rights among villagers (Edmunds and Wollenburg, 2003; Hyde et al., 2003), set back efforts to increase the forestry inventory. Planting of shelterbelts, engineered forests, and economic forests did not contribute large gains in coverage and volume until the early 1990s. Between 1950 and 1993, nearly 117 million ha of forest were established through afforestation and natural generation (Zhang and Song, 2006), yet a loss of mature forests during that time is estimated at nearly 50 percent (Bull and Nilsson, 2004).

Thus, for almost the entire latter half of the 20th century, tree-planting efforts were counteracted and often swamped by heavy deforestation that continued with the government’s emphasis on unimpeded economic expansion. But in 1998, the waters came. Catastrophic flooding hit the middle Yangtze region, devastating Hunan, Jiangxi and Hubei, and greatly changed China’s environmental thinking. The regime attributed the floods to increases in sediment due to erosion caused by decades of deforestation and forest degradation (Chen, 2000; Yi, 2003; Yin and Li, 2001). Although there is no evidence for increased sediment yield to the Yangtze (Lu and Higgitt, 1998, 1999; Higgitt and Lu, 1999; Lu et al., 2003a, 2003b), Salween, Mekong, Red, or Tsangpo (Schmidt et al., 2011) as a result of changing upstream land use, including deforestation, the floods constituted a wakeup call about the state of China’s environment in general. The State Council instituted a logging ban along the upper reaches of the Yangtze and Yellow Rivers, and adopted a set of six major environmental programs prioritizing forest protection and expansion, including two of the largest environmental programs in China: the Returning Farmland to Forest Program, described here; and the Natural Forest Protection Program (*tianranlin baohu gongcheng* | 天然林保护工程), designed to protect remaining areas of ecological concern and restore degraded lands. These six programs reflect the government’s response to a long history of poor forest management and address the need for forest protection and expansion,

⁴The figure for forest cover following the Great Leap Forward remains uncertain; it is estimated to be somewhere between 8.1–11.6 percent (Robbins and Harrell, 2014).

⁵Forest cover figures are scattered and unreliable until the first national forest inventory in 1976. After that, periodic inventories make figures from one period to another more robust, but the definition of forest was altered between the fourth and fifth national inventories (1989–93 and 1994–98), from 30% canopy cover to 20%.

not only to prevent floods and protect watersheds, but also to abate desertification, protect biodiversity, and support economic development (Zhu et al., 2004).

Returning Farmland to Forest Program

In 1999, the State Council initiated the RFFP with the explicit goal of increasing forest cover and controlling soil erosion. Assuming an inverse relationship between vegetation cover and soil erosion, the RFFP focused on increasing forest cover through cropland conversion, and afforestation and reforestation of barren hillsides (or wastelands). Sloping cropland, which is blamed for an estimated 65% of the 2 to 4 billion tons of silt released into the Yangtze and middle and upper reaches of the Yellow River each year, is a core target of the program (Bennett, Mehta, and Xu, 2011). Of the 14.67 million ha of cropland it aimed to convert, 4.4 million was to be on marginal cropland—land with a slope greater than 25 degrees.

In addition to restoring forest cover and environmental watershed services, the program is intended to alleviate poverty, drive rural economic development and contribute to the stability of the country's grain supply. The program, structured much like a scheme of payment for ecosystem services (PES), provides incentives for participation—households are provided in-kind and cash subsidies for retiring cropland and in turn provide the benefits of ecological restoration.

By supporting households in the conversion of farmland to forest, the program is also designed to release labor from on-farm to off-farm work and enable sustainable economic development. Meanwhile, in-kind compensation of grain is intended to reduce the national stockpile in the short term, and the overall ecosystems benefits of converting farmland to forests are believed to increase the productivity of land retained for cultivation (Xu et al., 2004; Zhu et al., 2004).

Households can convert cropland to one of two types of uses: (1) economic forests—orchards and plantations primarily producing fruits, nuts, edible oils, spices, medicinal plants or derivatives, and industrial raw materials; or (2) ecological forests, used for timber production, collection of fuel wood, environmental protection and conservation, and national defense.⁶ Households are provided with free seedlings, and are compensated with grain and cash subsidies if, after one year, a minimum percentage of trees survive. Compensation lasts for five years for economic forests and eight years for ecological forests, and conversion of grasslands to forests is compensated for two years. In 2007, the State Council extended the implementation of the program to further expand forest-land and to extend the period of compensation to already participating households for another cycle of 2–8 years (SFA, 2007).

⁶China classifies its forests into five types: protective forest, special-purpose forest, timber forest, economic forest, and fuel-wood forest. The Returning Farmland to Forest Program designates two types of forest planting: economic and ecological. While there is a relatively clear definition of economic forest, there is no definition of ecological forests by the State Forestry Administration. As discussed by Yan and Min (2004), we assume ecological forests to include all forest types and uses that are not part of the economic forest definition.

Implementation of RFFP

Among the six programs promulgated in 1998, the RFFP has received 53.3 percent of the total expenditure (Liu and Wu, 2010). The RFFP set out to convert 14.67 million ha of croplands to forests by 2010 and to afforest a comparable area of barren or degraded lands (SFA, 2002). Between 1999 and 2009, the program established 27.67 million ha of forests, of which 9.27 million ha was converted and 18.4 million ha afforested. It has become the largest land conservation program in the developing world (Xu et al., 2004; Uchida et al., 2005). Within its first decade, the program invested 233 billion RMB (Lin, 2012). With its recent extension to continue for another decade, the RFFP is expected to receive an additional 200 billion RMB between 2010 and 2021 (Central People's Government of the People's Republic of China, 2010). By the end of 2021, China will have spent more than 430 billion RMB on the program (CPG PRC, 2010).

Although reported figures present remarkable accomplishments of the RFFP at both the national level and provincial scales⁷ (see Sichuan Province Forestry Department, 2005), they simply communicate the assumption that land conversion and afforestation uniformly offer solutions to erosion and runoff, increased forest cover, and poverty alleviation. This approach inherently overlooks variability among local environments and economies, and prompts us to investigate local program implementation, results, and contributions to program goals.

Methods

Three Case Studies

We offer three case studies, from Yanyuan, Wenchuan, and Jiuzhaigou counties in Sichuan (Table 1; Figure 2). To contextualize the reported role of RFFP afforestation, reforestation, and cropland conversion in each of these administrative units, we gather government-documented figures on each. These figures are juxtaposed with our on-ground field work to give insight on what these figures indicate at each site and the extent to which these figures can be used as indicators across geographical space and time.

We evaluate the implementation of the RFFP in each case by examining the specific approaches employed by the program as the means for achieving its stated goals (Table 3). For example, to evaluate poverty alleviation and rural economic development we examine the PES-type compensation arrangement and the changes to household labor allocation to the farm. We specifically ask: were household incomes maintained or increased? Was labor freed for alternative activities? Are these alternative activities ecologically and economically sustainable?

Our summary evaluations of RFFP implementation in each study site also consider the appropriateness of the applied approaches in these specific localities. While we are

⁷In Sichuan province, 1.64 million ha of forests had been planted, 53 percent converted from farmland and the remainder through afforestation of wastelands. This reportedly increased the province's forest cover from 24 to nearly 29 percent, between 1999 and 2005; led to a 20–45 percent reduction in surface flow and soil erosion; increased grain output per unit of land; and the socio-economic development of rural areas. On average, for every 3 mu converted (15 mu = 1 ha), one individual had found off-farm work (Sichuan Province Forestry Department, 2005).

interested in finding the extent of cropland conversion and afforestation in these areas, we are equally interested in understanding what this forest expansion means in the larger context of specific local ecological, economic, and social systems.

Following the separate evaluation of each case, we compare the findings from each of the cases with one another. By identifying the commonalities and differences in RFFP forest expansion between the three studies we offer insights on the conditions that have shaped the successes and failures of the program's logic and strategies.

Results

Province-wide and County Summaries

Between 1999 and 2005, the RFFP reportedly contributed to the afforestation of over 3 percent of Sichuan's total land area. In each of the counties that we examine here, afforestation increased the forest cover by 1.3 to 1.5 percent. Conversion of farmland contributed almost twice as much as afforestation of wasteland in Jiuzhaigou and Wenchuan counties (Table 2); conversion and afforestation contributed about the same amount of forest in Yanyuan. Because of the large sizes of the counties, each has contributed more than the average area for all the counties and districts in Sichuan.

Case Study 1: Baiwu Township, Yanyuan County

Baiwu Township lies in the Yanyuan Basin and in the Zhalashan range to the west and north, at elevations from 2400 to 3900 m. It consists of eight administrative villages, of which Baiwu, Mianba, and Changma, described here, have the greatest percentage of forest land. Baiwu township's population of 20,038 in 2010 was approximately 92 percent Nuosu, a branch of China's officially designated Yi *minzu*, and 2 percent Prmi, officially designated part of the Zang, or Tibetan *minzu*. Almost all local inhabitants rely on grain farming, animal husbandry, and forestry for subsistence and a portion of their cash income, though off-farm migratory labor has recently become an important source of income. Forests provide fuel for cooking and heating, timber for house construction and tool manufacture, litter and branches to line stables and protect mud walls from rain, occasionally hunted animals for meat, browse for goats, non-timber forest products (NTFPs) for food and medicines, and watershed protection. Between 1957 and 1990, deforestation was severe, leading to increased travel time for wood collection, soil loss, and hydrological changes in local rivers (Urgenson et al., 2010). In the Reform Era, forested lands were divided into three classes: state forest, closed to collection except by permit; collective forest, open to fuel collection by collective members and to timbering upon local government permission; and private forests, contracted to individual households.

Some public and private reforestation efforts began in the early 1990s using the native *Pinus yunnanensis*, and were relatively successful. The NFPP was begun in Baiwu and Mianba Villages in 1998, and included plantings of two exotic species: *Prinsepia utilis*, a shrub native to Sichuan cultivated for its seed oil, and *Robinia pseudoacacia*, an exotic tree naturalized in southwest China. Trac surveyed eight reforestation sites in Baiwu Village and 12 in Mianba Village and found that all the NFPP sites showed either no growth or

struggling growth of the introduced species, while three sites planted earlier with *P. yunnanensis* showed successful growth (Trac et al., 2007).

RFFP began in Changma and three other villages in Baiwu in 2003.⁸ Three sites in Changma were planted with *Juglans regia* (walnut), *Zanthoxylum piperitum* (Sichuan peppercorn), and *Prinsepia utilis*. The first two, despite being common crops in the area, had apparently failed at the time of fieldwork in 2006; the *P. utilis* plantation was struggling. Farmers who planted *P. utilis* on former cropland were supposed to be compensated ¥260 per mu. Some farmers reported receiving their compensation; others not. In 2006, the Yanyuan Forestry Department inquired into reports from Changma that accused the village leader of embezzling farmers' compensation. Despite this decidedly mixed record, reports from Baiwu Township to the Yanyuan County Forest Bureau indicated that 100% of RFFP plantings in the township had reached the minimum success standard of 85 percent tree survival, and that all participating farmers had received full compensation.

Another series of reforestation efforts, not part of RFFP, took place in an alluvial valley in Baiwu Village between 2008 and 2012. In order to attempt to stabilize a flood plain, disrupted by earlier deforestation, stretches of river terraces and alluvial fans were planted with *Populus sp.* (Poplar) and fenced off against livestock intrusion. Plantings were partially subsidized by Yanyuan County and partly paid for by villagers' subscription. By 2012 about half of the plantations survived, the rest having been rooted by pigs or trampled by cattle, or both. In 2011, some of the areas where poplar had not survived were planted with walnut trees; a small percentage appeared to be thriving in 2012.

Case Study 2: Sanjiang Township, Wenchuan County

Sanjiang township lies in the Min River basin and along the Qionglai mountain range, at elevations from 1200 to 3500 m. Adjacent to the Wolong National Nature Reserve, the world's largest giant panda reserve, Sanjiang exhibits high biodiversity and receives considerable outside attention and support to protect the area's endemic wildlife and its forest habitat. Counting both plantation and natural forests, Sanjiang's forest cover stands at 60 percent. The township of Sanjiang has a population of approximately 4,000 people, of which more than 90% are farmers (Vina et al., 2007). It is made up of nine administrative villages, of which the study site, Caoxiu, is one.

Agriculture is the main economic activity for the 86 households of Caoxiu⁹, which have grown and relied on maize for generations. With the implementation of the RFFP in 2003, maize cultivation began to decline. Households with farmland all participated in the program, each retiring at least 1 mu of cropland for forestland. On average, households converted 5.4 mu of farmland and retained 5 mu for cultivation. This wide participation was driven in part by positive incentives, though negative political pressure also belies any impression that RFFP participation was optional. The program focused on the engagement of all households, and attempted to maximize land area without specifically focusing on

⁸Our field investigations of RFFP sites were restricted to Changma; we collected documents for the entire township.

⁹Pseudonym used for the village. Officially, there are 121 households in Caoxiu, as determined by the *hukou* records. This research examines households as units that live together, eat together, work together, and contribute and withdraw from a common household savings (Trac 2011).

marginal lands. Initially, households were allocated government-selected seedlings of kuding cha (苦丁茶 *Ilex latifolia*), also known as daye dongqing (大叶冬青), a holly tree with leaves commonly dried and sold in the tea market. Due to the low survival rate of the species and low market value described by households, they collectively decided to purchase and plant houpu (厚朴 *Magnolia officinalis*), a tree grown for its medicinal bark. According to villagers, houpu is ready for harvest every 15 years and fetches a market price of approximately ¥80 \$13 (US) per kg. Although tea leaves from the kuding tree can be dried and sold every year, villagers prefer houpu because of its more stable market price. By 2009, rows of houpu had clearly established what counted in the RFFP as forestland on previously cultivated cropland. Households were also planting houpu voluntarily outside of the program in spaces between fields and along roads and trails.

For participation, households received grain and cash subsidies. However, the grain subsidy was only distributed for two years, after which households received the equivalent in cash for a total RFFP cash subsidy of ¥260 RMB per mu [(\$38 USD/mu)]. Despite houpu plantations' clear fit with the definition of economic forest, these plantations were categorized as ecological, and households were granted compensation for eight years, and then an additional eight years when the program was extended. Households explained that this was only reasonable since it would take 15 years before the cultivated houpu could be harvested. In 2009, households had yet to harvest houpu, and many expressed that when the time comes, the profitability will determine whether they will replant the trees.

Existing forests outside of RFFP lands are another major economic area for households in Caoxiu. When needs have been met on the farm, household members spend time in forests illegally harvesting timber and collecting a variety of non-timber forest products, such as bamboo shoots and medicines. Extractive activities mostly take place in state forests. In contrast, household plantation forests, allocated to households in the late 1980s and planted with Chinese fir (*Cunninghamia lanceolata*), a species with high timber value, are left untouched. Households are also compensated for forest protection through the Natural Forest Protection Program: in exchange for making 3–4 trips a year to monitor for illegal activities in assigned tracts of protected land, households are given 550 RMB each year. During interviews, some households described men taking the long trek a few times a year, but multiple households also described the system as loose and compensation as granted so long as one was in favor with the village leader, who reported the completion of responsibilities.

Case Study 3: Jiuzhaigou National Park, Jiuzhaigou County

Jiuzhaigou National Park, in the Min Mountains of northern Sichuan near the Gansu border, is a protected area, a UNESCO World Heritage Site and Man and the Biosphere Reserve, and a tourist destination for almost 3 million visitors per year. With elevations between 2,000 and 4,700 meters, it is known for its rich biodiversity, including 1,936 species of native vascular plants, 72 of them protected; 203 of fungi; 539 of insects; and 312 of vertebrates, including over 50 rare animals species (Liu et al., 2007). Dominant vegetation types include mixed-conifer forest, broadleaf deciduous forest, extensive wetlands surrounding the area's famous lakes and waterfalls, and alpine vegetation.

Jiuzhaigou is also home to about 1,200 Tibetans who until very recently were subsistence agro-pastoralists, historically inhabiting the nine villages that give the valley its name, growing corn, wheat, barley, potatoes, hemp, turnips, and formerly opium, mostly in clearings in a layer of rich loess soil at about 2,300 and 2,700 meters elevation (Henck et al., 2010), pasturing sheep and goats in fallow agricultural plots and yaks in the alpine meadows, and using forests for firewood (deciduous species including oak, birch, and maple) and construction (conifers including pine and spruce).

Archaeological investigations have shown that people have practiced this kind of upland mixed economy for at least 2,200 years, thus maintaining the area's biodiversity (Li, Lü, and Taylor, n.d). China's drive to reforest, however, along with the economic desire to bring tourists into the park, meant the end of traditional subsistence patterns. Woodcutting was prohibited in 1995, and in 1999, the year RFFP was begun. Cultivation was prohibited, and grazing in cleared areas was stopped and animals removed from the park in 2002.

By the early 2000s, villagers did not miss farming; it was hard work, and the combination of RFFP subsidies and employment by the Park Administration brought more income than they lost from subsistence activities. Many of them, however, resented prohibitions on woodcutting and grazing, since they had to haul or purchase wood from distant areas outside the park, and no longer had animals, particularly yaks, with important cultural values. Other important cultural (e.g., loss of place-base continuity) and Park (e.g., loss of vistas and historical land-use context) attributes have been and would continue to be compromised.

In the past decade, RFFP plantings with *Pinus* and *Picea* have combined with natural incursion trees (e.g. *Pinus*, *Picea* and *Betula*) and shrubs (e.g., *Berberis*, *Cotoneaster*, *Hippophae*, etc.) to dramatically decrease the area of grasslands in the previously farmed layer. Remote sensing data showed a decrease of about 54 percent in meadow areas in the park as a whole, vegetation surveys of two meadows showed about 19 percent loss of lowland meadow to forest area just between 2007 and 2011, and both planted *Picea* and naturally recruited *Picea*, *Pinus* and *Betula* seedlings were thriving in formerly farmed or grazed areas.

Discussion

The RFFP has had very different degrees and kinds of success and failure in our three study sites, as set out in Table 4:

Baiwu

Overall assessment—Our observed results of RFFP in Changma sharply contrast to nationally reported success and contradict local official reports of tree-planting efforts. Ecological and economic problems of unsuitable species selection, combined with bureaucratic management issues, set the program up for total failure.

Ecological problems—Although previous reforestation with *Pinus yunnanensis* and current plantings of *Populus* reveal that successful reforestation in the region is feasible, the abysmal outcomes of RFFP and NFPP plantings with *Prinsepia utilis* and *Robinia*

pseudoacacia suggested a definite problem with the selected species. While *Prinsepia* grows wild in the region, distributed on slopes, wastelands and valleys of comparable elevation, the plantings either failed completely or were severely struggling.

Economic problems—*P. utilis* was promoted for its value in producing essential oils. But in this poor community, this shift to a cash crop involves a considerable risk for households. Without a market or a middle man, the plant's oil seeds are completely useless to households, which may have been a factor contributing to the failure.

Bureaucratic challenges—The above ecological and economic results seem inevitable in light of three management problems: implementation of the program from the top down, with no local participation in decision-making; lack of coordination between the government offices responsible for RFFP and other programs, or with those responsible for planning the program and financing it; and the lack of equipment and personnel to monitor and enforce the programs and their results (Trac et al., 2007).

Sanjiang

Overall assessment—The RFFP has made a visible impact on the landscape in Caoxiu. The successful cultivation of houpu forests on previously cultivated farmland presents clear evidence of China's expanding forest cover. However, this case study highlights two important problems: the permanence of forests, and the reallocation of labor.

Questions of permanence—In Caoxiu, program subsidies allow households to wait until houpu can be harvested and households can earn cash from the sale of the medicinal bark. But no household has committed to continue the practice after the subsidies end. Households see the cash potential of houpu, but the fact that they *voluntarily* plant these trees only in uncultivated spaces shows that they are reluctant to supplant maize, which has both subsistence and market value.

Reallocation of labor—Although time-labor data was not collected in Caoxiu during this transition, it is very likely that household labor was significantly impacted. On average, households converted half of household cropland. Some of them shifted labor to more environmentally degrading practices, particularly illegal timber harvest, an important source of cash. We do not blame illegal timber harvest on RFFP, but we do believe that the labor surplus created gives households more time to engage in this lucrative activity.

Conflicting outcomes—Simultaneous creation and destruction of forests in Caoxiu calls attention to the ambivalent environmental impact of RFFP. The value of RFFP to villagers lies not in ecosystem services, but in the potential sale value of houpu bark.

Jiuzhaigou

Overall assessment—The RFFP was for the most part inappropriate for Jiuzhaigou, ironically since it demonstrates the greatest success of plantings and natural recruitment. Its success is likely due to its economic irrelevancy; however, there is compounding evidence of ecological and cultural inappropriateness.

Ecological harm—Because of the top-down nature of the RFFP in general, and the inappropriate scale of planning, Jiuzhaigou was inappropriately made an RFFP site in the first place, even though farmers had maintained a patchy and biodiverse landscape in the area for more than 2,000 years. At a national scale, China needed more forests, and RFFP has provided them. But at the scale of Jiuzhaigou, meadows, grasslands, and agricultural fields have played an important role in system-wide diversity, and converting them to forests provides no additional ecosystem services, while diminishing habitat diversity and thus indirectly species diversity.

Economic irrelevance—It was perhaps not foreseeable when RFFP was begun in 1999, but within a few years it was obvious that Jiuzhaigou villagers were taking economic advantage of shares in their tourist corporation, employment by the Management Bureau, and opportunities to sell to tourists, and did not need extra income from RFFP subsidies to replace lost income from agriculture.

Cultural inappropriateness—Both a patchy landscape including forests and meadows, and ability to raise animals and use milk, wool and meat are deeply embedded in cultural practices of Jiuzhaigou villagers. The RFFP has made these practices more difficult or even impossible for villagers to continue. As fields disappear, parents and grandparents lose their visual and cultural connection to their original homes and fields.

Conclusion

There is no doubt that when the RFFP and other reforestation programs were started in the late 1990s, China's forests were inadequate, and that reforestation programs, judiciously applied, could have positive ecological, economic, and social effects at national and regional scales, and that if they had been applied differentially according to community needs, they could have had almost uniformly positive local effects as well. There is also little doubt that programs such as the RFFP have contributed to the expansion of China's forested area in the last decade and a half, as well as retarding erosion, beginning soil formation, and adding to the standing stock that will be available for sustainable lumbering in the coming decades. We are not opposed to the RFFP.

However, the program could have had so much better results had it not suffered from the panacea problem and thus created cross-scale mismatches and pathologies of resource management. Inappropriate species selection, planting trees in places better left as meadows or grasslands, failure to investigate the real needs of farmers whose lands were subject to forest conversion, lack of coordination among bureaucratic agencies, evaluation of local officials according to simple quantitative program targets, and the lack of effective monitoring personnel and equipment all contributed to partial or fake success of the RFFP in all of our study areas.

We believe that these partial local failures of the RFFP reflect a more pervasive problem with Chinese bureaucratic and management initiatives: emphasis is on quick, visible, and measurable results (Brandt et al., 2012), with little attention given to matters of spatial or temporal scale. Everything is judged by its initial appearance and its ability to promote the careers of those involved: officials pursue *zhengji* or bureaucratic accomplishments, which

consist of starting programs and achieving numerical targets, mostly of a fiscal nature (Wong 2009; Whiting 2004). RFFP meets these criteria nationally—to date, it has reforested 28.9 million hectares (Lin, 2012)—and it meets them locally in our three sites: there is more forest land in Jiuzhaigou than there was at the inception of the program. Although there is no additional forest cover in Baiwu due to the RFFP, it was reported to the higher authorities that there was, which is the important thing for local officials and their careers. Illegal tree harvest has gone unreported and overlooked in Caoxiu, thereby giving the impression that forestland has only been added while the RFFP has been implemented.

It could be argued that a regime that attempts to provide a public good (in this case, more forests) at a national scale must perforce implement a panacea-type solution; otherwise local communities would not comply with the national policy, and the national scale benefits would not happen. Whether or not this is the case, our study has shown that when a panacea program is implemented in this way, local communities will suffer, or at least not receive the benefits that would be possible according to a more locally sensitive approach. It is noteworthy that in two of our three study areas, the greatest successes in reforestation (although by no means unqualified) took place as a result of local initiatives. Sanjiang villagers took the initiative to replace undesirable *Ilex* with *Magnolia*, which is now thriving, and Baiwu villagers planted *Populus* in the flood plain on their own initiative, at least some of which are growing well four years later.

Panacea solutions and consequent cross-scale mismatches and pathologies of resource management are far from unique to China. But the Chinese bureaucratic system may encourage such problems more than do systems in other countries. The continued deterioration of many aspects of the Chinese environment, as documented in this special issue, may be evidence that the bureaucratic style of the Chinese regime, in spite of an admirable system of environmental, laws, regulations, and programs, may be at the root of many of China's environmental problems.

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Figure 1.
Total state investment in RFFP by 2012: 430 billion RMB. Source: Xinhua She.

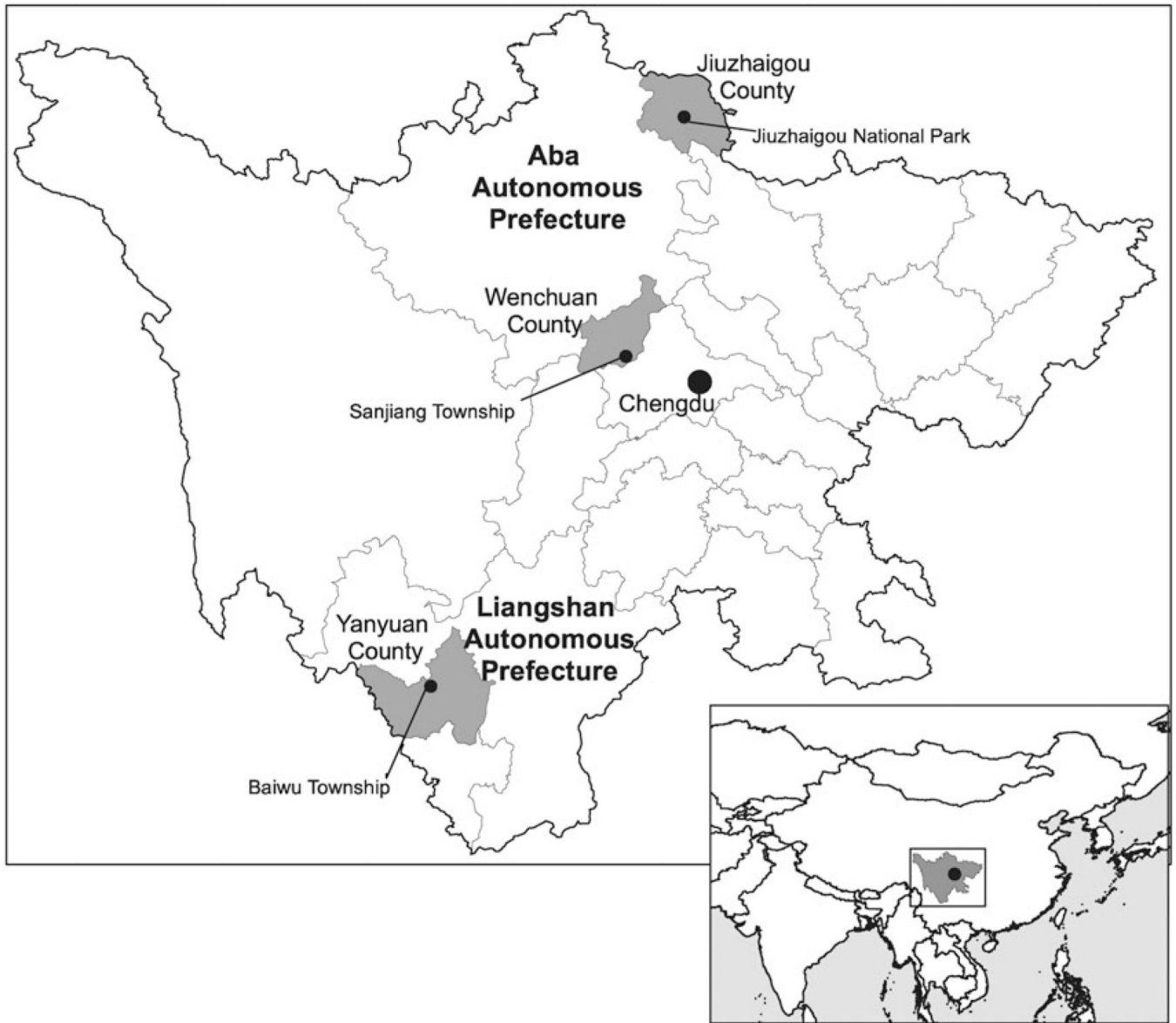


Figure 2.
Location of the three case studies in Sichuan. Map by Amanda H. Schmidt.



Figure 3. A NFPP reforestation site in Baiwu from the early 2000s, visited in 2012. Holes where *Pinsepia* was planted are still clearly visible. Photo by Stevan Harrell.



Figure 4. Partially successful 2008 *Populus* plantation has failed to prevent further erosion of a river terrace, 2012. Photo by Stevan Harrell.

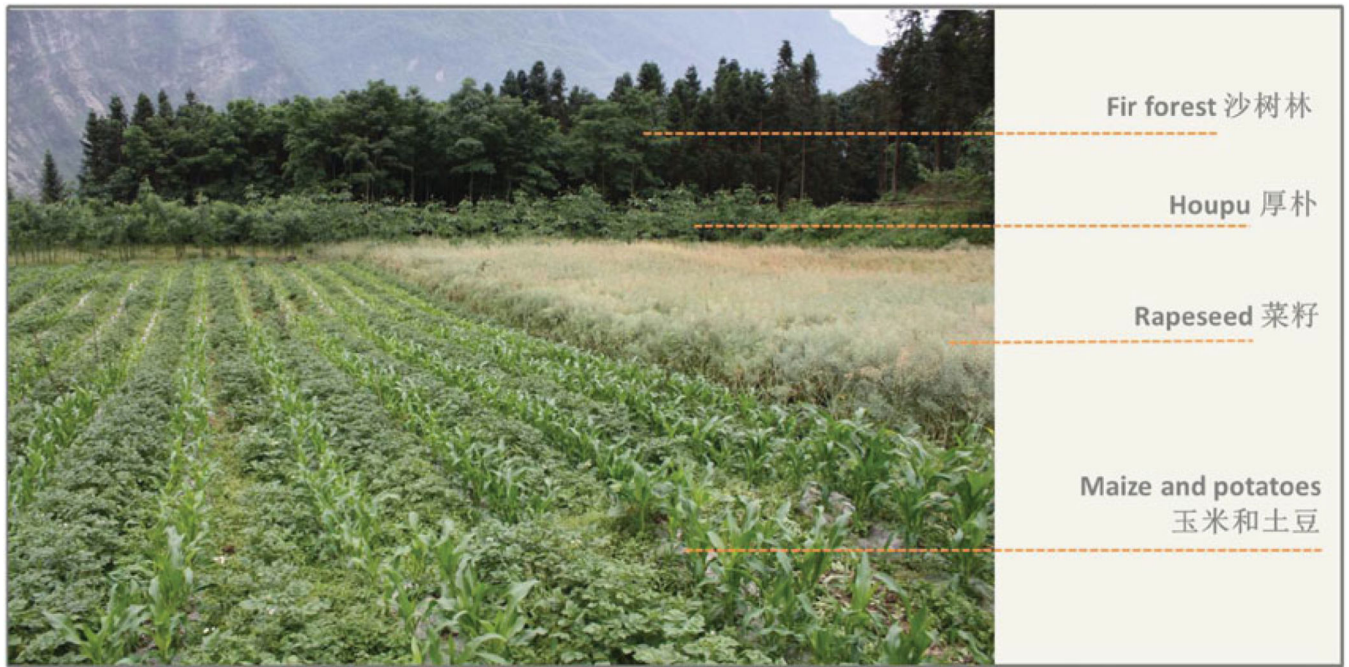


Figure 5. Successful conversion of household cropland to forest plantation of *M. officinalis* (houpu) has reduced the extent of farming. Photo by Christine Trac.



Figure 6. Conversion of cropland to *M. officinalis* plantations may have increased labor available for illegal timber harvest, 2009. Photo by Christine Trac.



Figure 7. Deciduous forest in Jiuzhaigou (foreground) traditionally maintained as a source of fuelwood. Photo by Stevan Harrell.



Figure 8. Archaeological excavation at a Han period (ca. 200 BCE) house front, showing location on edge of a terracette. Houses in similar locations were inhabited until 1980. Photo by Li Yongxian.



Figure 9. Time lapse photos of Jianpan Valley before and after introduction of RFFP, 1990s (*top*) to 2010 (*bottom*). Photos by Daniel Winkler and Thomas Hinckley, respectively.

Table 1

Details on case studies and research conducted

Case Study	Study Site	County	Fieldwork Dates	Field Researchers
1	Baiwu Township	Yanyuan	Aug 2005–Aug 2006 Aug–Sept 2008, Nov 2009	Trac (2005–2006, 2009), Harrell (all), Hinckley (2002, 2008), Urgenson (2008), Schmidt (2008, 2009, 2012)
2	Sanjiang Township	Wenchuan	May–Dec 2009	Trac
3	Jiuzhaigou National Park	Jiuzhaigou	April–May 2006, June 2007, September 2008, 2010, and 2011	Hinckley (2006, 2007, 2008) Urgenson (2007, 2008), Harrell (2008), Yang (all), Combs (2007), Schmidt (2007, 2010–11), Trac (2006).

Table 2

Questions used to evaluate the goals of the RFFP

Goals	Approach	Evaluation questions
<i>Ecological</i>		
Increase forest cover and decrease water runoff and soil erosion	Afforestation and reforestation of barren hills	Were trees or shrubs planted on barren hillsides? — <i>Did the planted trees grow on barren hillsides?</i>
	Conversion of farmland and grasslands, particularly marginal cropland (slopes greater than 25 degrees)	Did households retire cropland to plant trees or shrubs? — <i>Did the planted trees grow on retired cropland?</i> — <i>Was marginal cropland targeted?</i>
<i>Economic</i>		
Poverty alleviation and rural economic development	PES-scheme (compensation for cropland conversion)	Were household incomes maintained or increased from participation in RFFP?
	Release labor from the farm and open up opportunities for alternative livelihoods.	Was labor freed for alternative activities? — <i>Are these alternative activities ecologically sustainable?</i> — <i>Are these alternative activities economically sustainable?</i>
Short-term grain supply— reduce the national stockpile	Compensate households converting farmland to forestland with in-kind subsidy, i.e. grain.	Were villagers compensated with grain?
Long-term grain supply— increase output per unit area	Sustained improvement of the overall health of the land by maintaining increased forest cover to decrease water runoff and soil erosion.	Was there an increase in forestland? What is the likelihood for households to revert forestlands back to cropland or barren/grazing lands after program compensation ends?

Table 3
Area of forest created, total and by method, 1999–2005 (Sichuan Province Forestry Department, 2005)

Administrative District	Area (ha)	Farmland-to-Forest Conversion (ha)	Afforestation of Wastelands (ha)	Total Forest Creation (ha)	Total as percentage of land area (%)
PRC	964,082,100	3,424,733	3,746,000	7,170,733	0.7
Sichuan Province	48,700,000	878,933	767,333	1,646,267	3.4
Yanyuan County	837,600	5,333	5,533	12,200	1.5
Wenchuan County	408,500	3,667	1,466	5,467	1.3
Jiuzhaigou County	529,000	4,433	2,300	6,733	1.3
County-level Average for Sichuan Province		2,859.2	2,176	5,035.2	3.4

Table 4

Summary of findings in the three study sites based on fieldwork conducted

Goals	Approach	Evaluation Questions	Case Study 1 <i>Baiwu</i>	Case Study 2 <i>Sanjiang</i>	Case Study 3 <i>Juzhaigou</i>
<i>Ecological</i>					
Increase forest cover and decrease water runoff and soil erosion	Conversion of farmland and grasslands, particularly marginal cropland (slopes greater than 25 degrees)	Did households retire cropland to plant trees or shrubs? — <i>Did the planted trees grow on the retired cropland?</i> — <i>Was marginal cropland targeted?</i>	Yes Small percentage only Yes	Yes Yes—on second attempt No	Yes Yes No
	Afforestation and reforestation of barren hills	Were trees or shrubs planted on barren hillsides? — <i>Did the planted trees grow on the barren hillsides?</i>	No n/a	No n/a	Yes Yes
<i>Economic</i>					
Poverty alleviation and rural economic development	PES-scheme (compensation for cropland conversion)	Were household incomes maintained or increased from participating in RFFP?	No	Yes	Yes, but irrelevant
	Release labor from the farm and open up opportunities for alternative livelihoods	Was labor freed for alternative activities? — <i>Are these alternative activities ecologically sustainable?</i> — <i>Are these alternative activities economically sustainable?</i>	— n/a n/a	Yes No Yes	No—farming already abandoned for park jobs n/a n/a
Short-term grain supply—reduce the national stockpile	Compensate households converting farmland to forestland with in-kind subsidy, i.e. grain	Were villagers compensated with grain?	Yes, for the first couple of years.	Yes, for the first couple of years.	Not known, probably irrelevant
Long-term grain supply—increase output per unit area	Sustained improvement of the overall health of the land by maintaining increased forest cover to decrease water runoff and soil erosion	Was there an increase in forestland? What is the likelihood for households to revert forestlands back to cropland or barren/grazing lands after program compensation ends?	No High—households have already reverted	Uncertain Uncertain—depends on houpu market	Yes Unlikely